environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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File Reference Number:	12/12/20/ or 12/9/11/L
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Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Proposed 30-year Ash Disposal Facility at Kendal Power Station, Mpumalanga

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4.2 The specialist appointed in terms of the Regulations_

I, Dieter Kassier, declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Wetland Consulting Services (Pty.) Ltd.

Name of company (if applicable):

20 May 2016

Date:

Baseline Wetland Delineation and Assessment for the Kendal 30-Year ADF Project

For:

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Reference: 1032-2013

DOCUMENT SUMMARY DATA

PROJECT:	**DRAFT: Baseline Wetland Delineation and Assessment for the Kendal 30-Year ADF Project**
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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the authorꞌs best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty.) Ltd. was appointed by Zitholele Consulting to undertake the baseline wetland delineation and assessment for the proposed Kendal 30-year Ash Disposal Facility (ADF) project. The purpose of this report is to provide a description of the wetlands within various alternative sites investigated, to identify and assess the impacts to wetlands that are likely to occur, and to provide a suite of suitable mitigation and management measures that could be used to avoid, minimise and mitigate impacts to wetlands associated with the proposed ADF.

The requirement to establish the existence and/or extent of wetlands on the property is based on the legal requirements contained in the National Environmental Management Act (NEMA) and the National Water Act, as well as the Mineral and Petroleum Resources Development Act (MPRDA). Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively so as to minimize any potential impacts to the wetlands.

2. SCOPE OF WORK

The following task formed part of the agreed upon scope of work:

Baseline Assessment:

- Review of existing available data;
- Delineation and classification of all the wetlands within the study area;
- Determination of the Present Ecological State and Ecological Importance and Sensitivity of all the wetlands identified within the study area;
- Functional Assessment of all the wetlands identified;
- Comparative assessment of the 3 proposed alternatives from a wetland perspective; and
- Compilation of all the findings in a specialist report.

3. LIMITATIONS & ASSUMPTIONS

Field work for the wetland delineation and assessment was undertaken over several days in October 2013, and again in March 2014 (for Site H).

Adequacy of predictive methods

A number of generally accepted assessment methods were utilised within the current study for the assessment of the wetland habitats on site:

- WET-Eco-Services (Kotze et al., 2009)
- WET-Health (Macfarlane et al., 2009)

Although there are limitations associated with each of these methods, the methods are generally accepted and widely applied within wetland assessments in South Africa and are deemed adequate for the purpose of this study.

Adequacy of underlying assumptions

Reference conditions are unknown. This limits the confidence with which the present ecological category (PES) is assigned.

Uncertainties of information provided

The wetland boundaries falling within the four alternative sites were delineated in detail. Where appropriate the wetland boundaries of wetland systems outside the direct footprint of the four alternative sites were verified, which entails a lower sampling density, or mapped at a desktop level.

While an effort was made to visit every wetland within the four alternative sites, not every wetland boundary was walked. Extensive cultivation (current and historical) along and within the wetland boundaries in some portions of the study area, which results in complete removal of wetland vegetation and disturbs the soil profile, also presented obstacles to accurate delineation of the wetland boundaries on site.

Due to ongoing mining activities on three of the alternative sites, some portions of the site could not be accessed in the field and wetlands were mapped at a desktop level only. Areas that could not be accessed are indicated in Figure 1 below.

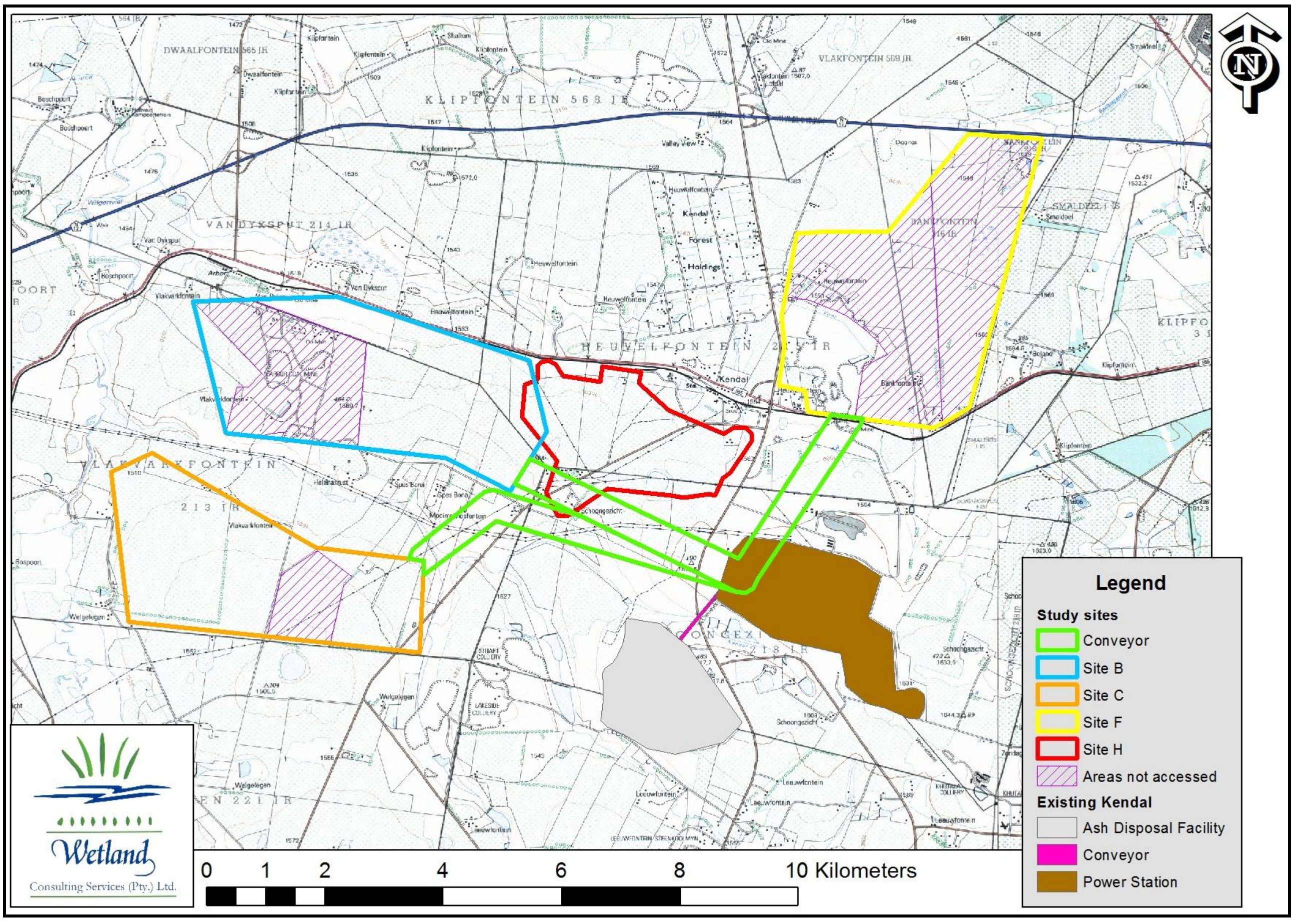

Figure 1. Map of the four alternative sites investigated, indicating areas that could not be accessed in the field (purple hatched areas) due to ongoing mining activities in these areas.

Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineated wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 5 m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

4. STUDY AREA

Four alternative sites for the proposed Kendal 30-year ADF were identified by Zitholele Consulting, namely:

- Site B
- Site C
- Site F
- Site H

All four of these sites, as well as a conveyor corridor to each of the sites, were investigated as part of this wetland study.

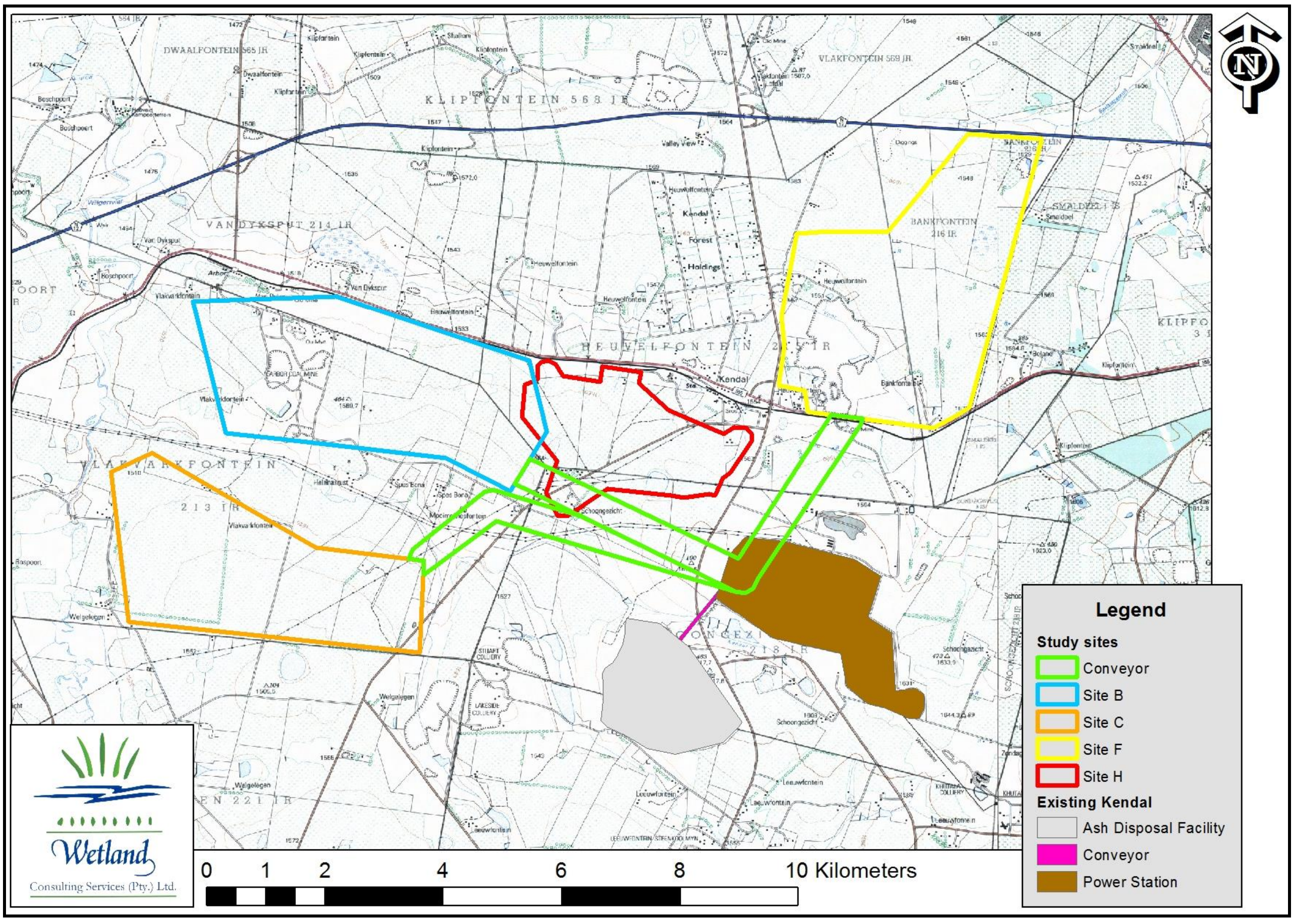

Figure 2. Map showing the 4 alternative sites investigated as part of the site selection process.

All sites are located in close proximity to the existing Kendal Power Station (Kendal PS) and are located south of the N12 highway, west of Ogies and east of the Wilge River. Sites B, C and H are located west of Kendal PS and Site F is located to the north.

Table 1. Table showing the sizes, in hectares, of the three sites investigated. Area figures provided are based on the size of the size of initial alternative sites investigated, and not based on actual development footprint.

Alternative	Area (hectares)
Site B	1 137.8
Site C	950.6
Site F	1 226.1
Site H	705.0

4.1 Catchments

The study area is located within the Olifants River Catchment (Primary Catchment B), with the four sites investigated extending across three quaternary catchments, namely B20E, B20F and B20G. The existing Kendal facilities are located along the boundary between catchments B20E and B20F.

Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Table 2. Table showing the mean annual precipitation and mean annual runoff run-off per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Precipitation (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
B 20 E	55 988	657.2	33.9	5.15 %
B 20 F	45 443	666.79	33.3	4.99 %
B 20 G	47 059	669.29	44.1	6.59 %

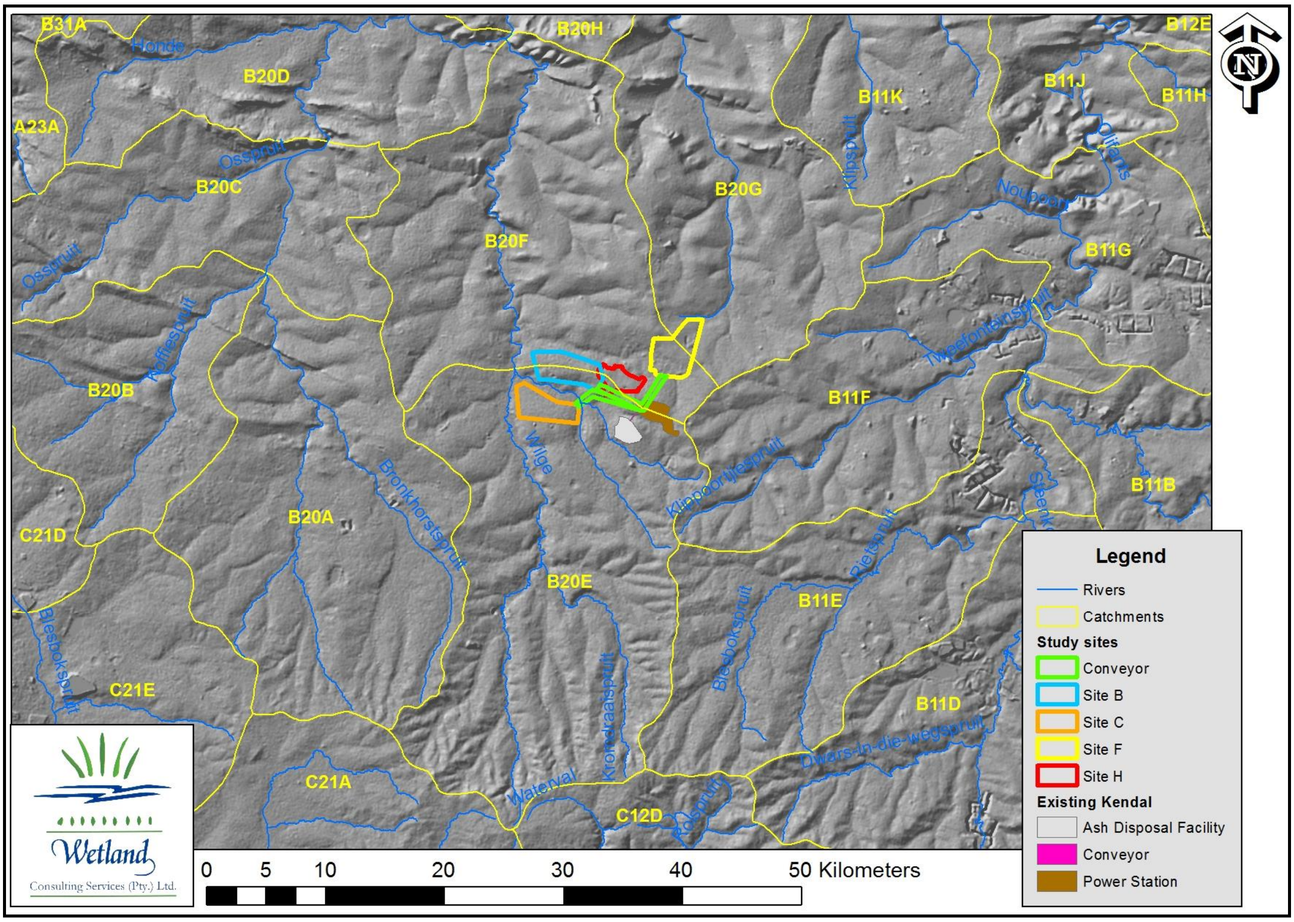

Figure 3. Map showing the study areas in relation to the quaternary catchments.

4.2 Vegetation

According to the most recent vegetation classification of the country, ñ*The Vegetation of South Africa, Lesotho and Swaziland*ò (Mucina and Rutherford, 2006), the four sites fall within the Grassland Biome, Mesic Highveld Grassland Bioregion. At a finer level, the study area is classed as Eastern Highveld Grassland and Rand Highveld Grassland.

Rand Highveld Grassland and Eastern Highveld Grassland are listed as ***Vulnerable*** on the National List of Ecosystems that are Threatened and in Need of Protection (GN 1002 of 2011) for Mpumalanga Province.

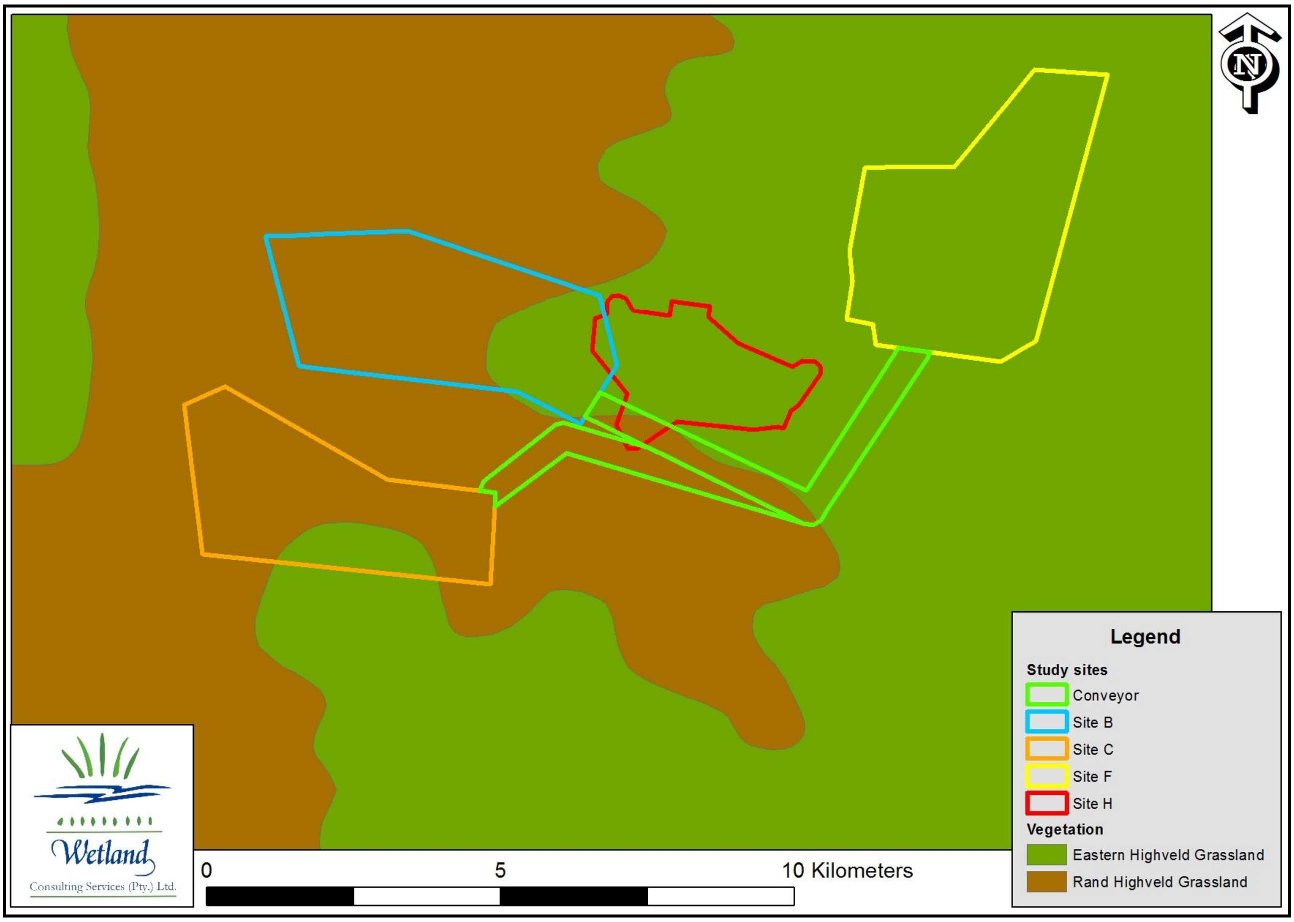

Figure 4. Map showing the vegetation of the area.

The recently published Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011a) (The Atlas) identified 791 wetland ecosystem types in South Africa based on classification of surrounding vegetation (taken from Mucina and Rutherford, 2006) and hydro-geomorphic (HGM) wetland type; seven HGM wetland types are recognised and 133 wetland vegetation groups, equating to 791 wetland ecosystem types.

The National Biodiversity Assessment 2011: Freshwater Component (Nel *et al*., 2011b) undertook an ecosystem threat status assessment for each of the 791 wetland ecosystem types where each wetland ecosystem type was assigned a threat status based on wetland type as well as on wetland vegetation group. A summary of the findings for the 4 wetland ecosystem types expected to occur on site is provided in Table 3 below.

Table 3. Summarised findings of the wetland ecosystem threat status assessment as undertaken by the National Biodiversity Assessment 2011: Freshwater Component (Nel *et al*., 2011b) for wetland ecosystems recorded on site.

Wetland Ecosystem Type	Wetland HGM Type	Threat Status	Protection level
Mesic Highveld Grassland Group 4_Seep	Seep	LT	Not Protected
Mesic Highveld Grassland Group 4_Depression	Depression	EN	Not Protected
Mesic Highveld Grassland Group 4_Channelled valley bottom	Channelled valley bottom	LT	Not Protected

CR = Critically Endangered, implying area of wetland ecosystem type in good (A or B) condition ≤ 20% of its original area
EN = indicates Endangered, area of wetland ecosystem type in good condition ≤ 35% of its original area
LT = Least Threatened

4.3 National Freshwater Ecosystem Priority Areas

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011a) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (NWI Wetlands) (SANBI, 2011) to provide information on the distribution and extent of wetland areas. The wetland mapping was recently updated for the Mpumalanga Highveld region as part of a WRC funded project (Mbona *et al*., 2015). An extract of the updated database for the Mpumalanga Highveld region as per Mbona *et al*. (2015) is illustrated in Figure 5 below.

No FEPA wetland occurs within Site H. All the remaining three sites have FEPA wetlands extending marginally into their boundaries. The Wilge River and its tributaries to the north and south of Site B have been classified as wetland FEPA's, as has a hillslope seepage wetland in the north of Site F.

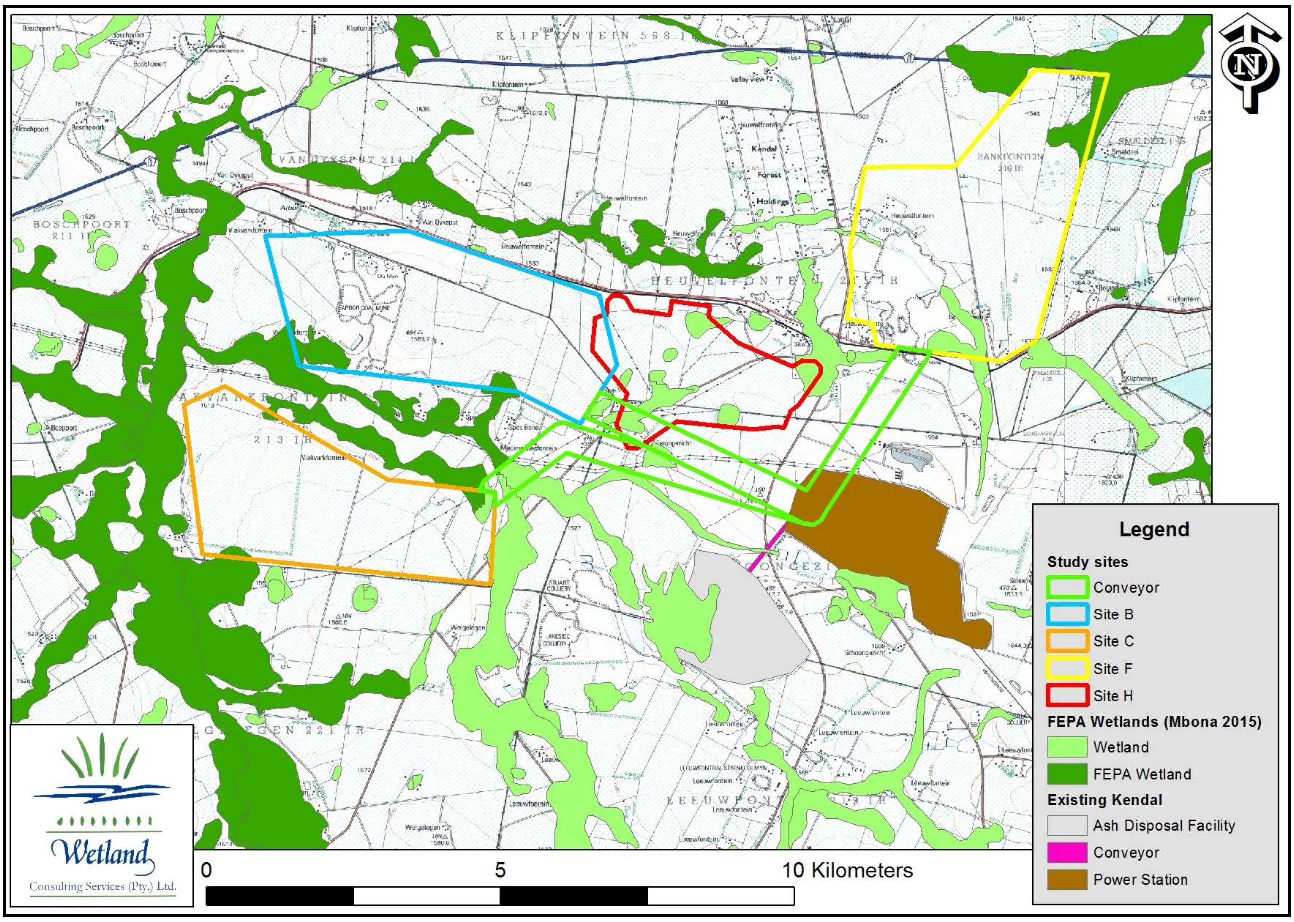

Figure 5. Map showing FEPA wetlands of the study area and surrounds (Mbona *et al.*, 2015).

4.4 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan 2013 (MBSP 2013) represents the most recent update of the Mpumalanga Biodiversity Conservation Plan. Figure 6 below shows the classification of the study area in terms of the terrestrial ecosystems assessment of the MBSP 2013.

From the map in Figure 6 the extensive transformation of the four sites is immediately apparent, with little remaining natural habitat indicated in any of the sites. Some natural habitat and a Critical Biodiversity Area (CBA) Optimal are located along the Leeufonteinspruit system between sites B and C, also extending into Site B, with a further two Critical Biodiversity Area (CBA) Optimal sites are located along the boundaries of Site H and extending marginally onto Site H in the north east.

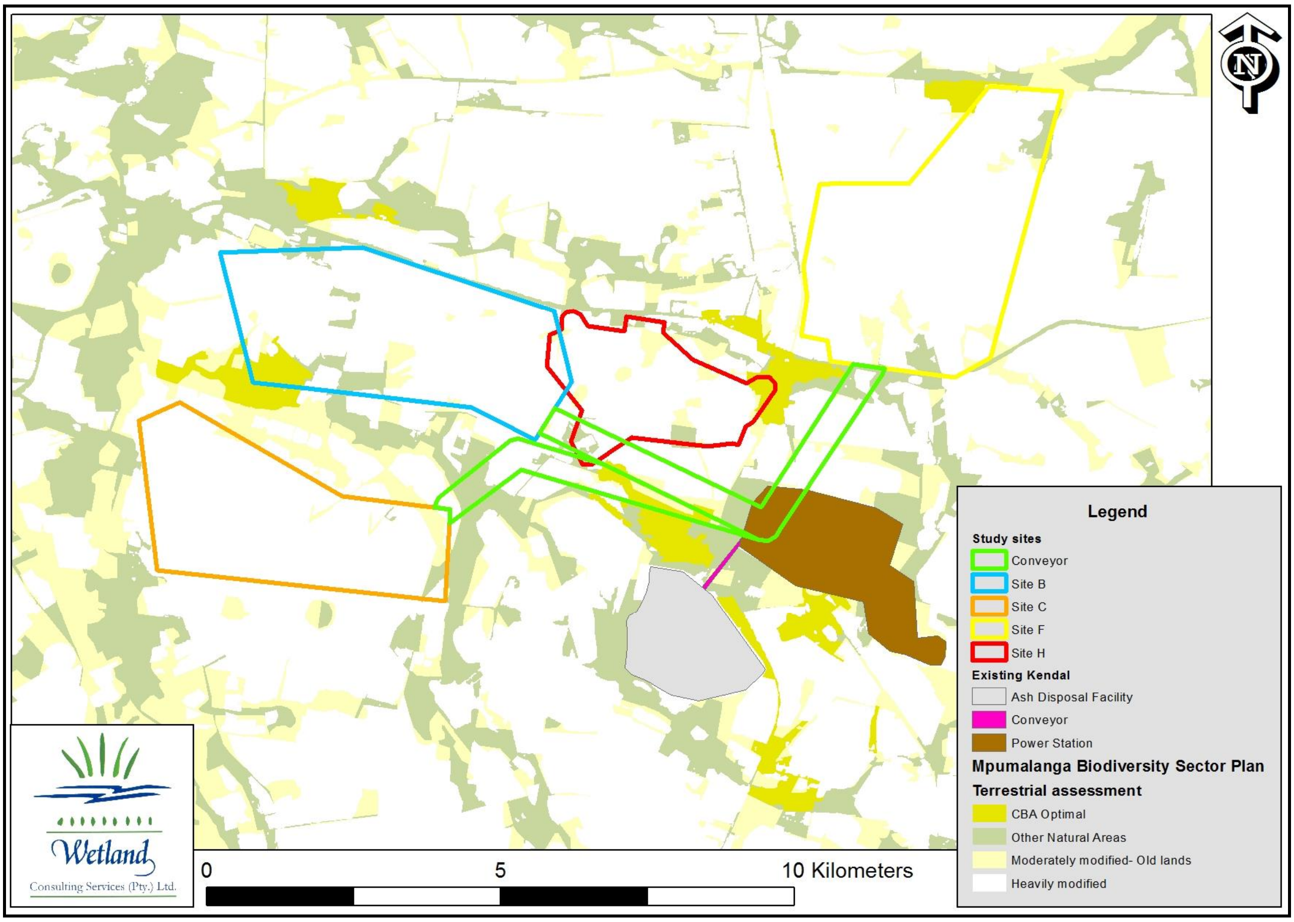

Figure 6. Map showing the terrestrial ecosystems assessment of the Mpumalanga Biodiversity Sector Plan 2013.

5. APPROACH

5.1 Wetland Delineation and Classification

The National Water Act, Act 36 of 1998, defines wetlands as follows:

> *"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."*

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in the figure below.

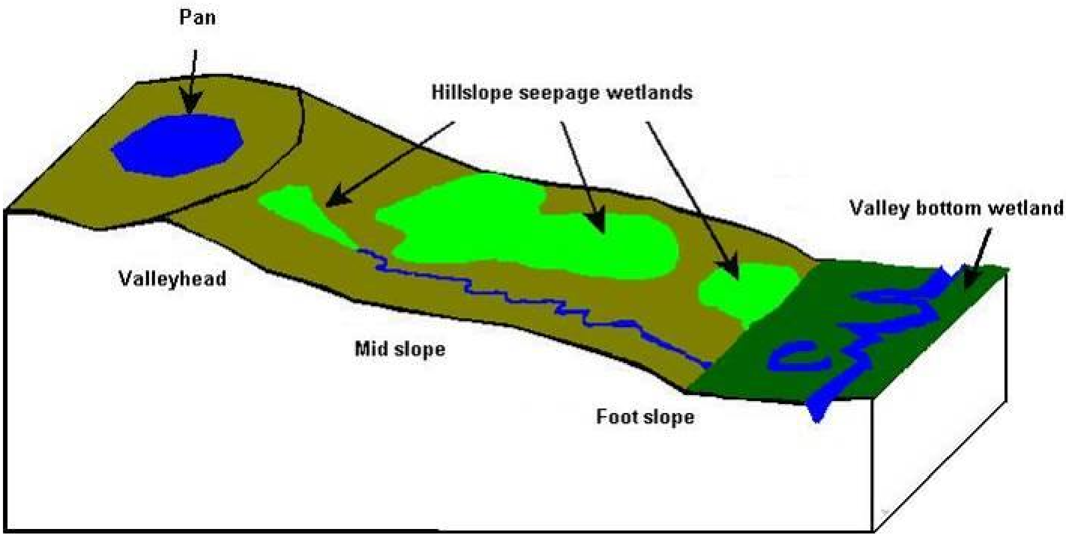

Figure 7. Diagram illustrating the position of the various wetland types within the landscape.

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands were then further investigated in the field.

Wetlands were identified and delineated according to the delineation procedure as set out by the ñA *Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*ò document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator.

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and modified for use in South African conditions by Marneweck and Batchelor (2002).

5.2 Functional Assessment

A functional assessment of the wetlands on site was undertaken using the level 2 assessment as described in ñWet-EcoServicesò (Kotze et al., 2007). This method provides a scoring system for establishing wetland ecosystem services. It enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions.

5.3 Present Ecological State and Ecological Importance & Sensitivity

A present ecological state (PES) and ecological importance and sensitivity (EIS) assessment was conducted for every hydro-geomorphic wetland unit identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

For the purpose of this study, the scoring system as described in the document ñ*Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems*ò (DWAF, 1999) was applied for the determination of the PES.

Table 4. Table showing the rating scale used for the PES assessment.

Mean*	Category	Explanation
Within generally acceptable range		
>4	A	Unmodified, or approximates natural condition
>3 and <=4	*B*	*Largely natural with few modifications, but with some loss of natural habitats*
>2.5 and <=3	*C*	*Moderately modified, but with some loss of natural habitats*
<=2.5 and >1.5	*D*	*Largely modified. A large loss of natural habitat and basic ecosystem function has occurred.*
Outside generally acceptable range		
>0 and <=1.5	E	*Seriously modified. The losses of natural habitat and ecosystem functions are extensive*
0	*F*	*Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat.*

For the purpose of this study, the scoring system as described in the document ñ*Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems*ò (DWAF, 1999) was applied for the determination of the EIS.

Table 5. Scoring system used for the EIS assessment.

Ecological Importance and Sensitivity categories	Range of Median	Ecological Management Class
Very high 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.	>3 and <=4	A
High 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.	>2 and <=3	B
Moderate Wetlands 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.	>1 and <=2	C
Low/marginal 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.	>0 and <=1	D

6. FINDINGS

6.1 Wetland Delineation and Classification

The delineated wetlands within the affected areas are shown in Figure 8.

The Wilge River floodplain is located to the west of sites B and C and flows in a northerly direction. Along its northern reach, in the vicinity of the N12 and R555 the system is confined to a fairly narrow system by the local geology, while the southern reaches are characterised by a broad floodplain with extensive footslope seepage wetlands.

Two tributaries to the Wilge drain from east to west across the area, to the north and south of Site B. The southern of these two systems, the Leeufonteinspruit, also includes the existing Kendal ADF in its catchment. The northern, unnamed tributary originates just below the Kendal PS and passes through an area of intense current and historical mining activities in Site F, before passing through an area of intense agricultural activities where a number of dams have been constructed along the wetland to supply water for irrigation purposes just to the north of Site B.

A further wetland system drains in a northerly direction away from Site F and forms the headwaters of the Saalboomspruit.

A large permanent pan which appears to be used for water storage and abstraction occurs within the centre of Site H, with a further two pans located along the southern boundary of Site C.

The wetlands of each of the 4 alternative sites will now be discussed individually.

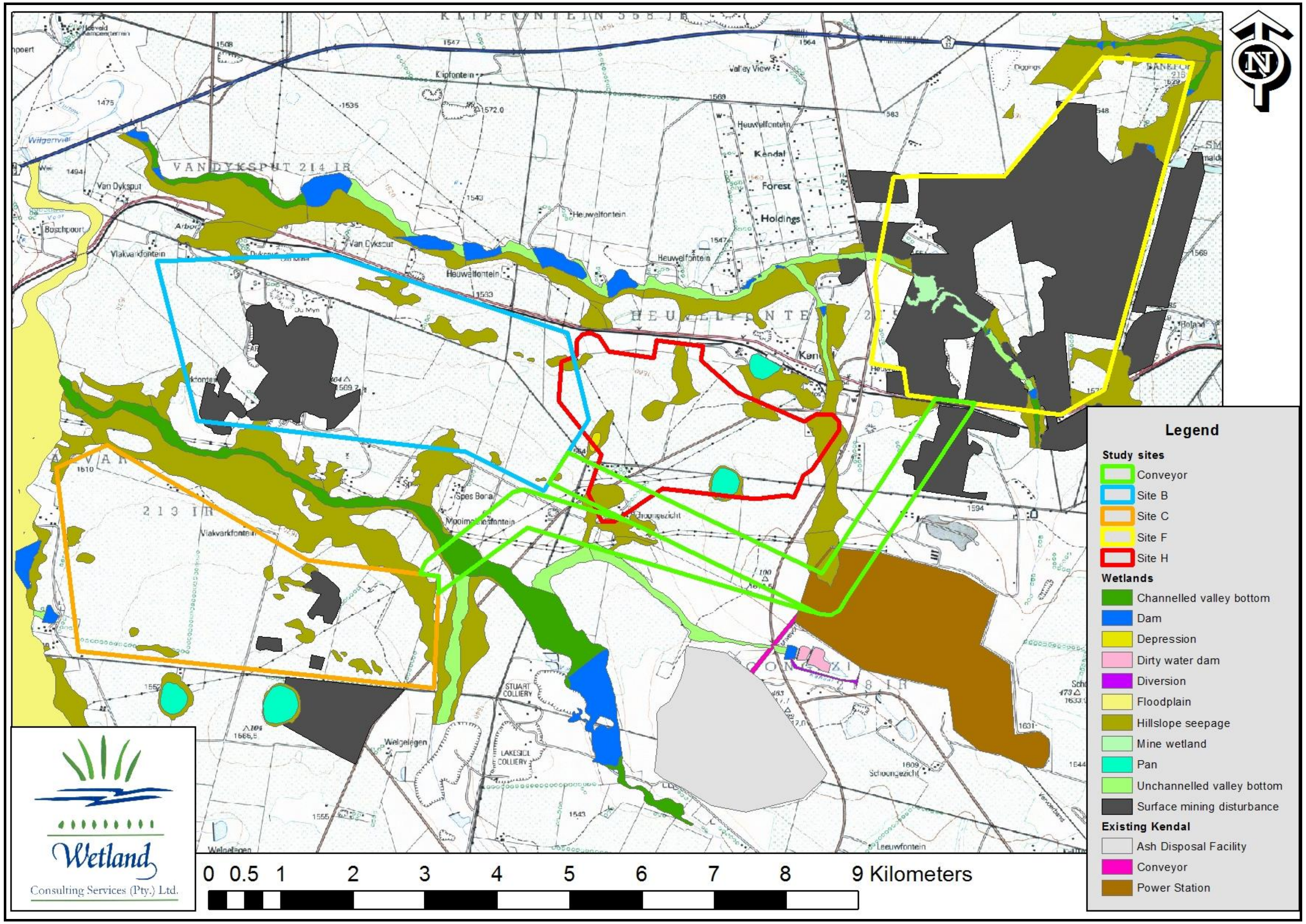

Figure 8. Map of the delineated wetlands within the four sites and adjacent areas. Wetland boundaries outside the direct site footprints are based on desktop mapping and limited field verification.

6.1.1 Site B Wetland Delineation

Approximately 49.74 hectares of wetland occur within the direct proposed footprint of Site B, making up only 4.37 % of the surface area. Only one hydro-geomorphic wetland type, hillslope seepage wetland, was recorded within the site boundaries.

The reason for the low wetland extent on site is the location of the site along the watershed between two tributaries of the Wilge River, a watershed which also marks the boundary of quaternary catchments B 20 F and B20 E.

Table 6. Table showing the extent (in hectares) of the wetlands recorded within Site B.

Wetland Type	Area (ha)	% of wetland area	% of study area
Hillslope seepage	49.74	100.00%	4.37%
TOTAL	**49.74**	**100.00%**	**4.37%**

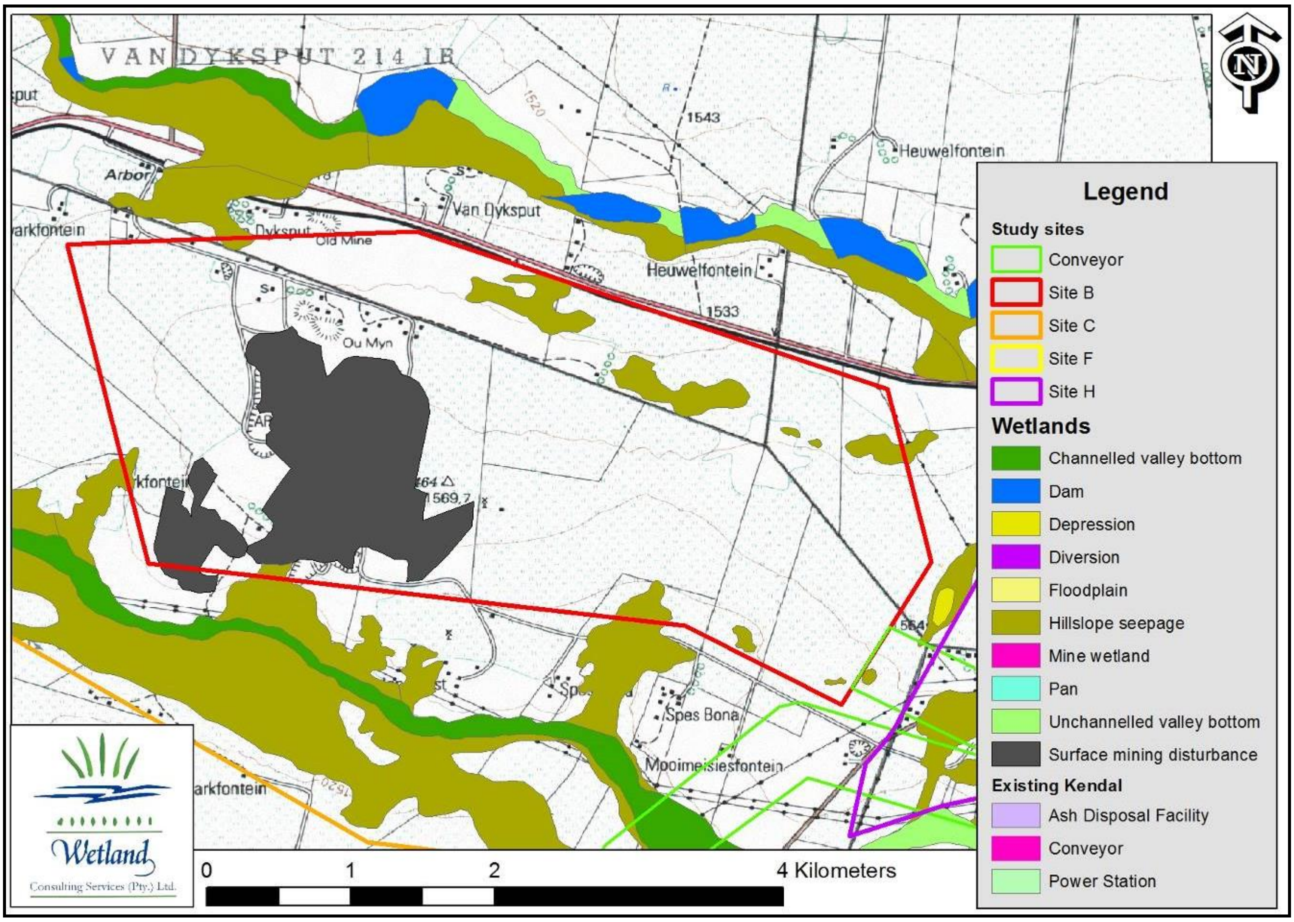

Figure 9. Map of the delineated wetlands within Site B.

The hillslope seepage wetlands in the north of Site B occur as seemingly isolated wetlands within cultivated fields and planted pastures, with most of these wetlands having been cultivated at some stage in the past and they are currently characterised by secondary vegetation, typically dominated by *Imperata cylindrica* or *Eragrostis* species in the case of planted pastures.

The southern hillslope seepage wetlands in contrast are generally connected to the downslope watercourse, the Leeufonteinspruit. One of these seepage wetlands is located downslope of opencast mining activity and appears heavily impacted by poor water quality, most likely high salinity and low pH waters. Although no water quality sample was collected (no surface water was observed at the time of the site visit), the vegetation of the system was dominated by *Juncus effusus, Cynodon dactylon* and *Populus x canescens* with areas of bare, eroding soils and signs of vegetation dieback, especially *Populus x canescens*.

Figure 10. Photographs of some of the hillslope seepage wetlands within Site B (clockwise from top left): isolated hillslope seepage wetland in the north of Site B; previously cultivated hillslope seepage wetland dominated by *Imperata cylindrica*; hillslope seepage wetland heavily impacted by poor quality water originating from mining activities; and a hillslope seepage wetland planted to *Eragrostis* pasture.

Adjacent to the site extensive wetland habitat occurs associated with the tributaries of the Wilge River draining past to the north and south of the site. Both these valley bottom wetlands have extensive seepage wetlands along their margins that are likely fed by water originating from the deeper agricultural soils located within the footprint of Site B.

The unnamed northern tributary has been extensively modified and impacted by agricultural activities within its reach adjacent to Site B, with at least 7 farm dams constructed along this approximately 7km stretch. These dams are thought to be used to abstract water for irrigation. The upstream reaches also pass through an area of intensive opencast mining activity.

The southern tributary, the Leeufonteinspruit, in contrast has no dams along its reach adjacent to sites B and C, though its headwaters are heavily impacted by mining, the existing Kendal Ash Disposal Facility and numerous dams. Large stands of *Imperata cylindrica* occur within the seepage wetlands fringing the Leeufonteinspruit, providing potentially suitable habitat for African Grass Owl, while species such as the Cape Clawless Otter and Serval are also known to occur.

6.1.2 Site C Wetland Delineation

Approximately 62.87 hectares of wetland occur within the direct proposed footprint of Site C, making up only 6.61 % of the surface area. Only one hydro-geomorphic wetland type, hillslope seepage wetland, was recorded within the site boundaries.

The reason for the low wetland extent on site is once again the location of the site on a crest in the landscape.

Table 7. Table showing the extent (in hectares) of the wetlands recorded within Site C.

Wetland Type	Area (ha)	% of wetland area	% of study area
Hillslope seepage	62.87	100.00%	6.61%
TOTAL	**62.87**	**100.00%**	**6.61%**

Similar as was the case for Site B, most of the hillslope seepage wetlands in Site C occur as seemingly isolated wetlands within cultivated fields and planted pastures, with many of these wetlands being extensively cultivated and planted to maize, and the remaining seepage wetlands having been cultivated at some stage in the past and are currently characterised by secondary vegetation, typically dominated by *Imperata cylindrica*.

An exception is a large hillslope seepage wetland located in the north eastern corner of the site. This system is at least partially linked to the adjacent drainage network. Water maintaining these seepage wetlands is once again thought to be derived from the adjacent deeper agricultural soils, with infiltrated rain water from these areas moving laterally through the soil profile and supporting hillslope seepage wetlands where this lateral flow approaches the soil surface. In the case of the hillslope seepage wetland located in the north eastern corner of the site, the sub-surface seepage appears to be forced to the surface by some geological control structure, resulting in a band of wetland habitat along the midslope. Further downslope deeper soils again allow sub-surface seepage at a deeper level, resulting in an area of more terrestrial soil/habitat downslope of the hillslope seepage wetland, before wetland habitat again forms along the footslope.

Adjacent to the site extensive wetland habitat occurs associated with the Leeufonteinspruit which flows past to the north of Site C. As indicated previously, this system has extensive seepage wetlands along its margins that are likely feed by water originating from the deeper agricultural soils located within the footprint of sites C and B. Large stands of *Imperata cylindrica* occur within the seepage wetlands, providing potentially suitable habitat for African Grass Owl, while species such as the Cape Clawless Otter and Serval are also known to occur.

The Wilge River floodplain is also located less than 200m from the western boundary of Site C at its closest point. Along this reach the floodplain is characterised by a broad floodplain with a clearly incised channel. At the time of the site visit flows within the channel was very low to almost stagnant, with water in the Wilge generally limited to a number of large pools. However, significant water inputs were observed entering the channel from the sides, indicating the importance of lateral seepage from adjacent terrestrial areas in maintaining the floodplain wetland during periods of low flows when no channel overtopping occurs.

Two pans also occur in close proximity to the southern boundary of Site C. Pump stations were observed along the shorelines of both pans and it is thought that these pans are used for storage of irrigation water. This assumption is further supported by the fact that both pans were fully inundated at the time of the site visit which coincided with the start of the summer season and low water levels would have been expected, and which was indeed the case within the Wilge River.

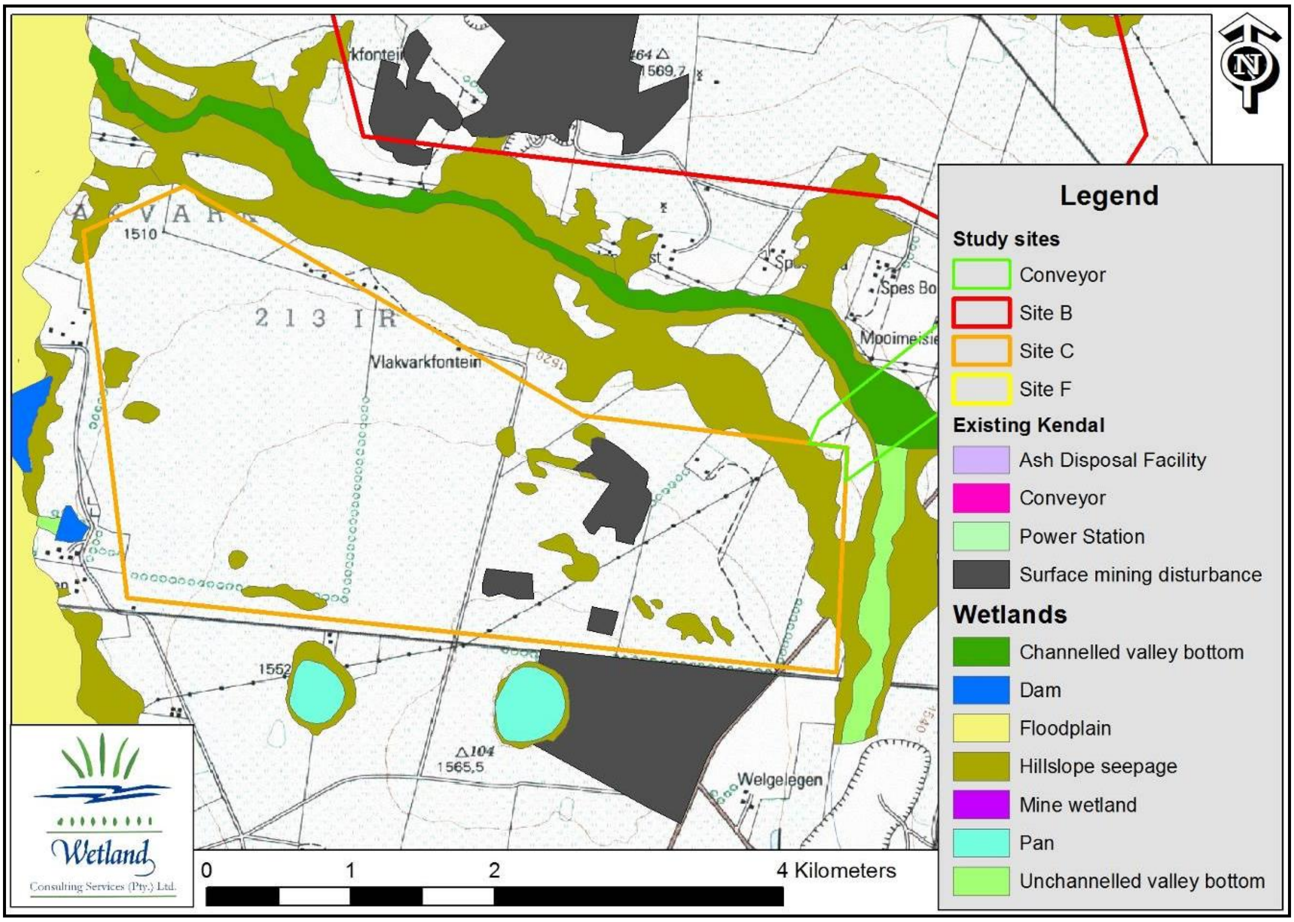

Figure 11. Map of the delineated wetlands within Site C.

Figure 12. Photographs of the cultivated hillslope seepage wetlands on Site C.

Figure 13. Photographs of the Wilge River to the west of Site C. The right photo shows water from lateral seepage entering the channel.

Figure 14. Photographs of the two pans to the south of Site C.

6.1.3 Site F Wetland Delineation

Large portions of Site F could not be accessed in the field due to active mining operations. These areas were mapped at a desktop level (refer to Section 3, Figure 1 above).

Approximately 105 ha of wetland habitat were delineated within the footprint of Site F, making up 8.54 % of the site. This includes 18 ha of wetland habitat that has formed on mining disturbed land and consists of numerous flooded voids and excavations. The natural wetland types recorded on site are as follows:

- Channelled valley bottom wetland
- Unchannelled valley bottom wetlands
- Hillslope seepage wetlands

4 small farm dams were also recorded.

Table 8. Table showing the extent (in hectares) of the wetlands recorded within Site F.

Wetland Type	Area (ha)	% of wetland area	% of study area
Channelled valley bottom	2.02	1.93%	0.16%
Unchannelled valley bottom	11.16	10.66%	0.91%
Hillslope seepage	71.24	68.05%	5.81%
Dam	2.20	2.10%	0.18%
Mine wetland	18.07	17.26%	1.47%
TOTAL	**104.69**	**100.00%**	**8.54%**

Site F is dominated by extensive mining disturbances, both current, active opencast mining and past opencast mining areas that have been rehabilitated to various degrees.

A water course, an unnamed tributary of the Wilge River which also drains past to the north of Site B, enters the site from the south and flows in a north westerly direction across Site F. Initially this wetland is confide to a narrow system between stockpiles and rehabilitated opencast pits, before entering an area of past mining activities that appear to have extended right across the wetland system. Aerial imagery appears to indicate a trench that in the past may have acted as a stream diversion, but currently flows enter a series of interlinked voids and excavations (see photographs in Figure 17 below). This wetland area has been termed a ómine wetlandô in the wetland delineation map below. In addition to the ómine wetlandô, a number of further flooded voids occur within the adjacent area that were not mapped as part of the ómine wetlandô as they did not appear directly connected to the ómine wetlandô via surface flows.

The flooded voids provide extensive wetland and open water habitat, and a number of bird species were recorded within this system that were not recorded elsewhere across the four sites, e.g. African Fish Eagle, Hamerkop, Purple Heron, and White-breasted Cormorant. Although man-made, this wetland habitat appears to support a diverse assemblage of faunal species. In terms of vegetation, the margins of the voids are dominated by *Phragmites australis*, with extensive stands of alien trees (*Eucalyptus* sp. & *Acacia mearnsii*) surrounding the wetland area. Shallow water areas also supported *Schoenoplectus corymbosus* and *Typha capensis*.

No water quality samples were analysed from this wetland system, though the presence of orange deposits (assumed to be iron hydroxide) in some locations of the wetlands (also visible on aerial imagery) is thought to indicate acid mine drainage from the old mine workings.

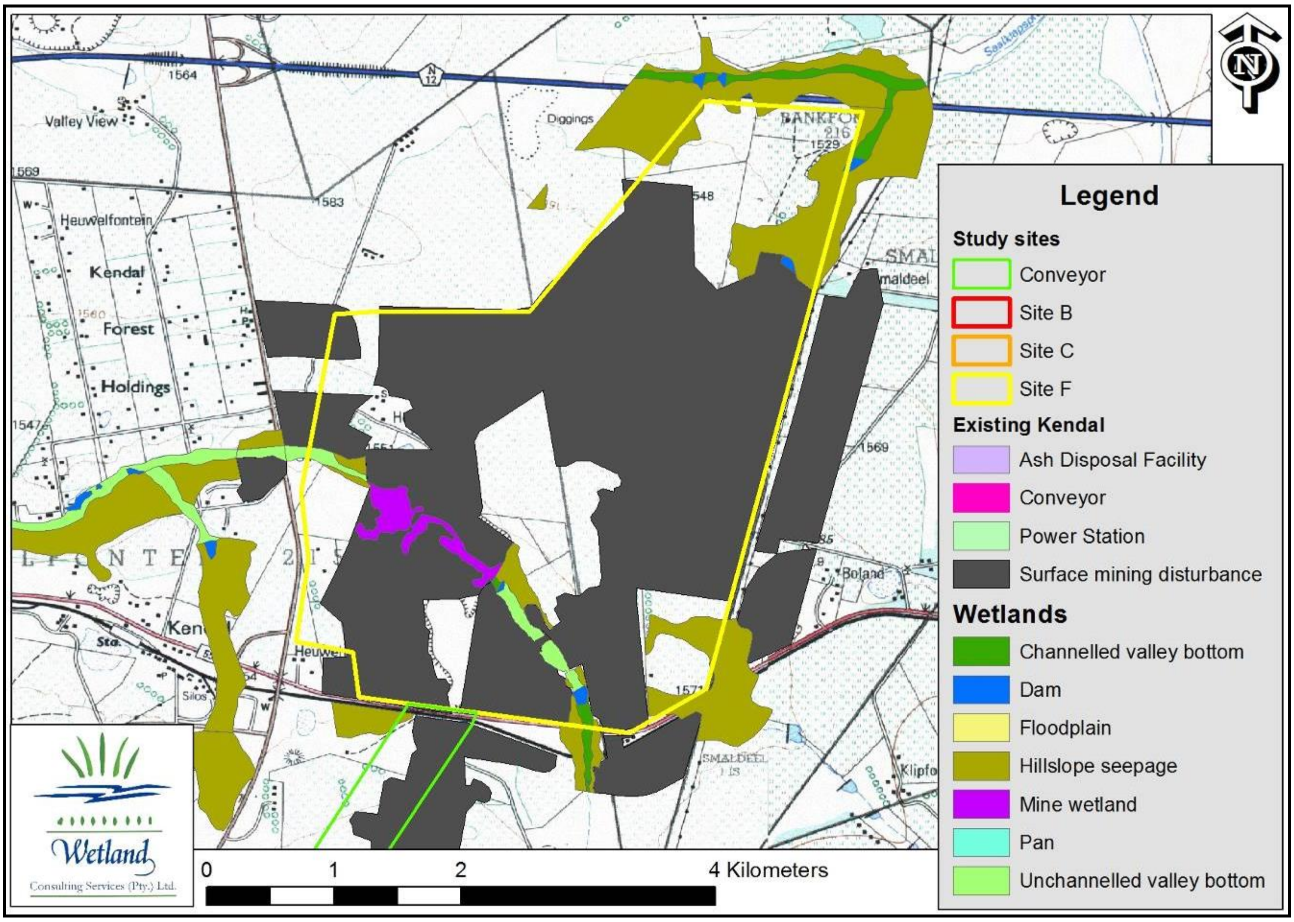

Figure 15. Map of the delineated wetlands within Site C.

Downstream of the ómine wetlandôthe natural valley bottom wetland reforms as an unchannelled system, though mining activities also take place right up against the wetland edge along this reach (see left photo in Figure 16).

In the north of Site F, the headwaters of the Saalklapspruit extend into the site boundaries, being made up of extensive hillslope seepage wetlands on site, with the valley bottom wetland just to the north and outside the study area.

Figure 16. Photographs of some of the wetlands on Site F, clearly indicating the mining impact.

Figure 17. Photographs of the 'mine wetland' area on Site F.

6.1.4 Site H Wetland Delineation

Although the initial baseline wetland investigation was undertaken on a larger footprint, this section has been updated based on the actual Site H development footprint.

Approximately 86.5 ha of wetland habitat were delineated within the proposed footprint of Site H, making up 16.3 % of the development footprint. This includes a large pan (11.6 ha) located mostly within the site which is used for water storage and abstraction for irrigation. The natural wetland types recorded on site are as follows:

- Pan/depression wetland
- Hillslope seepage wetlands

No farm dams were observed within Site H.

Table 9. Table showing the extent (in hectares) of the wetlands recorded directly within the footprint of Site H.

Wetland Type	Area (ha)	% of wetland area	% of footprint area
Pan/depression	12.6	14.6%	2.4%
Hillslope seepage	73.9	85.4%	13.9%
TOTAL	**86.5**	**100.0%**	**16.3%**

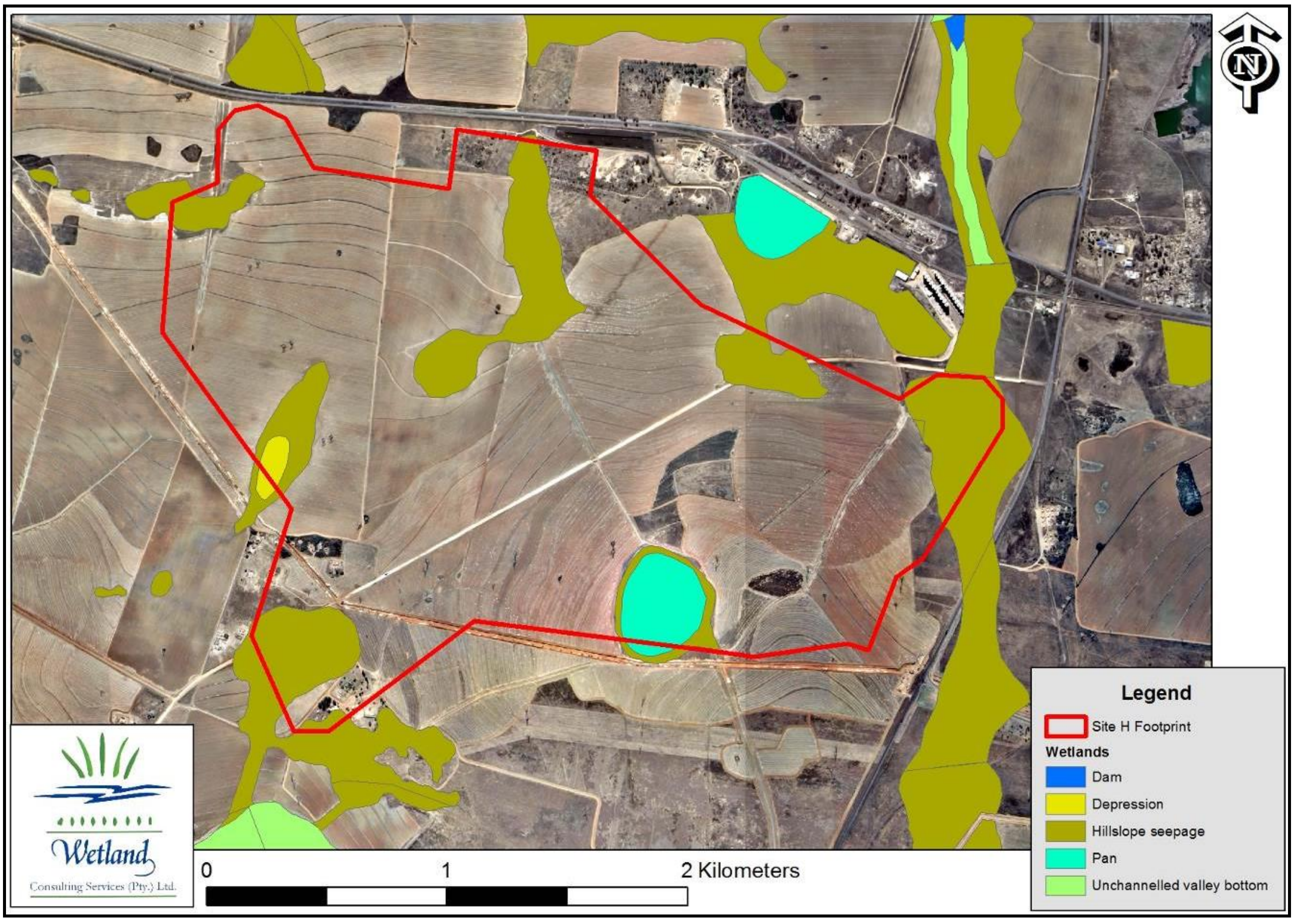

Figure 18. Map of the delineated wetlands within Site H.

Site H is once again located along a watershed, being located on the boundary between quaternary catchments B20E and B20F. As a result, most of the wetlands recorded on site, with the obvious exception of the central pan, drain away from Site H either to the north or south.

All of the north draining hillslope seepage wetlands on site are located within an extensively cultivated area, with cultivation often extending into the wetland margins, resulting in habitat degradation and the presence of numerous ruderal species along the wetland verges. However, the seepage wetlands represent the only remaining natural habitat in these areas. The large hillslope seepage wetland in the north eastern corner of the site originates within the Kendal Power Station fenced off security area and drains into an unnamed tributary of the Wilge River, the same tributary that crosses Site F and drains past to the north of Site B.

The central pan was fully inundated at the time of the site visit and appears to be a permanent pan, though this is assumed to be as a result of the storage and abstraction of water from the pan. A pump house was observed on the north eastern shore of the pan, together with an excavation into the pan to allow access to deep water for abstraction pipes. The pan is known to be used for the storage of irrigation water.

Figure 19. Photographs of some of the wetlands recorded within Site H (clockwise from top left): view across the central pan; the large hillslope seepage wetland in the north eastern corner of Site H; depression wetland along the western boundary of Site H; and hillslope seepage wetland draining north from Site H.

6.1.5 Conveyor corridors wetland delineation

Figure 20 below shows the various proposed conveyor corridors to each of the alternative sites.

Conveyor Corridor to Site B ï a single hillslope seepage wetland, possibly two, is likely to be crossed.

Conveyor Corridor to Site C ï a hillslope seepage wetland as well as the Leeufonteinspruit at its confluence with an unnamed tributary will need to be crossed. A further consideration is the close proximity of this corridor to the proposed expansion of the existing Kendal Ash Disposal Facility and the required stream diversion. It is highly possible that the conveyor will need to cross the stream diversion, potentially even twice.

Conveyor Corridor to Site F ï potentially a single hillslope seepage wetland crossing located within the existing Kendal Power Station fenced off security area.

Conveyor Corridor to Site F ï No wetland crossing.

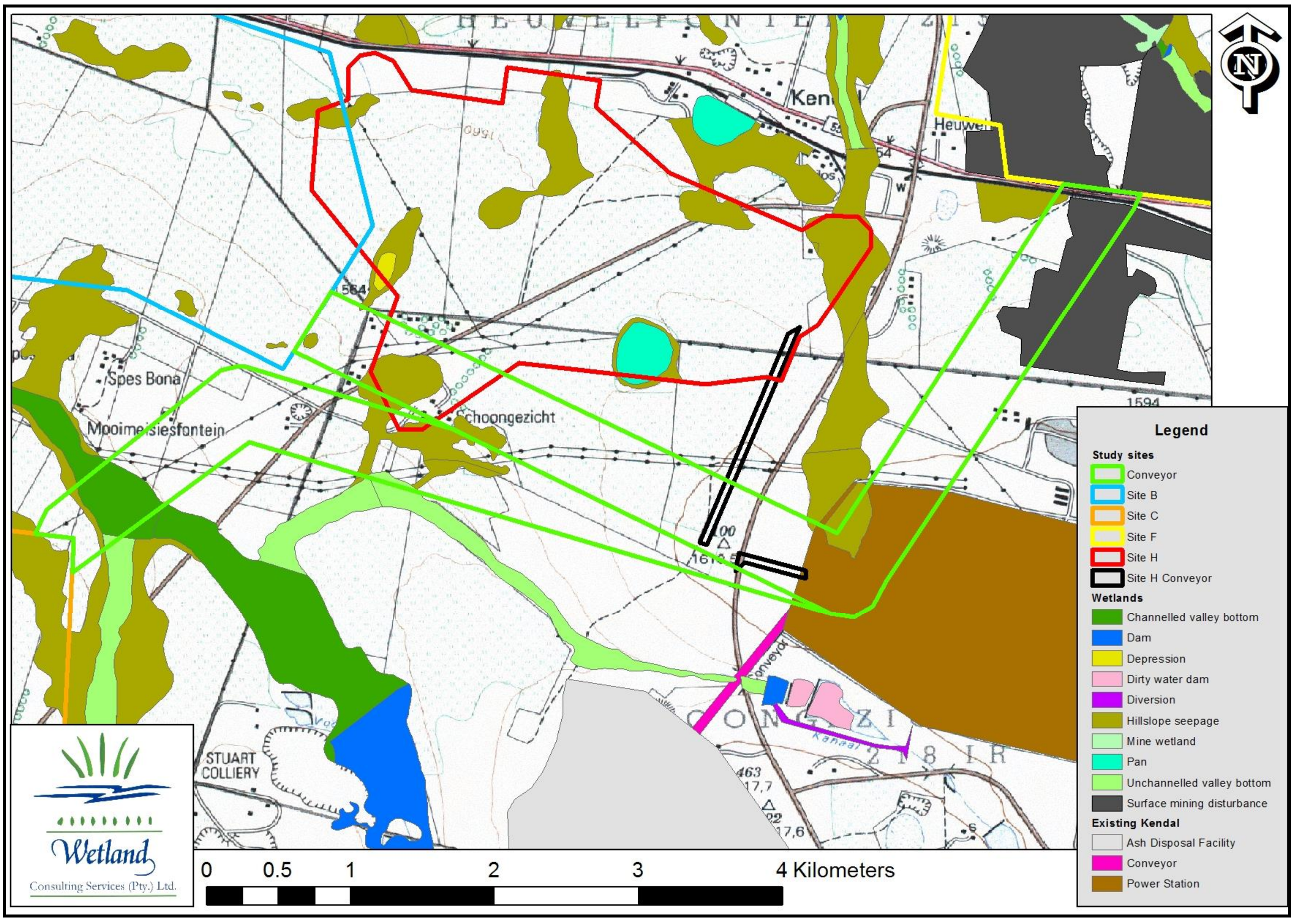

Figure 20. Map of delineated wetlands along the three potential conveyor servitudes.

6.2 Fauna & Flora

A specialist fauna and flora survey has been undertaken for all the investigated sites by Golder Associates Africa (Pty) Ltd, while a separate, standalone aquatic ecology report was also prepared by Golder Associates Africa (Pty) Ltd. Fauna and flora is addressed in detail in the mentioned reports; however, some comments on the fauna and flora as pertinent to wetlands are included in this report.

Given the close proximity of the sites to each other, as well as the fact that the sites are characterised by largely similar soils conditions and underlying geology, the vegetation within the wetlands across the sites is largely similar. Differences in vegetation observed between individual wetlands was mostly related to differences in the hydrological regime, specifically the hydroperiod and the duration of saturation of the soil profile, as well as the level of disturbance within the wetland system.

The Wilge River floodplain is characterised by an incised main channel with a narrow band of obligate wetland vegetation on either side of the river channel, characterised by *Phragmites australis* and *Cyperus* species. The greater portion of the floodplain however is temporarily to seasonally wet and is dominated by a mixture of grasses and sedges, with typical species including *Leersia hexandra*, *Eragrostis chloromelas*, *Eleocharis dregeana*, *Cyperus* sp. and *Hyparrhenia dregeana*. In some areas along the river the tree species *Salix babylonica*, *Rhus pyroides* and *Rhus dentata* were also observed. Numerous oxbows and cut-off meanders also form part of the floodplain.

The hillslope seepage wetlands were in many instances severely impacted upon by cultivation and in some cases the entire seep, or large portions along the edge, had been cultivated and planted with maize or soya bean. No natural vegetation remained in these areas. Those hillslope seeps not cultivated are characterised by species such as *Agrostis lachnantha, Andropogon eucomis, Cynodon dactylon, Eragrostis curvula*, *Imperata cylindrica*, *Paspalum dilatutum, Themeda triandra*, *Cyperus denudatus, Juncus effuses*, *Kyllinga erecta*, *Fuirena obcordata, Stoebe vulgaris* and *Hyparrhenia* species. Many of these seeps showed signs of heavy grazing by cattle.

Three large pans were identified within the study area. All three of these pans are expected to have been seasonal pans under natural conditions, though all pan appear now to be used for storage of irrigation water. The pans showed the lowest diversity of plant species amongst the wetland types on site. Typical species include *Leersia hexandra*, *Panicum repens*, *Typha capensis*, *Eleocharis dregeana*, *Cyperus* sp. and *Eragrostis curvula*.

The valley bottom wetlands, both channelled and unchannelled, recorded 82 and 86 species respectively. In the wetter parts of the valley bottoms and in those areas where channels were present, typical species encountered were *Leersia hexandra*, *Typha capensis*, *Setaria sphacelata* and various *Cyperaceae* species, including *Eleocharis dregeana*. Along either side of these wetter areas, in the temporary wet areas of the valley bottom, species such as *Themeda triandra*, *Hyparrhenia dregeana* and *Eragrostis curvula* dominated.

No Red Data plant species were observed within the wetlands on site, though a number of protected species do occur:

- *Crinum bulbispermum*
- *Erythrina zeyheri*
- *Gladiolus crassifolius*
- *Gladiolus eliottii*
- *Hypoxis hemerocallidea*

All of these species are protected in terms of the Mpumalanga Nature Conservation Act (Act 10 of 1998).

A number of alien invasive species were also observed within the wetlands on site, including *Acacia mearnsii*, *Eucalyptus* sp. and *Populus x canescens*.

6.2.1 Fauna

No Red Data mammal species were observed within the study area during the wetland assessment. However, scats of the Cape Clawless Otter (*Aonyx capensis*) were observed within a number of the valley bottom wetland systems on site, and Serval (*Felis serval*) is also known to occur.

Numerous Red Data listed bird species are expected to occur in the area, including:

- Blue Crane ï has been observed in close proximity to the study area on two occasions.
- Greater Flamingo ï was observed at the pans to the south of Site C.
- Lesser Flamingo
- African Grass Owl ï extensive suitable habitat between sites B and C
- Black-winged Pratincole
- Secretarybird

6.3 Functional Assessment

Numerous functions are typically attributed to wetlands, which include biodiversity support, nutrient removal (and more specifically nitrate removal), sediment trapping (and associated with this is the trapping of phosphates bound to iron as a component of the sediment), stream flow augmentation, flood attenuation, trapping of pollutants and erosion control. Many of these functions attributed to wetlands are wetland type specific and can be linked to the position of wetlands in the landscape as well as to the way in which water enters and flows through the wetland. Thus not all wetlands can be expected to perform all functions, or to perform these functions with the same efficiency. Despite this, certain assumptions on the functions supported by wetlands can be made, based on the hydro-geomorphic wetland classification system which classifies wetlands according to the way that water moves through the wetland as well as the position of the wetland within the landscape.

For the purpose of this study the Wet-EcoServices tool ((Kotze, Marneweck, Batchelor, Lindley and Collins, 2004) was applied to the four different types of wetland systems occurring within the study area. This tool enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions.

6.3.1 Valley bottom wetlands

The linear nature of valley bottom wetlands within the landscape and their connectivity to the greater drainage system provides the opportunity for these wetlands to play an important role as an ecological corridor, allowing the movement and migration of fauna and flora between remaining natural areas within the landscape. Within a landscape that has experienced large scale transformation of its terrestrial areas such as is the case in this area of the Mpumalanga Highveld where virtually all terrestrial grassland habitats have been lost to cultivation and mining, the importance of valley bottom wetlands in this regard is amplified. The two east-west draining tributaries to the north and south of Site B are a case in point, where very little natural vegetation remains in between these two valley bottom wetland systems.

Although modified in certain respects, these wetlands also still provide a natural refuge for biodiversity, and within the study area and surroundings, the valley bottom wetlands with associated footslope seepage wetlands represent the most significant extent of remaining natural vegetation, further enhancing their importance from a biodiversity support function.

Channelled valley bottom wetlands, through the erosion of a channel through the wetland, indicate that sediment trapping is not always an important function of these wetlands, except where regular overtopping of the channel occurs and flows spread across the full width of the wetland. Under low and medium flows, transport of sediment through, and out, of the system are more likely to be the dominant processes. Erosion may be both vertical and/or lateral and reflect the attempts of the stream to reach equilibrium with the imposed hydrology. A number of the valley bottom wetland systems show signs of erosion, presumably as a result of changes in landuse (conversion to cultivated fields) and altered hydrology due to farm road crossings and dams. As flows become more channel bound through vertical incision and lateral erosion of the channel, the ability of the wetlands to trap sediments decreases.

From a functional perspective channelled valley bottom wetlands can play a role in flood attenuation when flows over top the channel bank and spread out over a greater width, with the surface roughness provided by the vegetation further slowing down the flood flows. These wetlands are considered to play only a minor role in the improvement of water quality given the short contact period between the water and the soil and vegetation within the wetland.

Un-channelled valley bottom wetlands reflect conditions where surface flow velocities are such that they do not, under existing flow conditions, have sufficient energy to transport sediment to the extent that a channel is formed. In addition to the biodiversity associated with these systems it is expected that they play an important role in retaining water in the landscape as well as in contributing to influencing water quality through for example mineralisation of rain water. These wetlands could be seen to play an important role in nutrient removal, including ammonia, through adsorption onto clay particles. The large size of the unchannelled valley bottom wetland associated with the Bronkhorstspruit suggests that this wetland plays an important role in flood attenuation ï the temporary storage of flood waters within the wetland.

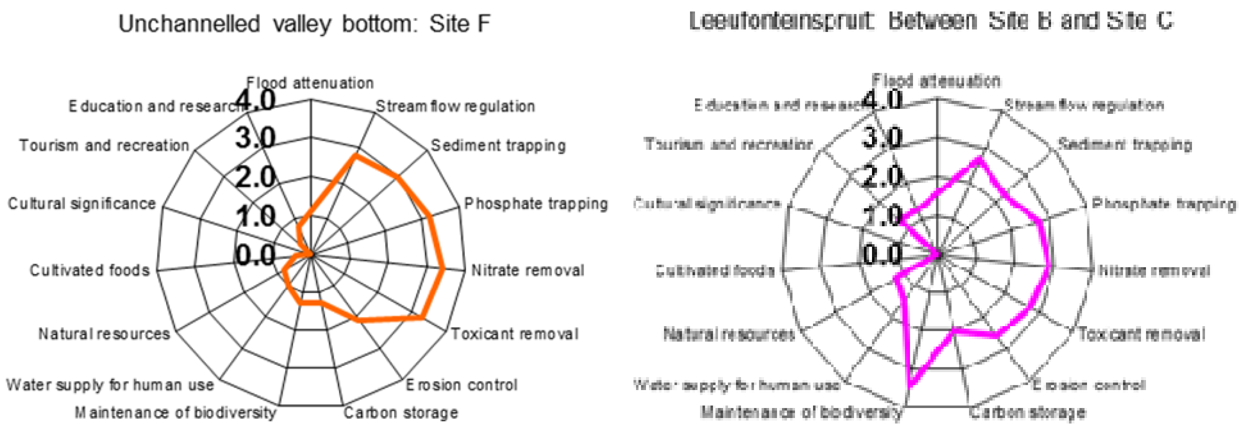

Figure 21. Radial plots showing the results of the WET-EcoServices assessment.

6.3.2 Hillslope seepage wetlands

Hillslope seepage wetlands are mostly maintained by shallow sub-surface interflow, derived from rainwater. Rainfall infiltrates the soil profile, percolates through the soil until it reaches an impermeable layer (e.g. a plinthic horizon or the underlying sandstone), and then percolates laterally through the soil profile along the aquitard (resulting in the formation of a perched water table). Such a perched water table occurs across large areas of the Mpumalanga Highveld, not only within hillslope seepage wetlands, but also within terrestrial areas, only at greater depth. The hillslope seepage wetlands are merely the surface expression of this perched water table in those areas where a shallow soil profile results in the perched water table leading to saturation of the profile within 50cm of the soil surface. The importance of individual seepage wetlands in temporarily storing and then discharging flows to downslope wetlands (flow regulation) varies and depends on a number of factors. Generally, seepage wetlands associated with springs and located adjacent to terrestrial areas characterised by deep, well-drained soils are more likely to play an important role in flow regulation than seepage wetlands where the wetland and catchment are characterised by shallower soils. Such seepage wetlands are likely often maintained mostly by direct rainfall and lose most of their water to evapotranspiration, and surface run-off during large storm events.

Hillslope seeps can support conditions that facilitate both sulphate and nitrate reduction as interflow emerges through the organically rich wetland soil profile, and are thus thought to contribute to water quality improvement and/or the provision of high quality water. The greatest importance of the hillslope seepage wetlands on site is thus taken to be the movement of clean water through the hillslope seepage wetlands and into the adjacent valley bottom wetlands, though the flow contribution from hillslope seepage wetlands to downslope wetlands was not quantified.

As hillslope seepage wetlands, for the most part, are dependent on the presence of an aquiclude, either a hard or soft plinthic horizon, they are not generally regarded as significant sites for groundwater recharge (Parsons, 2004). However, by retaining water in the landscape and then slowly releasing this water into adjacent valley bottom or floodplain wetlands, some hillslope seepage wetlands can contribute to stream flow augmentation, especially during the rainy season and early dry season. From an overall water yield perspective there is evidence that seepage wetlands contribute to water loss. The longer the water is retained on or near the surface the more likely it is to be lost through evapo-transpiration (McCarthy, 2000). Hillslope seepage wetlands are not generally considered to play an important role in flood attenuation, though early in the season, when still dry, the seeps have some capacity to retain water and thus reduce surface run-off. Later in the rainy season when the wetland soils are typically saturated, infiltration will decrease and surface run-off increase. Further flood attenuation can be provided by the surface roughness of the wetland vegetation; the greater the surface roughness of a wetland, the greater is the frictional resistance offered to the flow of water and the more effective the wetland will be in attenuating floods (Reppert et al., 1979). In terms of the hillslope seepage wetlands on site, the surface roughness is taken to be moderately low, given that most of the seepage wetlands are either cultivated of characterised by typical grassland vegetation, thus offering only slight resistance to flow.

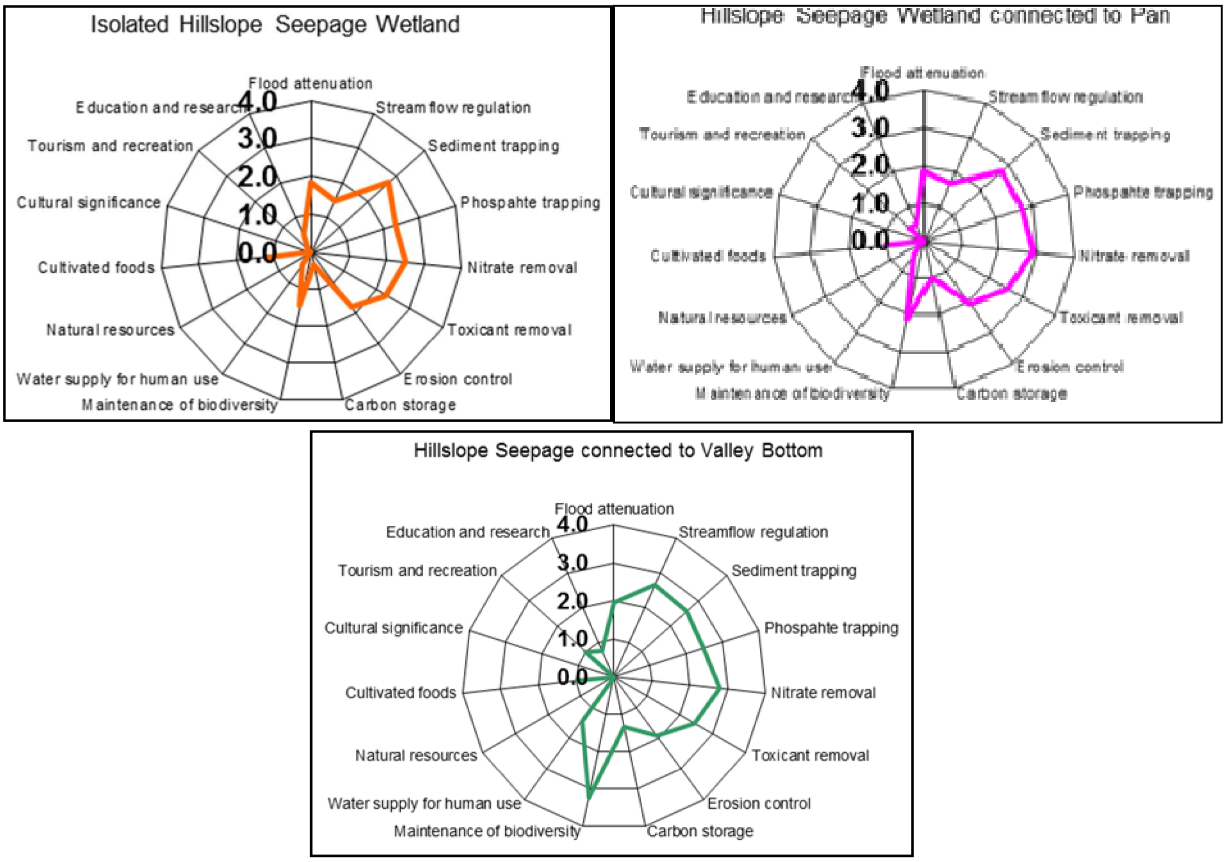

Figure 22. Radial plots showing the results of the WET-EcoServices assessment.

6.3.3 Pans/Depressions

Given the position of many pans within the landscape, which is usually isolated from any stream channels, the opportunity for pans to attenuate floods is fairly limited, though some run-off is stored in pans. In the cases where pans are linked to the drainage network via seep zones, the function of flood attenuation is somewhat elevated. Pans are also not considered important for sediment trapping, as many pans are formed through the removal of sediment by wind when the pan basins are dry. Some precipitation of minerals and de-nitrification is expected to take place within pans, which contributes to improving water quality. Some of the accumulated salts and nutrients can however be exported out of the system and deposited on the surrounding slopes by wind during dry periods.

The two pans to the south of Site C, as well as the pan within Site H, have pumping stations along their shorelines. This, together with the high water levels at the start of the rainy season suggests that water levels within the pans are supplemented and that the water is then used for irrigation (to supply the centre-pivot irrigation systems on site). The hydroperiod of these pans, as well as the water quality, is therefore likely to be substantially altered.

Nonetheless the pans, especially the eastern pan to the south of Site C, were seen to support a high number and diversity of waterbird species at the time of the wetland survey. This, the support of faunal and floral biodiversity, is generally considered one of the most important functions performed by pans. The Red Data listed Greater Flamingo was also observed feeding within the pans on site.

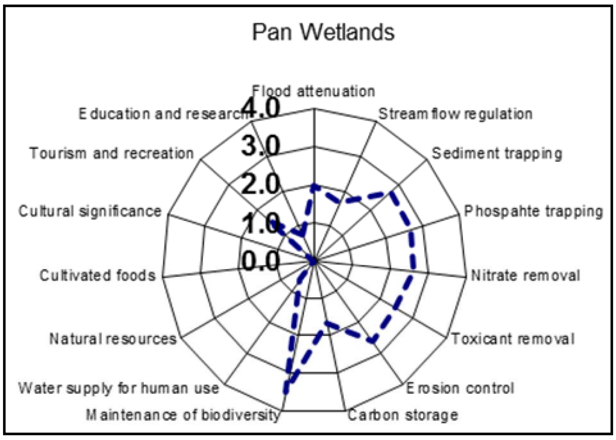

Figure 23. Radial plot showing the results of the WET-EcoServices assessment.

Figure 24. Photograph of Greater Flamingos observed within the pans on site.

6.4 Present Ecological Status (PES) Assessment

The results of the PES assessments are summarised in the figures and tables below. Of the wetlands within the various proposed footprints, over 70 % are considered to be moderately modified (PES category C), with only around 10 % of wetlands still within the *Natural* and *Largely Natural* (A & B) categories. Given that all the various alternatives investigated fall within close proximity to each other, and the land use of the various areas is similar, the impacts to the wetlands have been similar and the results of the PES assessment differ only marginally between the various sites.

Site B: The majority of the hillslope seepage wetlands within Site B are considered largely modified (PES category D), consisting mostly of the seepage wetlands in the north of the site. These wetlands have all been cultivated in their entirety, with some of the wetlands currently still under cultivation, some converted to planted pastures and some areas characterised by species poor secondary grassland (dominated by sparse, short *Imperata cylindrica*). In addition to the complete transformation of the wetland vegetation, cultivation also influences the hydrology through increasing surface runoff and reducing infiltration, and the geomorphology through increased soil erosion. The seepage wetland below the opencast mining activities on site has been classified as seriously modified (PES category E) due to extensive alien vegetation within the wetland, water quality deterioration and resultant changes in vegetation to high salinity tolerant species such as *Juncus effusus* and *Cynodon dactylon*.

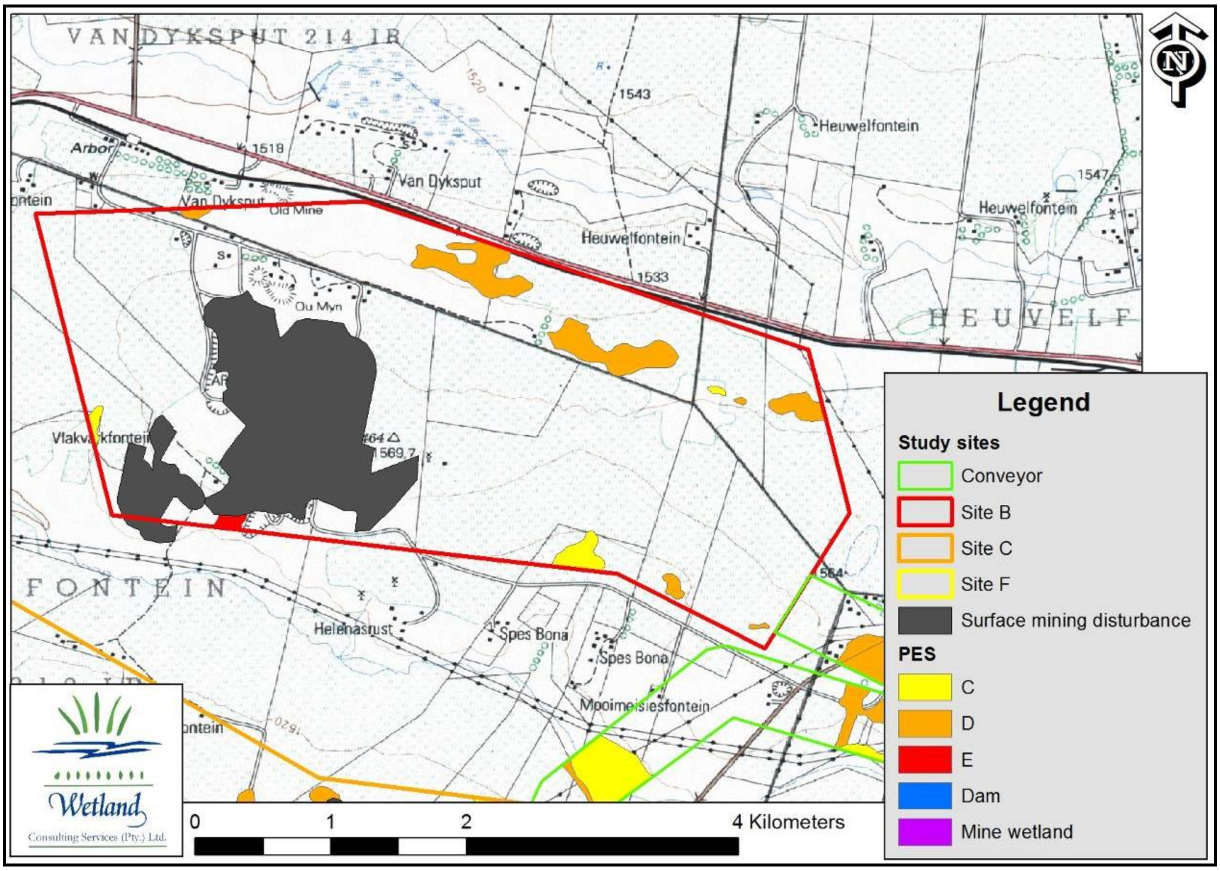

Figure 25. Map of PES results for Site B.

Table 10. Summarised PES results Site B.

Wetland Type	C	D	E	TOTAL
Hillslope seepage	7.99	39.96	1.78	49.74
TOTAL	**7.99**	**39.96**	**1.78**	**49.74**

Site C: Roughly 50 % of the wetlands within Site C are considered moderately modified (PES category C), with the remainder considered largely modified (PES category D). All of the wetlands have been impacted by cultivation within and adjacent to the wetlands. The largely modified wetlands have generally been cultivated in their entirety and are currently still under cultivation, while the moderately modified seepage wetlands are characterised by natural vegetation across most of their extent. Some excavations have also taken place within the larger eastern hillslope seepage wetland.

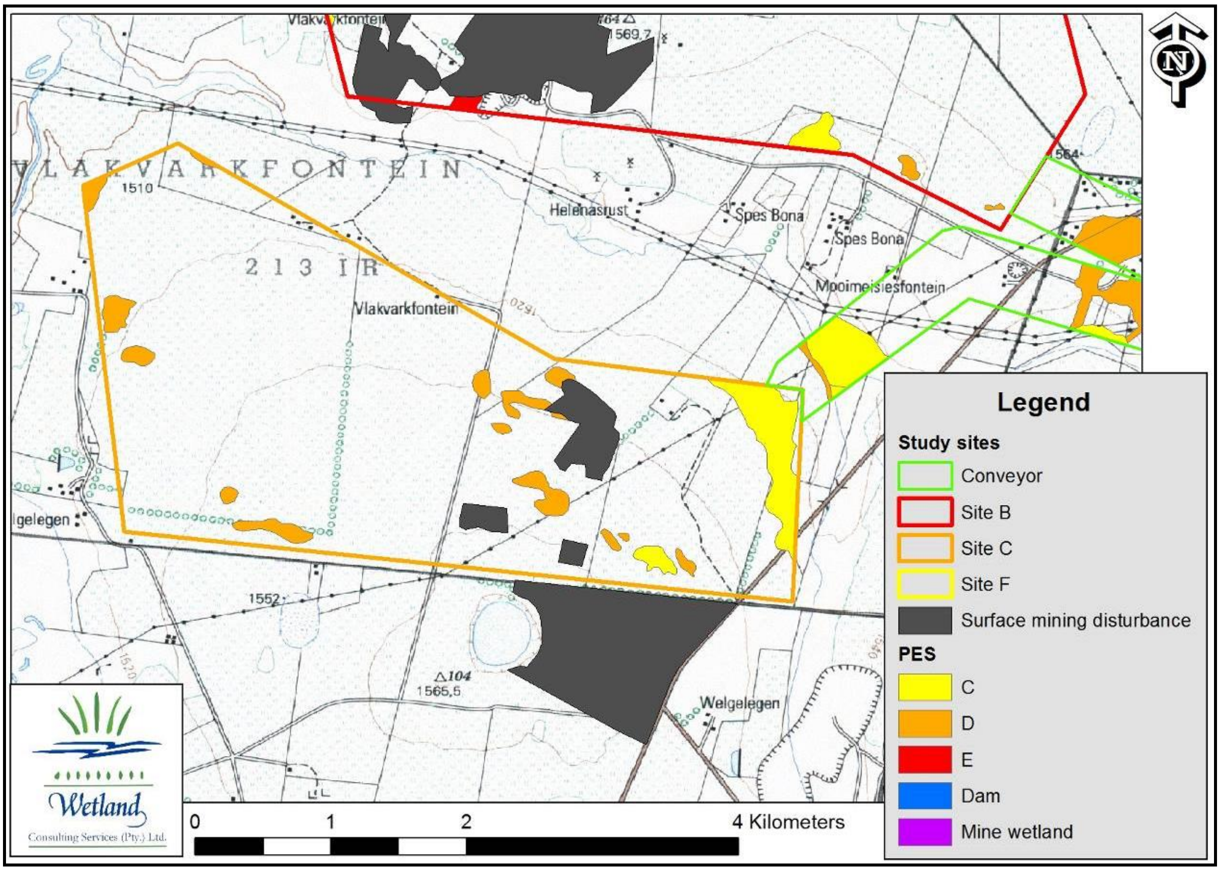

Figure 26. Map of PES results for Site C.

Table 11. Summarised PES results for Site C.

Wetland Type	C	D	TOTAL
Hillslope seepage	31.45	31.36	62.81
TOTAL	**31.45**	**31.36**	**62.81**

Site F: The wetlands on Site F have been heavily impacted by mining activities, especially the southern system. The hydrological drivers of this system have been seriously altered as a result, and large portions of the pre-mining wetland extent on site have been lost, with mining disturbance extending right across the southern valley bottom wetland.

The northern wetland system has also been impacted by mining activities taking place within the upper reaches of the wetlands and their catchments. However, these seepage wetlands have experienced less direct disturbances and are still characterised by natural vegetation for the most part. Unless carefully managed however, the ongoing mining activities are likely to result in further degradation of these wetlands.

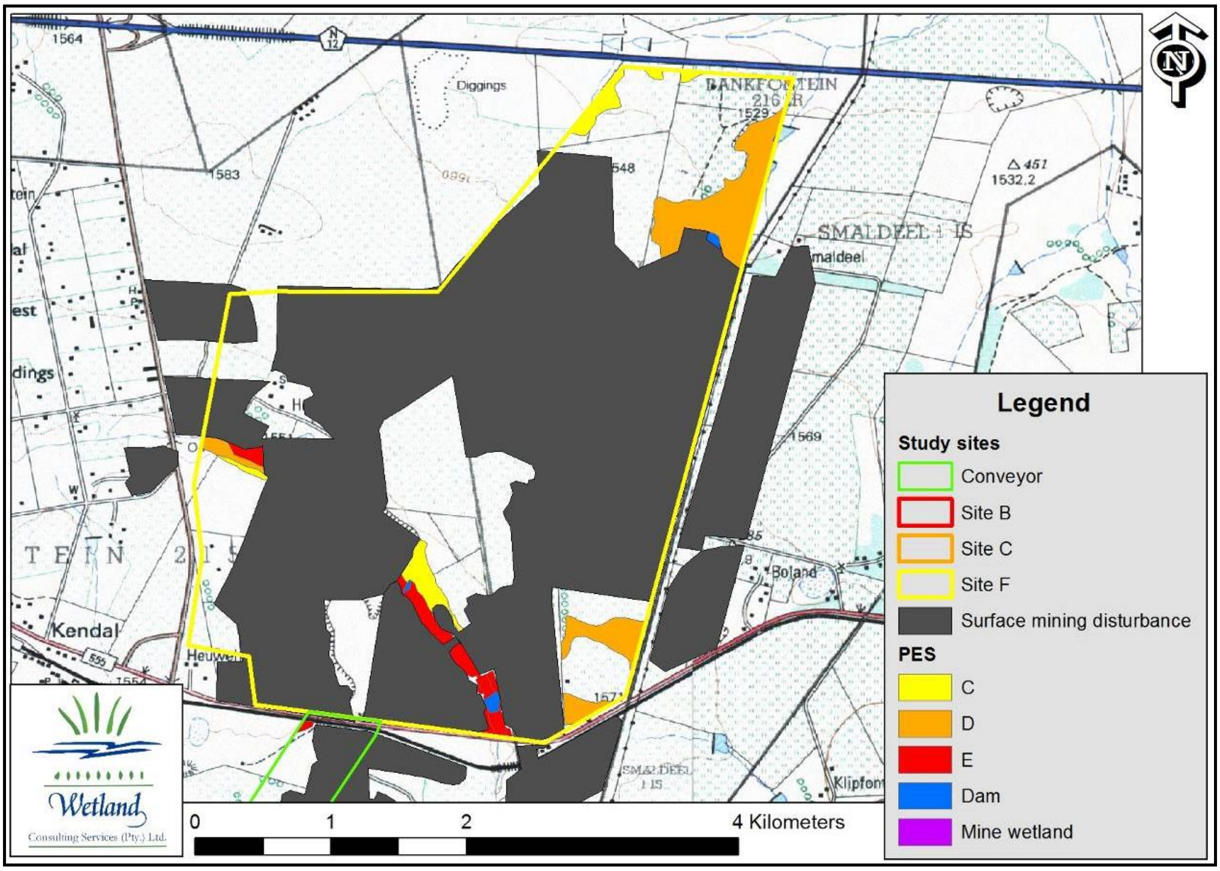

Figure 27. Map of PES results for Site F.

Table 12. Summarised PES results for Site F.

Wetland Type	C	D	E	TOTAL
Channelled valley bottom	0.00	0.00	2.02	2.02
Unchannelled valley bottom	0.00	3.14	8.03	11.16
Hillslope seepage	8.40	51.04	5.25	64.69
Dam	n/a	n/a	n/a	2.20
Mine wetland	n/a	n/a	n/a	18.07
TOTAL	**8.40**	**54.18**	**15.29**	**98.14**

Site H: The wetlands within Site H were mostly considered largely modified (PES category D), with the hillslope seepage wetlands most significantly impacted by cultivation and associated disturbances, and the large central pan having been altered by the storage and abstraction of water from the pan. The large hillslope seepage wetland in the north east of the study area is however characterised by a large expanse of natural wetland vegetation and shows limited impacts within the central portions of the wetland. This system is thus considered to be in only a moderately modified condition (PES category C).

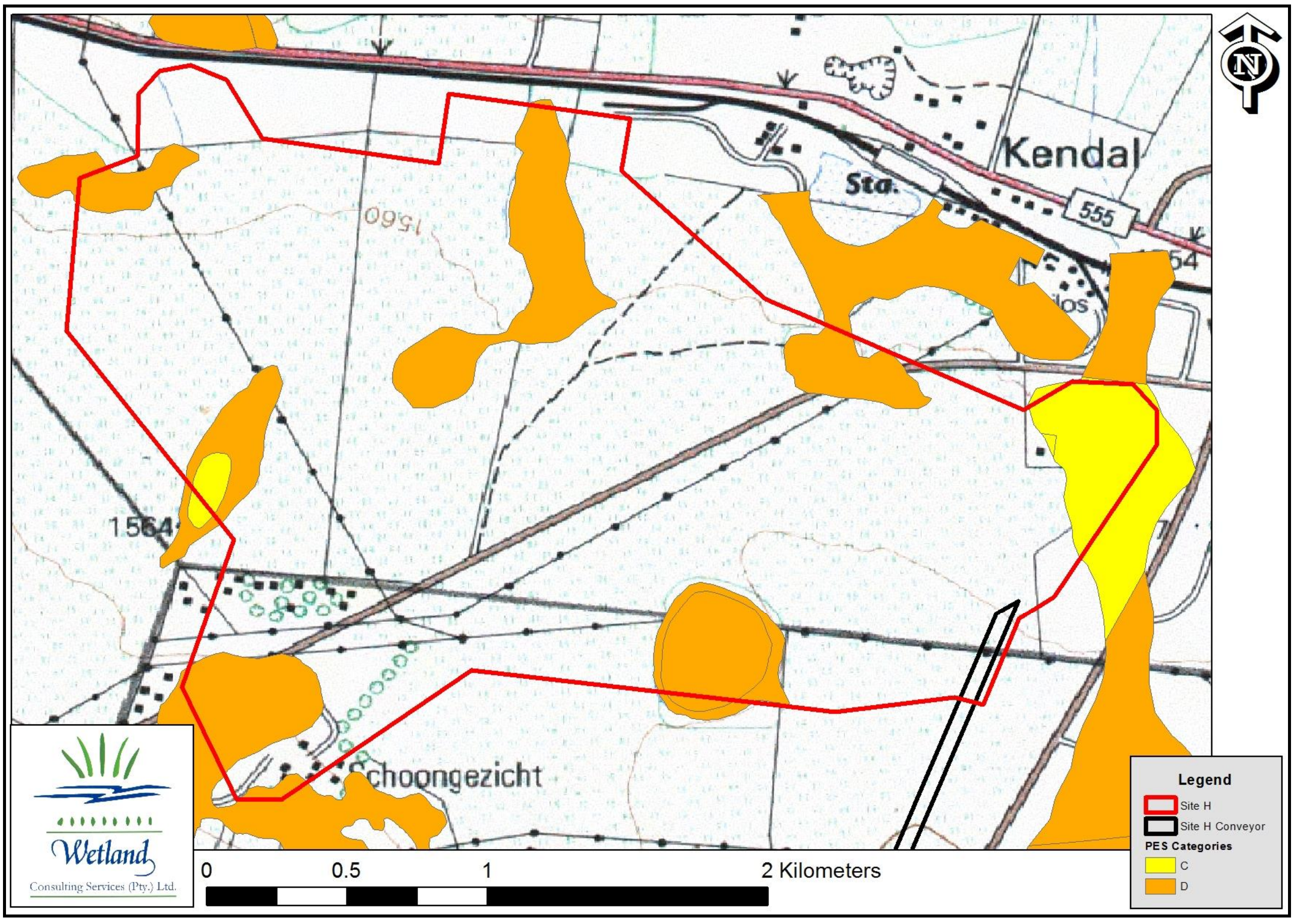

Figure 28. Map of PES results for Site H.

Table 13. Summarised PES results for Site H.

Wetland Type	C	D	TOTAL
Pan/Depression	1.8	10.8	12.6
Hillslope seepage	14.5	59.4	73.9
TOTAL	**16.3**	**70.2**	**86.5**
% of wetland area	**18.8 %**	**81.2 %**	**100.00%**

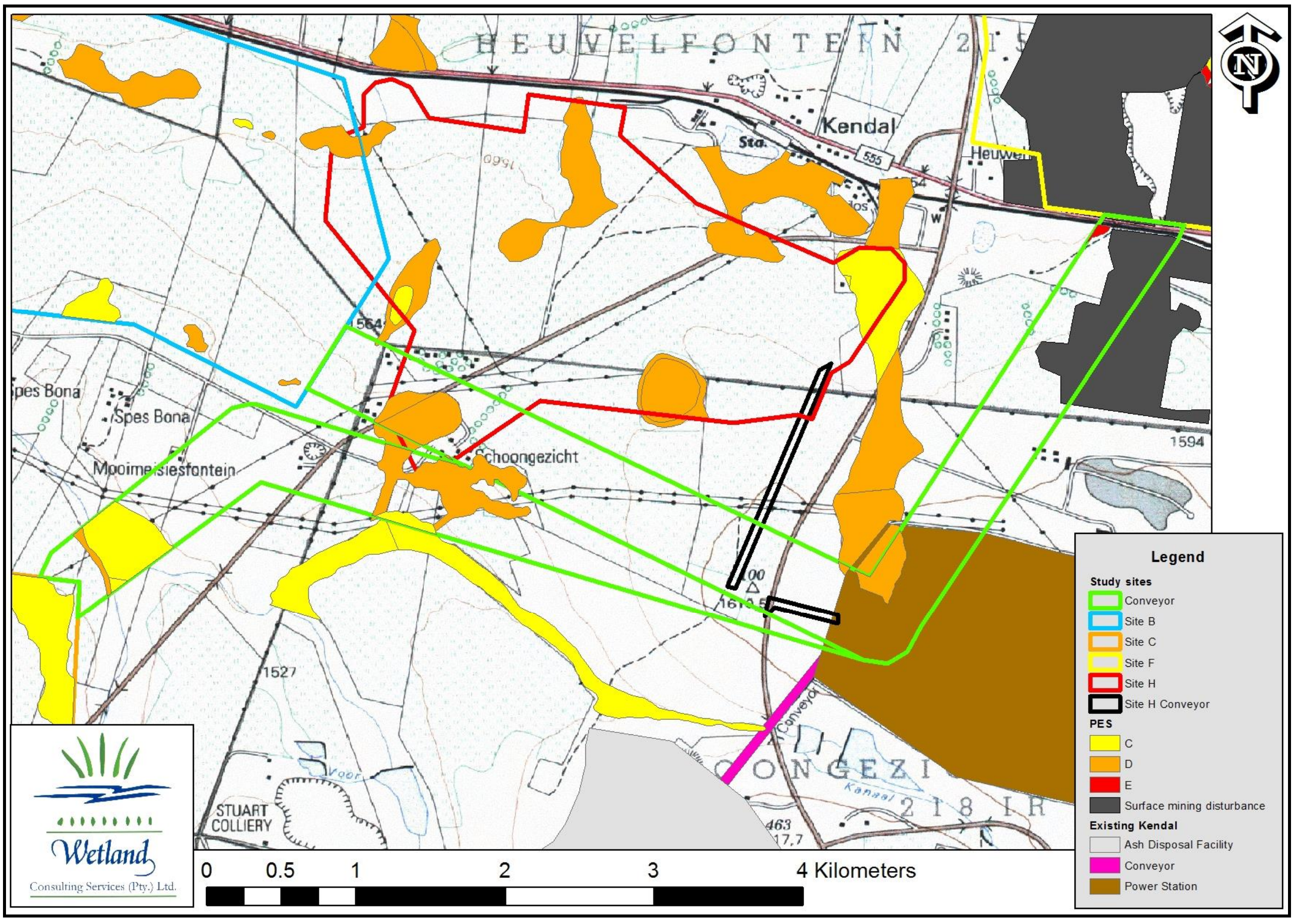

Figure 29. Map of PES results for the three conveyor servitudes.

6.5 Ecological Importance and Sensitivity (EIS)

“Ecological importance” of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. “Ecological sensitivity” refers to the system’s ability to resist disturbances and its capability to recover from disturbance once it has occurred. In determining the EIS of a wetland, the following factors are considered:

- Biodiversity – i.e. the presence of rare and endangered species, populations of unique species, species richness, diversity of habitat types, and migration/breeding and feeding sites for wetland species.
- Hydrology – i.e. sensitivity to changes in the supporting hydrological regime and/or changes in water quality.
- Functionality – i.e. flood storage, energy dissipation and particulate/element removal.
- Ecological Integrity – taken from the result of the PES assessment

The wetlands within the study area all form part of the Olifants River Primary catchment which is a heavily utilised and economically important catchment. Wetlands and rivers within the Olifants River Catchment upstream of Loskop Dam have been greatly impacted upon by various activities, which include mining, power stations, water abstraction, urbanization, agriculture etc. As a result of these impacts serious water quality concerns and also water quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all wetlands and rivers within the catchment that have as yet not been seriously modified. Within this context an EIS assessment was conducted for every hydro-geomorphic wetland unit identified within the study area. Further considerations that informed the EIS assessment include:

- The location of the study area within a vegetation type (Eastern Highveld Grassland) considered to be extensively transformed and threatened, and classed as ***Vulnerable.***
- The wetland ecosystem type of the area, Mesic Highveld Grassland Group 4 wetlands, is considered to be ***Critically Endangered.***
- The location of the three sites within the Wilge River catchment and in close proximity to the Wilge River, with the Wilge River being considered a priority water resource that plays and important role in diluting the poor quality water from the Upper Olifants River catchment.
- The presence of Red Data and protected species within the wetlands on site.
- The level of degradation observed within the wetland systems on site.

It is these considerations that have informed the scoring of the systems in terms of their ecological importance and sensitivity. The results of the assessment and rankings based on our current understanding of the wetlands is illustrated in Figure 30 and summarised in Table 14, while an explanation of the scoring system is presented in Table 5.

Considering all of the wetlands delineated within the direct footprints of all of the various sites, roughly 60 % of the wetlands assessed are considered to of *Low/Marginal* ecological importance and sensitivity (EIS category D), with all of the remaining wetlands considered to be of *Moderate* importance and sensitivity (EIS category C). These generally low scores come as a direct result of the extensive transformation that has occurred within the wetland habitats as a result of agricultural and mining activities. The degradation and loss of natural vegetation within the wetlands has significantly reduced the importance of these systems in terms of biodiversity support.

Table 14. Summarised results of the EIS assessment. Figures indicate extent of wetland within the site footprints as illustrated in Figure 30.

Site	Moderate	Low/Marginal	TOTAL
Site B	7.99	41.74	49.74
Site C	28.00	34.80	62.81
Site F	53.55	30.87	84.42
Site H	24.64	61.84	86.48
TOTAL	**114.18**	**169.25**	**283.43**

Some of the wetlands within the surrounding area are however considered to be of High ecological importance and sensitivity, most notably the Wilge River floodplain to the west of Sites B and C. This floodplain wetland is considered of High importance in terms of biodiversity support as well as hydrological functioning (e.g. flood attenuation), and is considered to be of High sensitivity in terms of changes in flow volumes and quality given the stress being placed on the system by changes in landuse and increased mining development within its catchment.

The Leeufonteinspruit draining between Sites B and C, as well as the unnamed Wilge River tributary to the north of Site B, are considered of *Moderate* importance and sensitivity.

The upper reaches of the Saalklapspruit which drain northwards away from Site F are considered to be of *Moderate* importance and sensitivity.

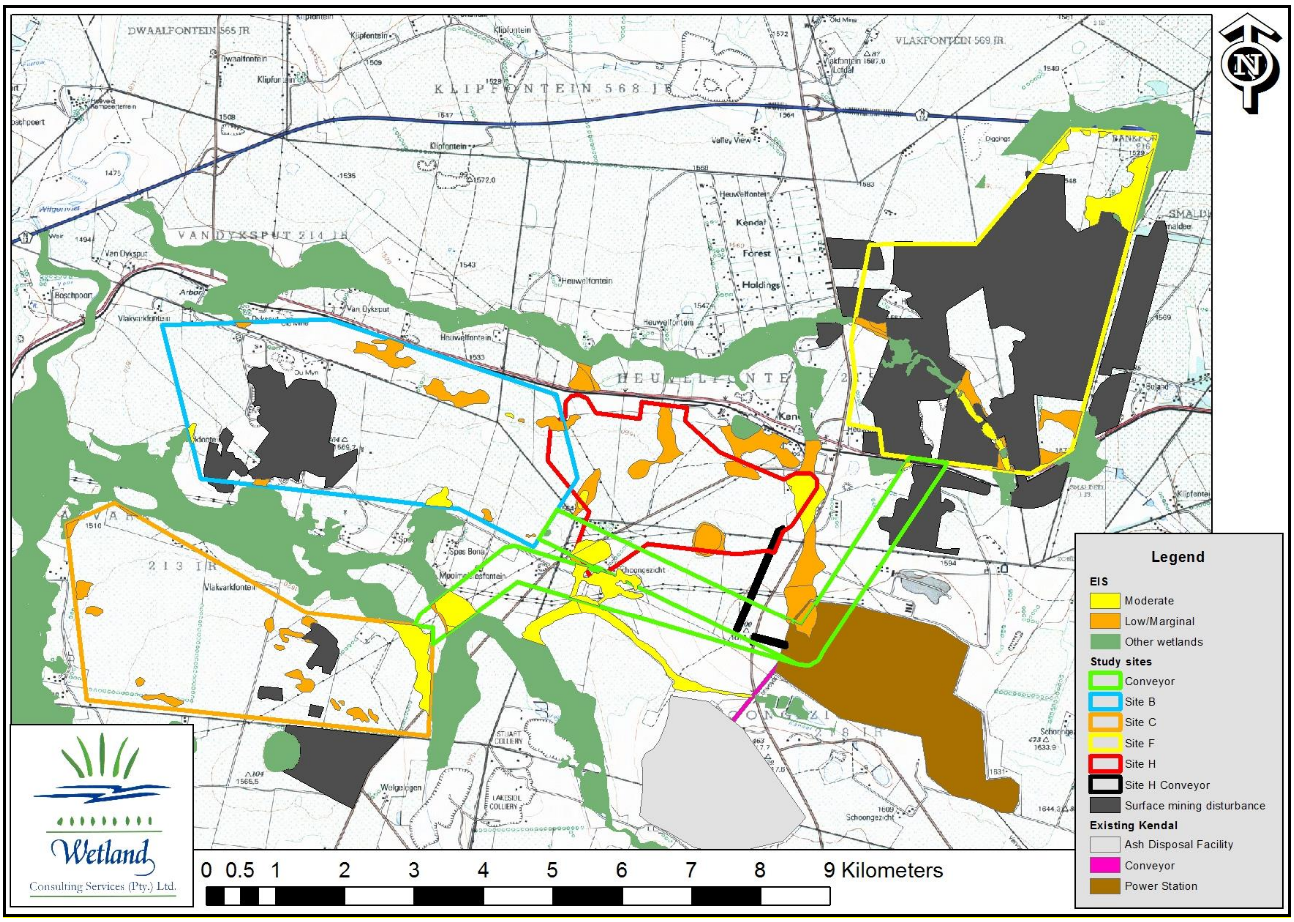

Figure 30. Results of the EIS assessment.

7. PREFERRED ALTERNATIVE

Based on a comparison of the 4 alternative sites investigated, Site F was initially selected as the recommended alternative from a wetland perspective. Selection of this site was based on the extensive mining disturbances that have already taken place on site and the resulting low wetland extent on site.

However, given various constraints which included the ongoing mining activities within Site F and the ownership of mineral rights in the area, Site F was not considered favourable. These same constraints also rendered Sites B and C unsuitable.

As a result, **Site H was selected as the preferred alternative from an overall project perspective and was found to be the only technically feasible site of the alternatives investigated**.

8. IMPACT ASSESSMENT

The following summarised project description has been extracted from information supplied by Zitholele Consulting. For a detailed project description, the reader is referred to the full EIA documentation.

The Kendal 30 year project is for an additional, new ADF required to accommodate the ash up to **2058**:

- The Kendal 30 year site will need to accommodate **176.2 Mm^3** of ash;
- The deposition rate will be **539,000m^3/month**;
- The maximum height of the ADF will be **75 m**; and
- Life of operation will be **27 years**, and construction will start in **2025**.

The ADF will be constructed in phases (Figure 31) and will include associated infrastructures such as pollution control dams (PCD), clean water dams, conveyor from the Kendal Power Station and an emergency dump (e-dump) along the conveyor route.

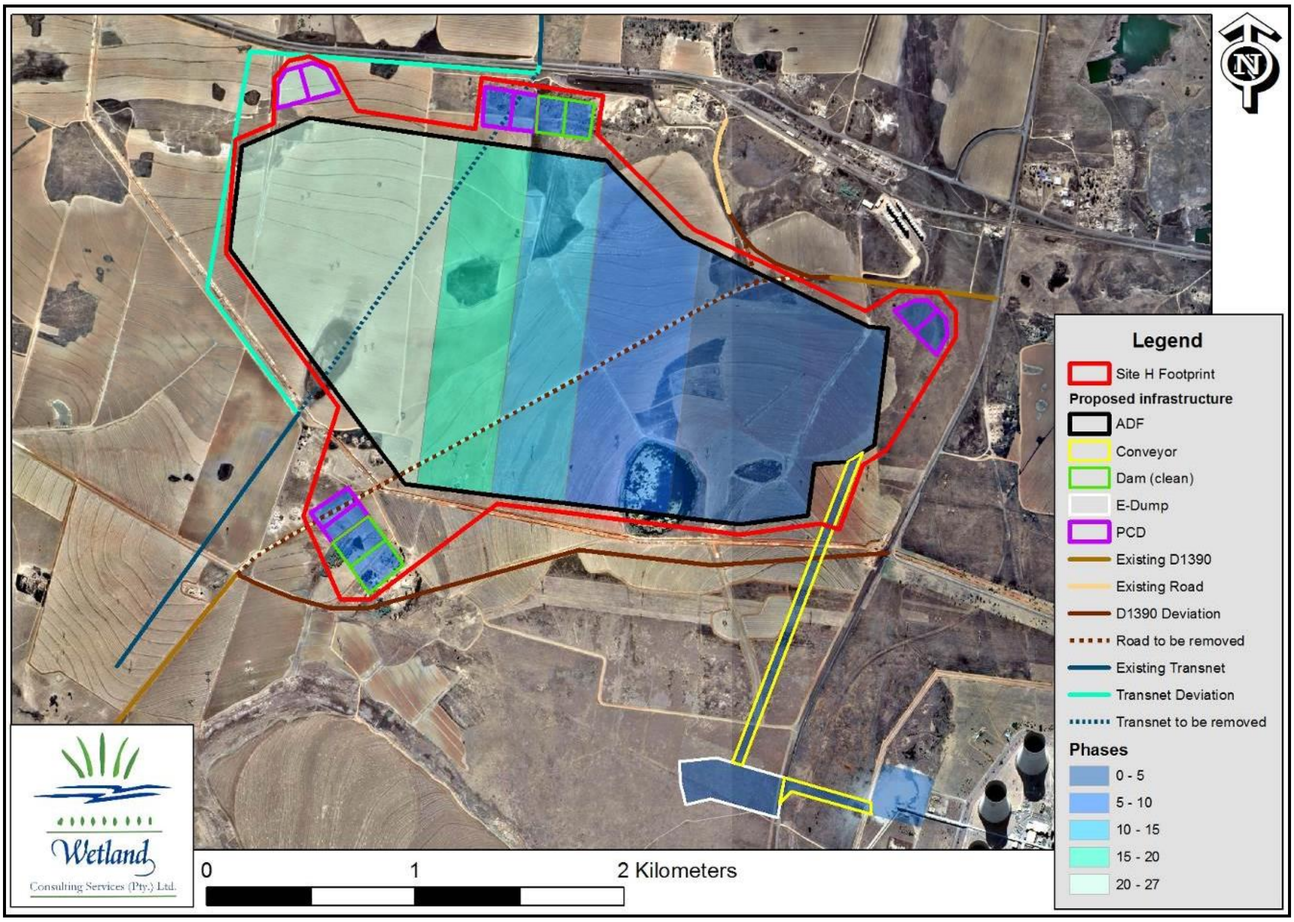

Figure 31. Map showing the proposed footprint of the ADF indicating position of PCD's and the phased nature of development.

The ash waste is classified as Type 3 (low hazard) waste in terms of DEA's waste classification regulations:

- This classification was the result of the leachable concentration of boron and the total concentration of barium and fluoride in the ash;
- Disposal on a Class C barrier system is proposed; and
- Ash is below limit set for material to be considered as radioactive.

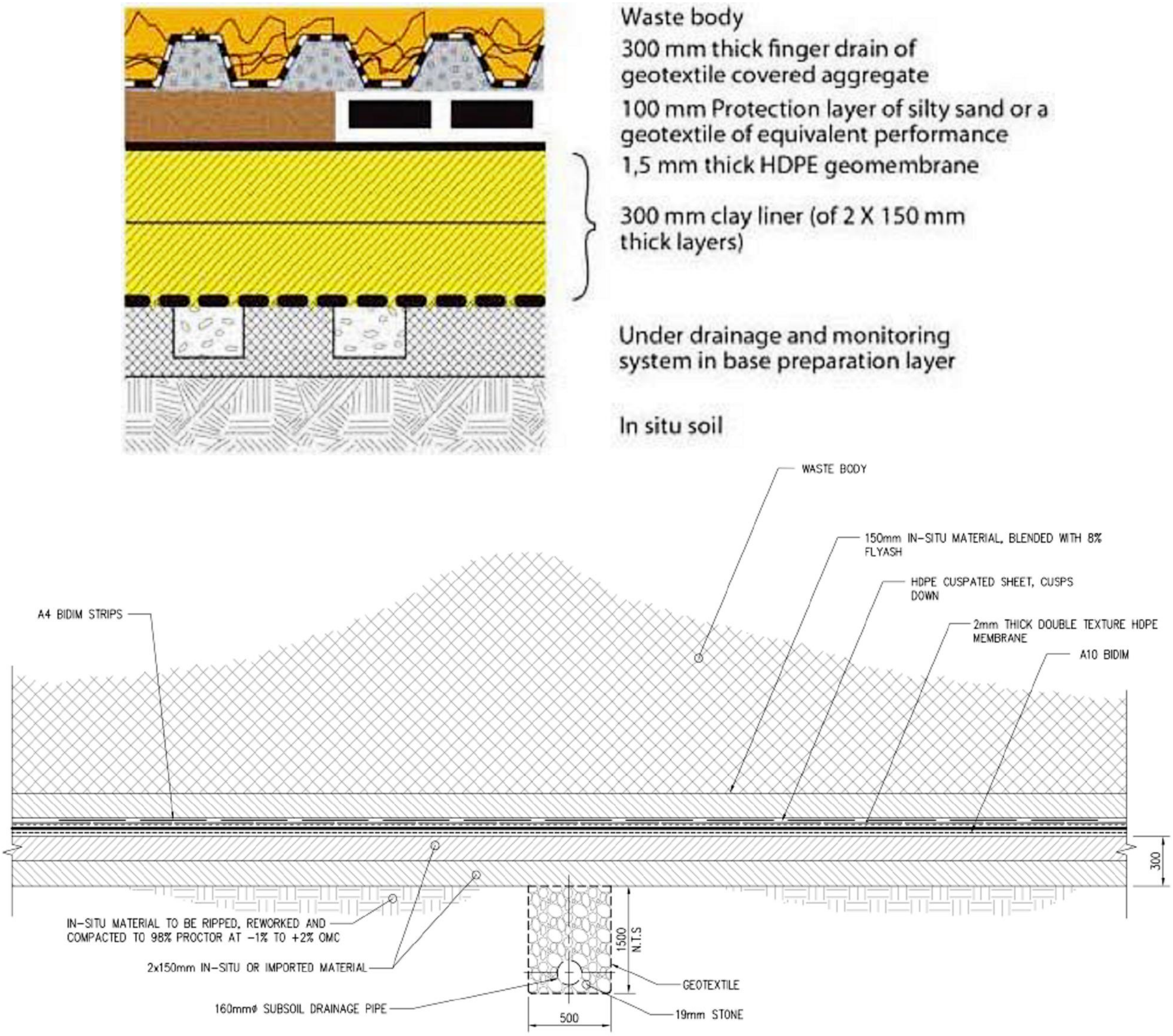

Figure 32. Diagrams showing a typical class C liner and the proposed lining and subsoil drain system for the Kendal 30-year ADF.

Once ash deposition in an area has been completed, it is proposed that the ADF be capped using a 30cm layer of topsoil, and then vegetated (Figure 33).

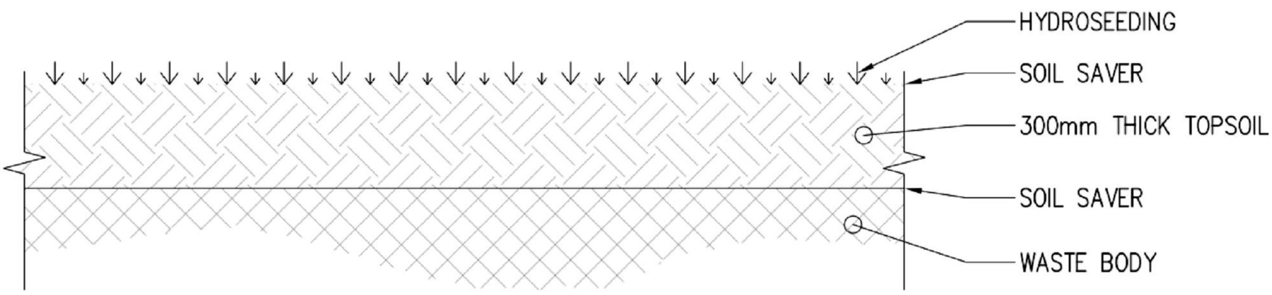

Figure 33. Proposed capping of the ADF.

In order to construct the Site H ADF, the following infrastructure will have to be deviated (Figure 31):

- The D1390 (gravel road);
- Distribution lines: 11kV, 22kV, 88kV, 132kV;
- Transmission line: 400 kV;
- Transnet 18ö fuel pipeline.

8.1 Impact Assessment Methodology

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 15.

Table 15. Quantitative rating and equivalent descriptors for the impact assessment criteria

Rating	Significance	Extent Scale	Temporal Scale
1	VERY LOW	*Proposed site*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

8.1.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 16 below.

Table 16. Description of the significance rating scale

Rating		Description
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

8.1.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 17.

Table 17. Description of the significance rating scale

Rating		Description
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the Eskom property.

Rating		Description
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

8.1.3 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 18.

Table 18. Description of the temporal rating scale

Rating		Description
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

8.1.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 19 below.

Table 19. Description of the degree of probability of an impact occurring

Rating	Description
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	Itâs going to happen / has occurred

8.1.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 20. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 20. Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

8.1.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{SIGNIFICANCE} + \textit{Spatial} + \text{Temporal})}{\mathbf{3}} \text{ X } \frac{\text{Probability}}{\mathbf{5}}$$

An example of how this rating scale is applied is shown below:

Table 21. Example of Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	LOW	*Local*	Medium-term	*Could Happen*	
Impact to air	**2**	***3***	**3**	**3**	**1.6**

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the Table 22 below.

Table 22. Impact Risk Classes

Rating	Impact Class	Description
0.1 – 1.0	**1**	**Very Low**
1.1 – 2.0	**2**	**Low**
2.1 – 3.0	**3**	**Moderate**
3.1 – 4.0	**4**	**High**
4.1 – 5.0	**5**	**Very High**

Therefore, with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

8.1.7 Cumulative Impacts

It is a requirement that the impact assessments take cognisance of cumulative impacts. In fulfilment of this requirement the impact assessment will take cognisance of any existing impact sustained by the operations, any mitigation measures already in place, any additional impact to environment through continued and proposed future activities, and the residual impact after mitigation measures.

It is important to note that cumulative impacts at the national or provincial level will not be considered in this assessment, as the total quantification of external companies on resources is not possible at the project level due to the lack of information and research documenting the effects of existing activities. Such cumulative impacts that may occur across industry boundaries can also only be effectively addressed at Provincial and National Government levels.

8.1.8 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

- Significance or magnitude- IN CAPITALS
- Temporal Scale ï in <u>underline</u>
- Probability ï in <u>*italics and underlined*</u>
- Degree of certainty - in **bold**
- Spatial Extent Scale ï in *italics*

8.2 Identification of Impacts

Likely impacts have been identified and are discussed individually below. The assessment of impacts has been split into two sections:

- Impacts related to the ADF and associated infrastructures
- Impacts related to infrastructure deviations

Impacts have been grouped per development phase during which they are likely to manifest:

- Pre-construction and construction phase
- Operational phase
- Closure phase

Identified impacts were rated and assessed as per the impact assessment methodology provided by Zitholele and which is detailed in Section 8.1 above. Ratings are summarised in the impact assessment tables in Sections 8.2.2 and 8.2.4 respectively.

8.2.1 ADF and Associated Infrastructures

8.2.1.1 Pre-construction & Construction Phase – Loss of wetland habitat & wetland functionality

The proposed Kendal 30-year ADF Project will result in the permanent loss of all wetland habitats located within the direct footprint of the proposed ADF (Site H) and associated infrastructure. A total of 86.5 ha of wetland falls within the direct development footprint and will be permanently lost. Added to this direct loss is a further 1.5 ha of pan/depression wetland habitat in which all functionality is expected to be lost as more than 50 % of each of the two pan/depression wetlands will be permanently lost due to the proposed ADF, with the remaining sections unlikely to remain functional. It is however expected that some of the remaining adjacent wetlands will also be impacted. Although an extensive list of mitigation measures is proposed and detailed as part of this report and in the full EIA/IWULA reports, some residual impact is likely to remain, resulting in further wetland degradation, mostly as a result of decreased water inputs to the wetlands due to catchment exclusion and changes in hydrology. These are referred to as indirect impacts and refer to the loss of wetland functionality that can occur due to habitat degradation, although the wetlands themselves will remain post-mining.

In total, the direct and indirect impacts will affect 149.3 ha, of which 88 ha will be permanently lost. In terms of hectare equivalents, **the overall impact was determined to be 63.5 hectare equivalents**.

It is important to note that not all wetland loss will be realised during the construction phase. As the ADF will be constructed in phases, considerable wetland loss will be realised during the operational phase. Wetland impact, direct and indirect, during the construction phase will be 73.5 ha.

Table 23. Table summarising the extent of wetland impacted per development phase.

Development Phase (Years)	Wetland Loss	Hectare Equivalents
0 - 5	73.5	31.4
5 - 10	28.5	10.6
10 - 15	12.5	7.5
15 - 20	6.3	3.8
20 - 27	28.5	10.2
Total Loss	**149.3**	**63.5**

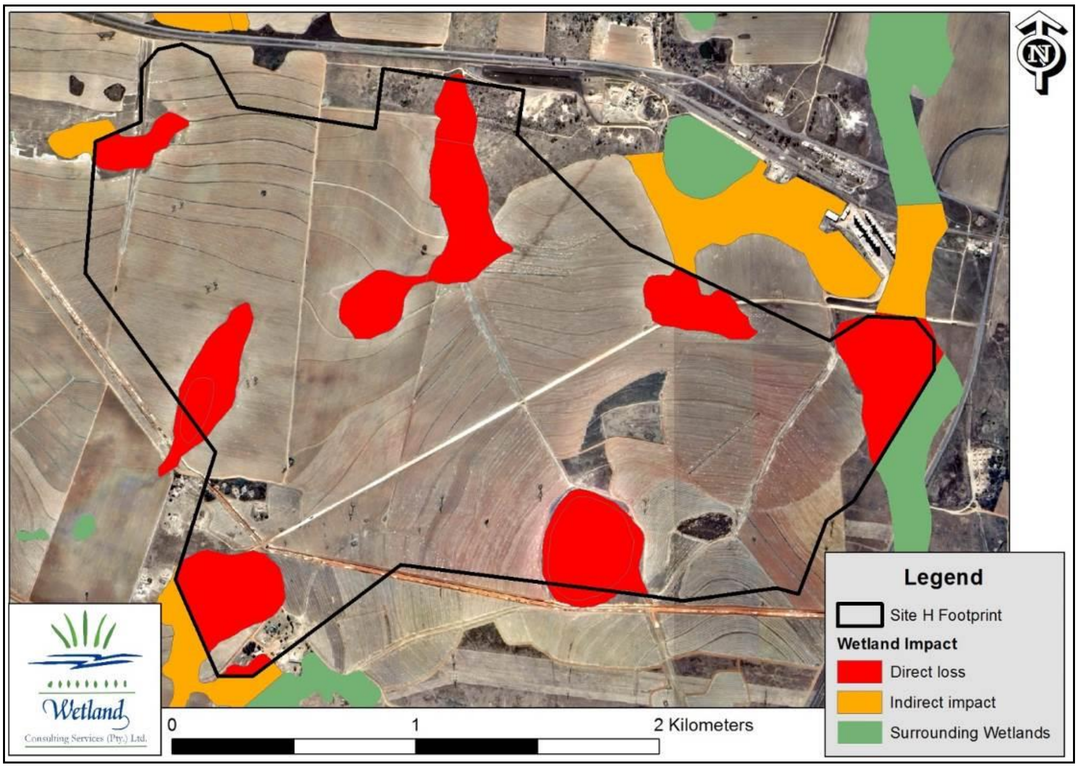

Figure 34. Map showing the extent and location of direct and indirect impacts to wetlands. Wetlands shown in red will be permanently lost, while wetlands shown in orange are likely to experience indirect impacts.

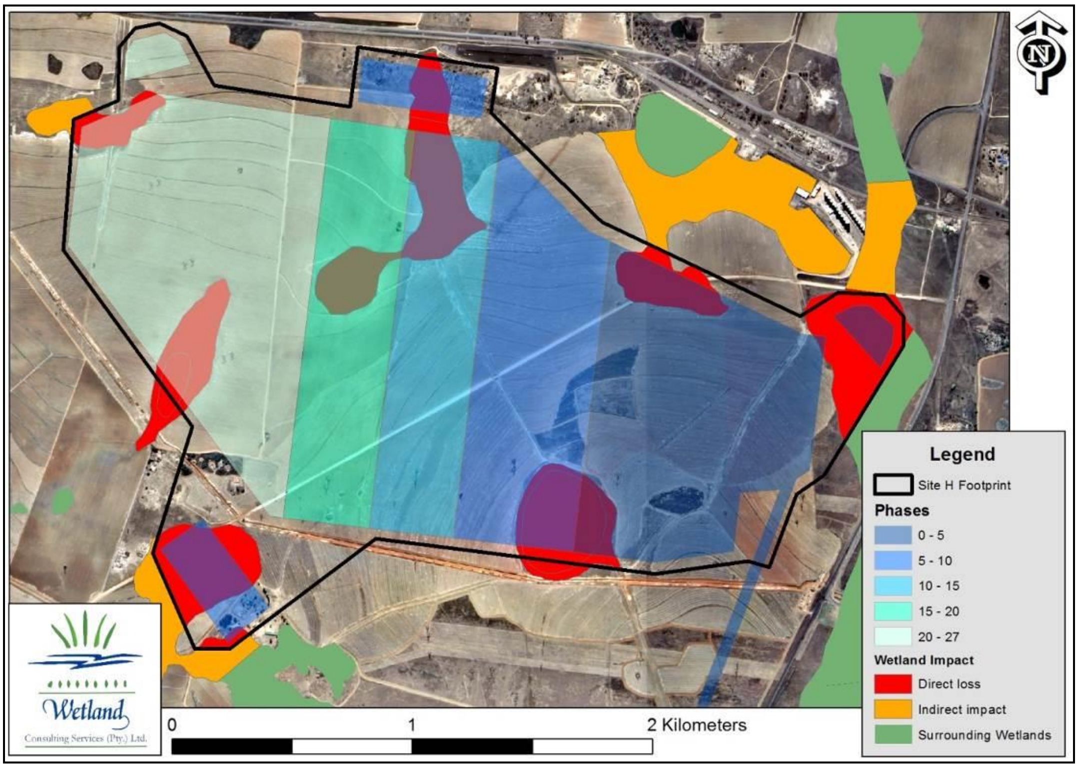

Figure 35. Map showing the 5 project phases and the wetland impact, direct and indirect, associated with each phase.

Mitigation

The mitigation hierarchy has been applied and followed throughout the project as far as possible. In trying to avoid impacts to wetlands, a detailed site selection process was undertaken considering numerous potential sites within the greater Kendal environs. However, given the extent of wetlands and especially also the extent of active mining in the area, as well as the extent of existing mining rights not yet actively mined, the currently selected site appeared as the only suitable option.

Minimisation of impacts through alteration of the ADF layout and footprint were also considered. Any reduction in the ADF footprint does however impact on the volumes of ash that can be deposited. A study undertaken by Zitholele (Technical Memorandum, 18 March 2016, and attached as Appendix 1 to this report) indicated that excluding the main pan and the north eastern hillslope seepage wetland from the ash dam footprint would result in the loss of 5 years storage space and significantly increase construction costs associated with the clean and dirty water dams. Such a scenario raises the possibility that a further ADF site would then need to be found to accommodate an additional 5 years of storage space.

Even though the ADF will be capped and vegetated following completion of ash deposition, no wetland habitat is expected to reform on the ADF and the direct loss of wetland habitat within the ADF footprint can thus not be mitigated on site. **The loss of this wetland habitat will thus require a wetland offset/wetland mitigation strategy**. The need for such a wetland offset strategy was already identified during discussions with the DWS and requested by the DWS, and is in the process of being developed (Wetland Consulting Services, 2016).

Such an offset can be achieved either through the rehabilitation, protection and management of identified wetlands to achieve a net gain in functional hectare equivalents as well as achieving certain ecosystem conservation targets. The newly developed draft SANBI Wetland Offsetting Guidelines (SANBI and DWS, 2014) should be used to guide the latter in cases where offsetting is recommended.

Disturbance of wetland habitat outside the direct development footprint should however be avoided and minimised:

- Design of infrastructure areas should be optimised to minimise the size of the development footprint.
- All wetland habitats adjacent to but outside of the direct disturbance footprints should be fenced off using a standard 5 strand cattle fence. The purpose of the fence is to clearly demarcate sensitive areas and prevent accidental vehicle access to these areas while not posing a hazard to the movement of small mammals. Where possible, the fenced off area should include the wetlands as well as a 50m buffer zone around the wetlands. Alternatively, the authorised development footprints should be fenced off.
- All construction staff should be educated on the sensitivity of wetland areas and should be made aware of all wetland areas in close proximity to the construction sites.
- Locate all temporary stockpiles, constructorꞌs camps, laydown areas, ablution facilities etc. a minimum of 50m from any delineated wetland area.

- Develop and implement a construction stormwater management plan prior to the commencement of site clearing activities.
- All disturbed areas outside the direct development footprints should be rehabilitated and re-vegetated as soon as possible. Refer to the guidelines below.

8.2.1.2 Pre-construction & Construction Phase – Increased sedimentation and erosion in wetlands

Vegetation clearing and soil stripping will result in large areas of bare, compacted soils that will increase surface runoff volumes and velocities, and reduce time to concentration in adjacent wetlands and watercourses. Changes in runoff will be most significant during regular return runoff events and lead to more regular bank full events in receiving streams, increasing the erosive energy of flows and enhancing channel incision and lateral erosion. Increased channel erosion will lower the local water table and increase channel capacity, decreasing the occurrence of channel overtopping events, further leading to desiccation of the valley bottom wetlands.

Mitigation

A construction stormwater management plan must be developed and implemented prior to the commencement of large scale vegetation clearing activities or construction activities. Such a plan should aim to minimise the transport of sediment off site as well as prevent the discharge of high velocity flows into downslope wetlands. Sediment traps and sediment barriers should be installed where necessary, and discharge points should be protected against erosion and incorporate energy dissipaters.

Vegetation clearing and soil stripping activities should be phased to minimise the extent of bare soils surfaces exposed at any one time. Vegetation clearing and soil stripping should also only be undertaken immediately preceding the onset of construction activities on site. A scenario of cleared areas lying bare and unused for weeks on end must be avoided.

To minimise the impact of increased runoff and sediment transport into adjacent wetlands, vegetation clearing and soil stripping should be concentrated in the dry season as far as this is partially possible. Given the duration of construction activities as well as uncertainties around the commencement date, limiting all construction activities to the dry season is likely to be impossible.

- Erosion within the construction site must be minimised through the following:
    - Limiting the area of disturbance and vegetation clearing to as small an area as possible;
    - Where possible, undertaking construction during the dry season;
    - Phasing vegetation clearing activities and limiting the time that any one area of bare soil is exposed to erosion;
    - Control of stormwater flowing onto and through the site. Where required, stormwater from upslope should be diverted around the construction site;
    - Prompt stabilisation and re-vegetation of soils after disturbance and construction activities in an area are complete; and
    - Protection of slopes. Where steeper slopes occur, these should be stabilised using geotextiles or any other suitable product designed for the purpose.

- Sediment transport off the site must be minimised through the following:
  - Establishing perimeter sediment controls. This can be achieved through the installation of sediment fences along downslope verges of the construction site. Where channelled or concentrated flow occurs, reinforced sediment fences or other sediment barriers such as sediment basins should be used (refer to US EPA guidelines on Stormwater Pollution Prevention);
  - Discharge of stormwater from the construction site into adjacent grassland rather than directly into wetland habitat. Discharged flows must be slow and diffuse; and
  - Regular inspection and maintenance of sediment controls

8.2.1.3 Pre-construction & Construction Phase – Water quality deterioration in wetlands

During the construction phase, as activities are taking place adjacent to wetlands, there is a possibility that water quality can be impaired through contaminated surface runoff entering wetlands. Typically, impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment within the wetlands. It is possible that hydrocarbons will be temporarily stored and used on site, as well as cement and other potential pollutants.

Mitigation

Refer to the sedimentation and turbidity control measures above (Section 8.2.1.2).

In addition, ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are placed no closer than 50m from a wetland or water course. No abstraction of water from the wetlands is allowed unless expressly authorized by the DWS.

In order to reduce the potential impacts associated with the introduction of contaminants dissolved or suspended in the runoff from construction sites, where practically possible, no runoff should be introduced into wetlands directly. Introduction into dryland areas is preferred as the vegetation and soils provide an opportunity to limit the movement of contaminants and the environment is conducive for natural degradation.

Potential contaminants used and stored on site should be stored and prepared on bunded surfaces to contain spills and leaks. Sufficient spill clean-up material must be kept on site at all times to deal with minor spills. Larger spills should be reported to the Environmental Officer and the relevant authorities (DWS) immediately, with specialists appointed to oversee the clean-up operations.

8.2.1.4 Operational Phase - Loss of wetland habitat & wetland functionality

This is a continuation of the impact commencing during the construction phase and described in Section 8.2.1.1 above. The impact description and recommended mitigation measures have however been repeated here for completeness.

The proposed Kendal 30-year ADF Project will result in the permanent loss of all wetland habitats located within the direct footprint of the proposed ADF and associated infrastructure. A total of 86.5 ha of wetland falls within the direct development footprint and will be permanently lost. Added to this direct loss is a further 1.5 ha of pan/depression wetland habitat in which all functionality is expected to be lost as more than 50 % of each of the two pan/depression wetlands will be permanently lost due to the proposed ADF, with the remaining sections unlikely to remain functional. It is however expected that some of the remaining adjacent wetlands will also be impacted. Although an extensive list of mitigation measures is proposed and detailed as part of this report and in the full EIA/IWULA reports, some residual impact is likely to remain, resulting in further wetland degradation. These are referred to as indirect impacts and refer to the loss of wetland functionality that can occur due to habitat degradation, although the wetlands themselves will remain post-mining.

In total, the direct and indirect impacts will affect 149.3 ha, of which 88 ha will be permanently lost. In terms of hectare equivalents, the overall impact will be 63.5 hectare equivalents. 31.4 hectare equivalents will be lost during the construction phase and **32.1 hectare equivalents will be lost during the operational phase.**

It is important to note that not all wetland loss will be realised during the construction phase. As the ADF will be constructed in phases, considerable wetland loss will realised during the operational phase. Wetland impact, direct and indirect during the construction phase will be 73.5 ha.

Table 24. Table summarising the extent of wetland impacted per development phase.

Development Phase (Years)	Wetland Loss	Hectare Equivalents
0 - 5	73.5	31.4
5 - 10	28.5	10.6
10 - 15	12.5	7.5
15 - 20	6.3	3.8
20 - 27	28.5	10.2
Total Loss	**149.3**	**63.5**

Mitigation

The mitigation hierarchy has been applied and followed throughout the project as far as possible. In trying to avoid impacts to wetlands, a detailed site selection process was undertaken considering numerous potential sites within the greater Kendal environs. However, given the extent of wetlands and especially also the extent of active mining in the area, as well as the extent of existing mining rights not yet actively mined, the currently selected site appeared as the only suitable option.

Minimisation of impacts through alteration of the ADF layout and footprint were also considered. Any reduction in the ADF footprint does however impact on the volumes of ash that can be deposited. A study undertaken by Zitholele (Technical Memorandum, 18 March 2016, and attached as Appendix 1 to this report) indicated that excluding the main pan and the north eastern hillslope seepage wetland from the ash dam footprint would result in the loss of 5 years storage space and significantly increase construction costs associated with the clean and dirty water dams. Such a scenario raises the possibility that a further ADF site would then need to be found to accommodate an additional 5 years of storage space.

Even though the ADF will be capped and vegetated following completion of ash deposition, no wetland habitat is expected to reform on the ADF and the direct loss of wetland habitat within the ADF footprint can thus not be mitigated on site. **The loss of this wetland habitat will thus require a wetland offset/wetland mitigation strategy**. The need for such a wetland offset strategy was already identified during discussions with the DWS and requested by the DWS, and is in the process of being developed (Wetland Consulting Services, 2016).

Such an offset can be achieved either through the rehabilitation, protection and management of identified wetlands to achieve a net gain in functional hectare equivalents as well as achieving certain ecosystem conservation targets. The newly developed draft SANBI Wetland Offsetting Guidelines (SANBI and DWS, 2014) should be used to guide the latter in cases where offsetting is recommended.

Disturbance of wetland habitat outside the direct development footprint should however be avoided and minimised:

- Design of infrastructure areas should be optimised to minimise the size of the development footprint.
- All wetland habitats adjacent to but outside of the direct disturbance footprints should be fenced off using a standard 5 strand cattle fence. The purpose of the fence is to clearly demarcate sensitive areas and prevent accidental vehicle access to these areas while not posing a hazard to the movement of small mammals. Where possible, the fenced off area should include the wetlands as well as a 50m buffer zone around the wetlands. Alternatively the authorised development footprints should be fenced off.
- All construction staff should be educated on the sensitivity of wetland areas and should be made aware of all wetland areas in close proximity to the construction sites.
- Locate all temporary stockpiles, constructorǿs camps, laydown areas, ablution facilities etc. a minimum of 50m from any delineated wetland area.
- Develop and implement a construction stormwater management plan prior to the commencement of site clearing activities.
- All disturbed areas outside the direct development footprints should be rehabilitated and re-vegetated as soon as possible. Refer to the guidelines below.

8.2.1.5 Operational Phase – Increased sedimentation and erosion in wetlands

Due to the phased nature of the ADF, vegetation clearing and construction activities will take place at regular intervals during the operational phase. Many of the impacts identified during the construction phase will therefore also manifest during the operational phase.

Vegetation clearing and soil stripping will result in large areas of bare, compacted soils that will increase surface runoff volumes and velocities, and reduce time to concentration in adjacent wetlands and watercourses. Changes in runoff will be most significant during regular return runoff events and lead to more regular bank full events in receiving streams, increasing the erosive energy of flows and enhancing channel incision and lateral erosion. Increased channel erosion will lower the local water table and increase channel capacity, decreasing the occurrence of channel overtopping events, further leading to desiccation of the valley bottom wetlands.

Mitigation

A construction stormwater management plan must be developed and implemented prior to the commencement of large scale vegetation clearing activities or construction activities. Such a plan should aim to minimise the transport of sediment off site as well as prevent the discharge of high velocity flows into downslope wetlands. Sediment traps and sediment barriers should be installed where necessary, and discharge points should be protected against erosion and incorporate energy dissipaters.

Vegetation clearing and soil stripping activities should be phased to minimise the extent of bare soils surfaces exposed at any one time. Vegetation clearing and soil stripping should also only be undertaken immediately preceding the onset of construction activities on site. A scenario of cleared areas lying bare and unused for weeks on end must be avoided.

To minimise the impact of increased runoff and sediment transport into adjacent wetlands, vegetation clearing and soil stripping should be concentrated in the dry season as far as this is partially possible. Given the duration of construction activities as well as uncertainties around the commencement date, limiting all construction activities to the dry season is likely to be impossible.

- Erosion within the construction site must be minimised through the following:
    - Limiting the area of disturbance and vegetation clearing to as small an area as possible;
    - Where possible, undertaking construction during the dry season;
    - Phasing vegetation clearing activities and limiting the time that any one area of bare soil is exposed to erosion;
    - Control of stormwater flowing onto and through the site. Where required, stormwater from upslope should be diverted around the construction site;
    - Prompt stabilisation and re-vegetation of soils after disturbance and construction activities in an area are complete; and
    - Protection of slopes. Where steeper slopes occur, these should be stabilised using geotextiles or any other suitable product designed for the purpose.
- Sediment transport off the site must be minimised through the following:
    - Establishing perimeter sediment controls. This can be achieved through the installation of sediment fences along downslope verges of the construction site. Where channelled or concentrated flow occurs, reinforced sediment fences or other sediment barriers such as sediment basins should be used (refer to US EPA guidelines on Stormwater Pollution Prevention);
    - Discharge of stormwater from the construction site into adjacent grassland rather than directly into wetland habitat. Discharged flows must be slow and diffuse; and
    - Regular inspection and maintenance of sediment controls

8.2.1.6 Operational Phase – Water quality deterioration in wetlands

Due to the phased nature of the ADF, vegetation clearing and construction activities will take place at regular intervals during the operational phase. Many of the impacts identified during the construction phase will therefore also manifest during the operational phase.

During the operational phase, as construction activities are taking place adjacent to wetlands, there is a possibility that water quality can be impaired through contaminated surface runoff entering wetlands. Typically impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment within the wetlands. It is possible that hydrocarbons will be temporarily stored and used on site, as well as cement and other potential pollutants.

Mitigation

Refer to the sedimentation and turbidity control measures above (Section 8.2.1.5).

In addition, ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are placed no closer than 50m from a wetland or water course. No abstraction of water from the wetlands is allowed unless expressly authorized by the DWS.

In order to reduce the potential impacts associated with the introduction of contaminants dissolved or suspended in the runoff from construction sites, where practically possible, no runoff should be introduced into wetlands directly. Introduction into dryland areas is preferred as the vegetation and soils provide an opportunity to limit the movement of contaminants and the environment is conducive for natural degradation.

Potential contaminants used and stored on site should be stored and prepared on bunded surfaces to contain spills and leaks. Sufficient spill clean-up material must be kept on site at all times to deal with minor spills. Larger spills should be reported to the Environmental Officer and the relevant authorities (DWS) immediately, with specialists appointed to oversee the clean-up operations.

8.2.1.7 Operational Phase – Water quality deterioration due to seepage out of the ADF

The ash disposed of on the ADF will contain a number of pollutants. Contaminated surface water runoff from the ADF or water seeping out of the ADF or the pollution control dams will result in water quality deterioration in receiving water resources. Overflow of pollution control dams could also occur and impact on water quality within receiving systems, which will ultimately be the Wilge River.

Mitigation

It is important that all dirty water areas, including the entire ADF, are isolated from the surrounding catchment and that all dirty water is retained on site. To ensure this, the ADF will be lined using an engineered Class C liner, which will include a combination of geotextile, compacted clay layers and HDPE plastic layers, as well as an under drainage system to collect seepage. All dirty water will be collected and stored in pollution control facilities and re-used for dust suppression within the dirty water areas.

- Clean and dirty storm water need to be separated;
- No contaminated water should be allowed to enter the clean storm water system;
- No dirty water may be released into the wetlands. All dirty water should be contained and treated on site, or used for dust suppression within dirty water areas. Should contaminated water enter the wetlands due to spillages or other unforeseen circumstances a wetland/water quality expert should be consulted regarding implementation of suitable mitigation and/or rehabilitation measures; and
- Required PCDs should be designed to be in compliance with the applicable legislation requirements as well as accepted best management practices;
- To prevent seepage and leakage out of PCDs, these facilities should be lined with a suitable engineered liner;
- An emergency response plan for handling large spills or leaks due to infrastructure failure must be compiled and put in place, with regular practice drills to ensure its effectiveness;
- A water quality and bio-monitoring plan should be compiled and implemented (if not already in place) to monitor for any deterioration in water quality in the adjacent wetland systems; and
- Regular maintenance and inspections of PCDs should be undertaken to ensure operation of the dams as per design specifications. A log book of inspections and maintenance activities must be kept.

8.2.1.8 Operational Phase – Water quality deterioration due to ash dust from the ADF

Ash dust is likely to be blown from the ADF as well as from the required conveyor transporting ash from the power station to the ADF. Direct deposition of this dust into wetlands could result in contamination of surface waters with a resultant loss in sensitive species.

Mitigation

Dust suppression measures must be put in place for both the ADF and the conveyor transporting ash to the ADF. The measures recommended by the air quality specialist must be fully implemented in this regard. A water quality and bio-monitoring plan should be compiled and implemented (if not already in place) to monitor for any deterioration in water quality in the adjacent wetland systems.

8.2.1.9 Closure Phase - Water quality deterioration due to seepage out of the ADF

The ash disposed of on the ADF will contain a number of pollutants. Contaminated surface water runoff from the ADF or water seeping out of the ADF or the pollution control dams will result in water quality deterioration in receiving water resources. Overflow of pollution control dams could also occur and impact on water quality within receiving systems, which will ultimately be the Wilge River.

Mitigation

It is important that all dirty water areas, including the entire ADF, are isolated from the surrounding catchment and that all dirty water is retained on site. To ensure this, the ADF will be lined using an engineered Class C liner, which will include a combination of geotextile, compacted clay layers and HDPE plastic layers, as well as an under drainage system to collect seepage. All dirty water will be collected and stored in pollution control facilities and re-used for dust suppression within the dirty water areas. During closure the ADF will be capped and vegetated. Capping will take the form of a soil saver followed by a 30cm layer of topsoil and covered by a further soil saver. This will then be hydro-seeded to ensure establishment of vegetation. Runoff from the capped ADF will then be classed as clean water runoff.

- Integrity and stability of the capping layer must be ensured in the long-term. Regular inspections and maintenance work must be undertaken to ensure this. A log book of inspections and maintenance activities must be kept.
- Surface runoff from the ADF must be reintroduced into adjacent wetland systems in a manner that will prevent erosion and mimic natural water inputs to the wetlands as far as possible.
- A water quality and bio-monitoring plan should be compiled and implemented (if not already in place) to monitor for any deterioration in water quality in the adjacent wetland systems. If any deterioration linked to the ADF is discerned, corrective measures should be put in place.

8.2.1.10 Closure Phase – Mobilisation of ash due to erosion of capping layer

During closure the ADF will be capped and vegetated. Capping will take the form of a soil saver followed by a 30cm layer of topsoil and covered by a further soil saver. This will then be hydro-seeded to ensure establishment of vegetation. Runoff from the capped ADF will then be classed as clean water runoff. Should this capping layer erode, the underlying ash will be exposed and could potentially be transported into adjacent wetlands.

Mitigation

- Integrity and stability of the capping layer must be ensured in the long-term. Regular inspections and maintenance work must be undertaken to ensure this. A log book of inspections and maintenance activities must be kept.
- Surface runoff from the ADF must be reintroduced into adjacent wetland systems in a manner that will prevent erosion and mimic natural water inputs to the wetlands as far as possible.
- A water quality and bio-monitoring plan should be compiled and implemented (if not already in place) to monitor for any deterioration in water quality in the adjacent wetland systems. If any deterioration linked to the ADF is discerned, corrective measures should be put in place.

8.2.1.11 Closure Phase – Increase in alien vegetation

It is likely that alien vegetation will utilise areas disturbed during the rehabilitation activities to become established, including on the slopes of the ADF. Alien vegetation could then spread to adjacent wetland areas as seed is transported by surface runoff to these wetlands.

Mitigation

- Compile and implement an alien vegetation management plan for the entire affected area.
- Regular surveys for alien vegetation should be undertaken and populations of alien species controlled. Where possible, the populations should be removed and impacted areas rehabilitated.
- All removal of alien vegetation must be undertaken under supervision of suitably trained and qualified individuals.

8.2.2 Impact Assessment Table – ADF and Associated Infrastructure

Refer to attached Excel spreadsheet.

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
PRE-CONSTRUCTION & CONSTRUCTION PHASE									
Servitude clearing & construction	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	§Method statements should be developed for each of the crossings. Such method statements should be commented on by a suitable wetland specialists. The extent of disturbance should be limited by limiting all construction activities to the servitude as far as practically possible. The servitude should be fenced off using a 5 strand cattle fence or other suitable fence/demarcation prior to the commencement of vegetation clearing or earthmoving activities. No materials should be stockpiled within the wetland areas along the routes and driving within the wetland areas should be kept to an absolute minimum. Clearly defined access routes should be used. As far as possible, the existing roads and farm tracks should be used to provide access during construction as this will reduce the extent of the disturbed area along the routes. In the case of the pipeline, which will likely be buried, it is important that the natural landscape profile be restored after construction to prevent the formation of preferential flow paths through the wetland. Post construction all alien invasive vegetation should be removed from the servitudes. This will also require long-term follow up to ensure establishment of natural vegetation in all disturbed areas. Ideally construction activities within wetlands should take place in winter (during the dry season).	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.
		Cumulative	2	3	4	5	3 - MOD		Linear infrastructures will have to cross wetland habitat. Construction activities will lead to disturbance. Habitat within the direct footprint will be lost.
		Residual	1	3	3	5	2.3 - MOD		Some wetland loss and disturbance is unavoidable. Mitigation measures aim to minimise impact
Servitude clearing & construction	Increased risk of erosion in wetlands	Existing	1	2	1	3	0.8 - VERY LOW	Minimise the construction footprints within the wetland areas. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks as far as possible to access the construction sites. Install erosion prevention measures and sediment traps/barriers prior to the onset of construction activities. Maintain surface flow connectivity in wetlands during the construction phase by temporarily diverting streams around the construction area. Given that all affected wetlands are characterised by mostly subsurface seepage, this might not be necessary. Key to crossing structures should be the maintenance of flow connectivity across the crossings. Regular culverts should also be installed to accommodate surface flow and ensure flow connectivity across the full width of the crossing. Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands. In the case of the pipeline crossings, it is important that the pipeline does not form a preferential flow path in the subsurface. Where the	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing risk of erosion. This will be exacerbated where flow concentration takes place
		Residual	1	3	2	3	1.2 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
								pipeline runs down a slope, it is therefore recommended to place trench breakers at regular intervals to prevent this.	
Servitude clearing & construction	Sediment transport into wetlands	Existing	1	2	2	4	1.3 - LOW	Install erosion prevention measures and sediment barriers prior to the commencement of construction activities. Minimise the construction footprint within the wetland area. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks as far as possible to access construction areas. Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible. Undertake construction during the dry season as far as possible. Re-vegetate and rehabilitate areas as soon as possible after completion of construction. Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands.	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	3	2	4	1.6 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite
Servitude clearing & construction	Water quality deterioration	Existing	1	2	2	4	1.3 - LOW	Ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are placed no closer than 50m from a wetland or water course. In order to reduce the potential impacts associated with the introduction of contaminants dissolved or suspended in the runoff from construction sites, where practically possible, no runoff should be introduced into wetlands directly. Introduction into dryland areas is preferred as the vegetation and soils provide an opportunity to limit the movement of contaminants and the environment is conducive for natural degradation. Potential contaminants used and stored on site should be stored and prepared on bunded surfaces to contain spills and leaks. Sufficient spill clean-up material must be kept on site at all times to deal with minor spills. Larger spills should be reported to the Environmental Officer and the relevant authorities immediately, with specialists appointed to oversee the clean-up operations	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	2	2	4	1.3 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite
Servitude clearing & construction	Habitat fragmentation	Existing	3	3	3	5	3 - MOD	Position linear infrastructure as close as possible to the security fence around the ADF.	Wetland habitat on site is already highly fragmented due to cultivation activities.

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
		Cumulative	3	3	3	5	3 - MOD		Proposed crossings will be located immediately downslope of the proposed ADF, limiting impact on habitat fragmentation
		Residual	3	3	3	5	3 - MOD		Proposed crossings will be located immediately downslope of the proposed ADF, limiting impact on habitat fragmentation
Servitude clearing & construction	Establishment and spread of alien species	Existing	1	3	1	3	1 - VERY LOW	An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.	Most wetlands show only minor alien vegetation invasions, with the exception of one hillslope seepage wetland
		Cumulative	3	4	3	3	2 - LOW		Disturbed areas could be colonised by alien vegetation. These infestations could form seed sources leading to infestations in adjacent wetlands.
		Residual	1	3	1	2	0.7 - VERY LOW		Alien vegetation management plan will control establishment and spread of aliens. Existing infestations will be cleared.
OPERATIONAL PHASE									
Operation	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	All wetlands along the infrastructure servitudes should be clearly demarcated as sensitive habitats and staff/contractors made aware of the location and sensitivity of these habitats. No temporary laydown or stockpiling of material required for maintenance activities may take place in wetland areas. All vehicular and machinery movement along the servitude must be restricted to defined service road. No off-road driving should be allowed. If necessary to prevent wetland disturbance, the servitude should be fenced off with a 5 strand cattle fence to prevent vehicles and staff accessing wetlands outside the servitude area. A 5 strand cattle fence is preferred to a razor wire security fence as it allows for free movement of small mammals and reptiles under the fence. If electrification of the fence is required, the lowest electrical fence strand should be positioned to still allow for free movement of small mammals and reptiles under the fence without causing fatalities of these species.	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.
		Cumulative	2	4	3	5	3 - MOD		Regular operation and maintenance of the road and associated culverts and stormwater interventions (e.g. mitre drains) could result in localised disturbances to the wetland habitat adjacent to the road
		Residual	1	4	3	5	2.7 - MOD		Limiting maintenance activities to the defined servitude will prevent unnecessary disturbances.
Operation	Erosion and sedimentation due to storm water discharges from road	Existing	1	2	2	4	1.3 - LOW	Regular inspections and maintenance of all wetland crossings and stormwater management infrastructure should be undertaken and any damage repaired and flow obstructions cleared to ensure optimal functioning.	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion
		Cumulative	2	4	3	4	2.4 - MOD		Culverts and stormwater drains associated with the road could become blocked/damaged during operation and lead to suboptimal functioning, possibly leading to flow impoundment or concentration and increased erosion risk

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
		Residual	1	4	2	3	1.4 - LOW		Regular inspections and maintenance activities will be undertaken to ensure optimal functioning of stormwater infrastructure. Damage will be repaired.
CLOSURE PHASE									
Decommissioning	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	Limit disturbance to wetland habitat by limiting decommissioning activities to the actual disturbance footprint. No access to wetland areas should be allowed unless infrastructure to be decommissioned is located within a wetland area. Only make use of existing roads and tracks to access the site during decommissioning phase. Implement an alien vegetation management plan to prevent establishment and spread of alien species.	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.
		Cumulative	2	3	3	5	2.7 - MOD		Linear infrastructures crosses wetland habitat. Decommissioning and removal activities will lead to disturbance.
		Residual	1	3	3	5	2.3 - MOD		Limiting decommissioning activities to the servitude footprint will prevent further disturbances to wetland habitat.
Decommissioning	Increased risk of erosion in wetlands	Existing	1	2	1	3	0.8 - VERY LOW	All disturbed areas should be landscaped to approximate the natural landscape profile, but should avoid steep slopes and concentrated run-off. Compacted soils should be ripped and scarified. The rehabilitated areas should be re-vegetated (using a mix of locally occurring indigenous species) as soon as possible following completion of the earthworks to minimise erosion. Regular long-term follow up of rehabilitated areas will be required to ensure the successful establishment of vegetation and to survey for any erosion damage on site. Erosion damage should be repaired immediately. The recommendations contained within the specialist vegetation and soils reports should be fully implemented to ensure successful rehabilitation	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion
		Cumulative	3	4	3	4	2.7 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing risk of erosion. This will be exacerbated where flow concentration takes place
		Residual	1	2	2	3	1 - VERY LOW		Stable, vegetated landforms resembling the natural landscape profile must be re-established after closure. This will prevent erosion.
Decommissioning	Sediment transport into wetlands	Existing	1	2	2	4	1.3 - LOW	Install erosion prevention measures and sediment barriers prior to the commencement of decommissioning and closure activities. Minimise the decommissioning and closure footprint within the wetland area. Clearly demarcate the required servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks to access decommissioning and closure areas. Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible. Undertake decommissioning and closure during the dry season as far as possible. Re-vegetate and rehabilitate areas as soon as possible after completion of decommissioning and closure. Locate all stockpiles, laydown areas and temporary decommissioning and closure infrastructure at least 50m from the edge of delineated wetlands.	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	2	2	4	1.3 - LOW		Stable, vegetated landforms resembling the natural landscape profile must be re-established after closure. This will prevent erosion and sediment transport into wetlands.

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
Decommissioning	Establishment and spread of alien species	Existing	1	3	1	3	1 - VERY LOW	An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.	Most wetlands show only minor alien vegetation invasions, with the exception of one hillslope seepage wetland
		Cumulative	3	4	3	3	2 - LOW		Disturbed areas could be colonised by alien vegetation. These infestations could form seed sources leading to infestations in adjacent wetlands.
		Residual	1	3	1	2	0.7 - VERY LOW		Alien vegetation management plan will control establishment and spread of aliens. Existing infestations will be cleared.

8.2.3 Infrastructure Deviations

In order to construct the Site H ADF, the following infrastructure will have to be deviated (Figure 36):

- The D1390 (gravel road);
- Distribution lines: 11kV, 22kV, 88kV, 132kV;
- Transmission line: 400 kV;
- Transnet 18" fuel pipeline.

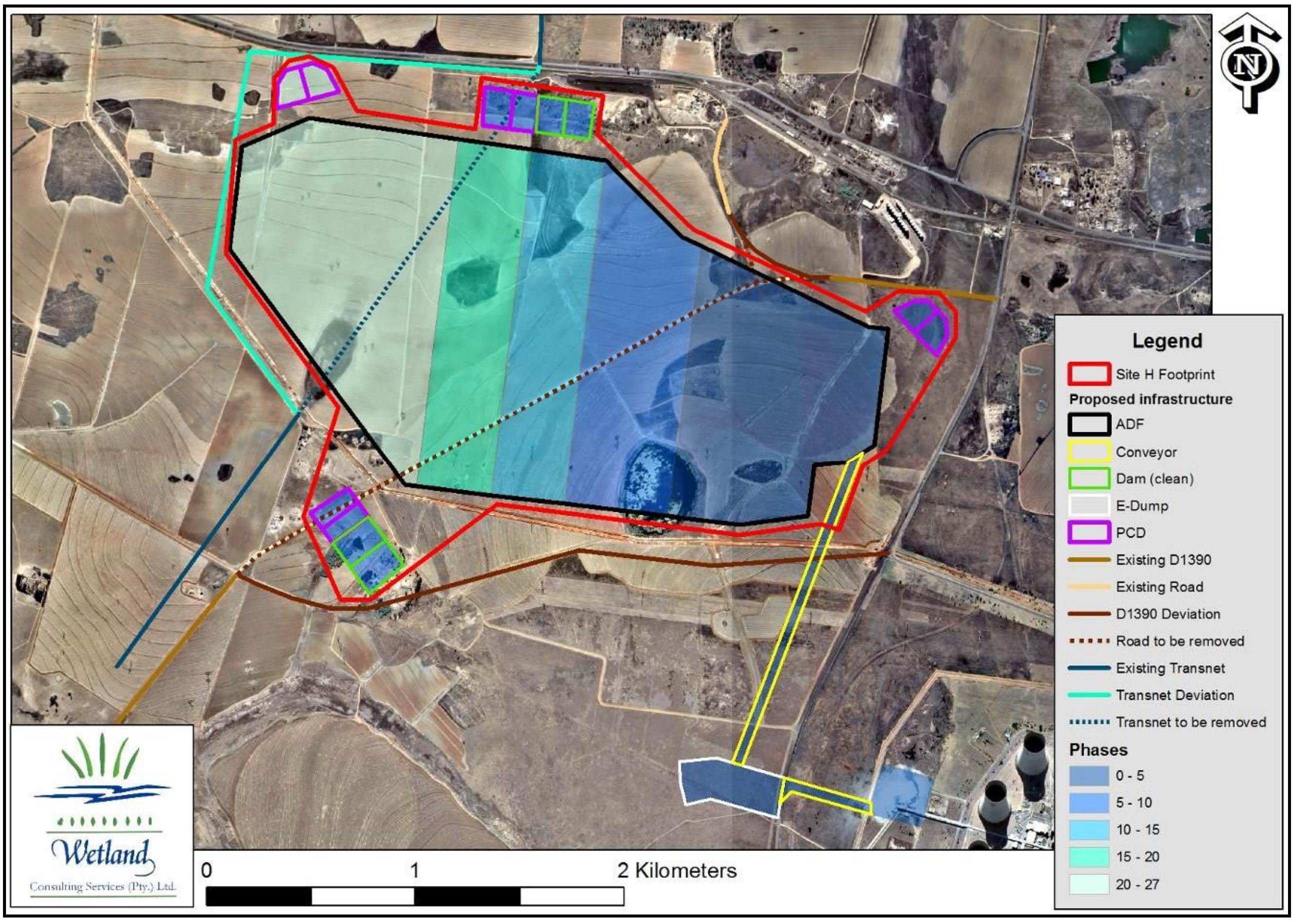

Figure 36. Map showing the proposed footprint of the ADF indicating linear infrastructure deviations required.

Based on the information provided, 4 wetland crossings have been identified (see Figure 37). All of the 4 crossings will be located in wetlands immediately downslope of the proposed ADF and as such these wetlands will be impacted on by the ADF as well. The indirect impact of the ADF on these wetlands, which is expected to be manifest in the form of decreased flows and soil saturation, has already been included in the hectare equivalent losses determined for the ADF. Crossings are as follows (numbering as per Figure 37):

1. Crossing of the re-aligned D1390 gravel road over a hillslope seepage wetland. This is an existing crossing that will be somewhat modified, with the disturbed footprint expected to

increase somewhat. The crossing will be located immediately downslope of the proposed ADF.

2. Crossing of the re-aligned Transnet fuel pipeline through an isolated hillslope seepage wetland.
3. Crossing of the re-aligned Transnet fuel pipeline through a hillslope seepage wetland. This hillslope seepage wetland is expected to dry out an lose all functionality as a result of the construction of the proposed ADF. The loss of this wetland has already been accounted for in the hectare equivalent losses determined for the ADF.
4. Crossing of the re-aligned D1390 gravel road over a hillslope seepage wetland. This crossing will be located immediately downslope a set of clean and dirty water control dams associated with the ADF. The wetland is likely to suffer decreased flows due to the construction of the ADF and water management dams. Downslope of the crossing the river diversion required for the extension of the existing ash dump will be constructed.

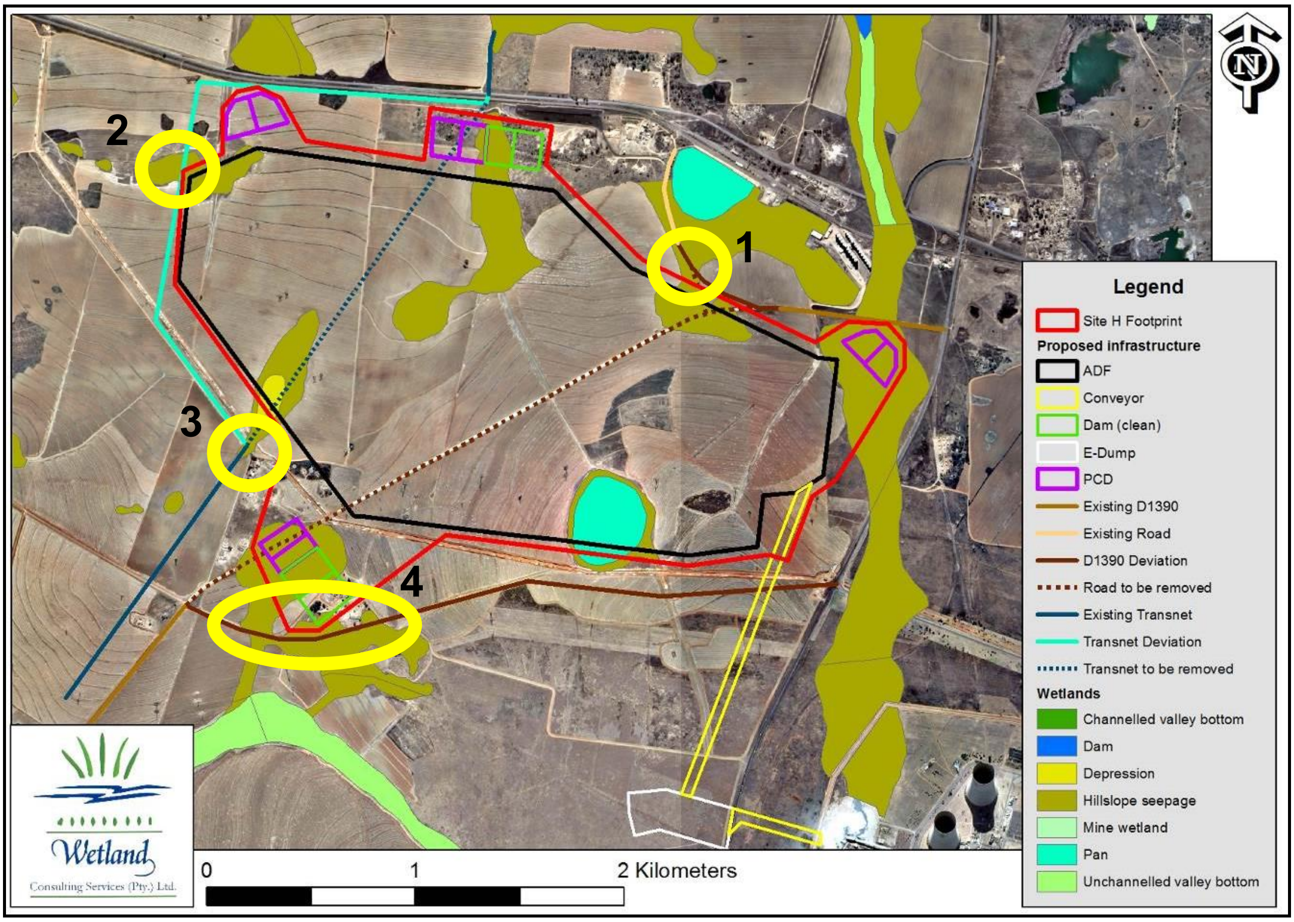

Figure 37. Map showing the location of the linear infrastructure crossings described in the text.

It is clear from the above descriptions that all of the identified crossings will be located in wetlands that are already impacted and will further be substantially impacted and altered by the proposed construction of the ADF. None of the crossings are therefore considered of high sensitivity, though adequate mitigation will be required for each of the crossings to ensure impacts to the downstream water resources are minimised.

8.2.3.1 Preconstruction & Construction - Disturbance and degradation of wetland habitat

4 wetland crossings have been identified along the proposed linear infrastructure deviations, consisting of a number of hillslope seepage wetlands. Wetland habitat falling within the footprint of the proposed linear infrastructure, especially the gravel road and the pipeline, will be disturbed during the construction process, and some wetland habitat is also likely to be lost.

In addition, construction vehicles accessing the routes, turning, offloading materials on site etc. are also likely to contribute to disturbance and destruction of wetland habitat outside the servitudes. Disturbance of the wetland vegetation is also likely to provide opportunity for invasion by alien vegetation and increase the risk of erosion.

Mitigation

To minimise the significance of impacts, the following mitigation measures should be strictly enforced:

- Method statements should be developed for each of the crossings. Such method statements should be commented on by a suitable wetland specialist.
- The extent of disturbance should be limited by limiting all construction activities to the servitude as far as practically possible.
- The servitude should be fenced off using a 5 strand cattle fence or other suitable fence/demarcation prior to the commencement of vegetation clearing or earthmoving activities.
- No materials should be stockpiled within the wetland areas along the routes and driving within the wetland areas should be kept to an absolute minimum. Clearly defined access routes should be used.
- As far as possible, the existing roads and farm tracks should be used to provide access during construction as this will reduce the extent of the disturbed area along the routes.
- In the case of the pipeline, which will likely be buried, it is important that the natural landscape profile be restored after construction to prevent the formation of preferential flow paths through the wetland.
- Post construction all alien invasive vegetation should be removed from the servitudes. This will also require long-term follow up to ensure establishment of natural vegetation in all disturbed areas.
- Ideally construction activities within wetlands should take place in winter (during the dry season).

8.2.3.2 Preconstruction & Construction - Increased risk of erosion in wetlands

The soils within the hillslope seepage wetlands affected by the identified crossings are generally fairly shallow. Such soils can be highly susceptible to erosion. The clearing of vegetation, together with the disturbance of the soil and the potential flow concentration within wetlands during the construction phase pose a significant erosion risk, with eroded sediment transported downstream into adjacent wetland areas.

Mitigation

Minimise the construction footprints within the wetland areas. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area.

Make use of existing roads and tracks as far as possible to access the construction sites.

Install erosion prevention measures and sediment traps/barriers prior to the onset of construction activities. Measures could include low berms on approach and departure slopes to crossings to prevent flow concentration, sediment barriers along the lower edge of bare soil areas, placement of hay bales around the within wetland construction areas and re-vegetation of disturbed areas as soon as possible.

Maintain surface flow connectivity in wetlands during the construction phase by temporarily diverting streams around the construction area. Given that all affected wetlands are characterised by mostly subsurface seepage, this might not be necessary.

Key to crossing structures should be the maintenance of flow connectivity across the crossings. Where hillslope seepage wetlands are crossed parallel to the direction of flow (i.e. perpendicular to the contour), no means of conveying flow under the road is required. However, measures should be put in place to prevent the formation of preferential flow paths along the road verges. This should be achievable through the placement of regular low berms parallel to the contour along the road verges. Where hillslope seepage wetlands are crossed perpendicular to the direction of flow (i.e. parallel to the contour), provision will need to be made to allow flows to pass through underneath the road. Key here would be to prevent the concentration of flows as this would lead to erosion at the discharge point on the downslope side, as well as partial desiccation of the wetland area. Consideration should be given to installing subsurface drains under the road. This could be achieved through installing a coarse gravel pioneer layer at natural ground level (from just below NGL to just above) under the pavement layers of the road through which water could flow. To prevent water just flowing along the drain, impermeable plastic trench breakers should be installed within the coarse gravel layer across the road. Regular culverts should also be installed to accommodate surface flow and ensure flow connectivity across the full width of the crossing.

Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands.

In the case of the pipeline crossings, it is important that the pipeline does not form a preferential flow path in the subsurface. Where the pipeline runs down a slope, it is therefore recommended to place trench breakers at regular intervals to prevent this.

8.2.3.3 Preconstruction & Construction - Sediment transport into wetlands

Sediment washed off the bare soil areas associated with construction areas will be deposited in wetland areas and eventually enter tributaries of the Wilge River. Sediment deposition in wetlands will lead to changes in wetland vegetation.

Mitigation

- Install erosion prevention measures and sediment barriers prior to the commencement of construction activities.
- Minimise the construction footprint within the wetland area. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area.
- Make use of existing roads and tracks as far as possible to access construction areas.
- Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible.
- Undertake construction during the dry season as far as possible.
- Re-vegetate and rehabilitate areas as soon as possible after completion of construction.
- Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands.

8.2.3.4 Preconstruction & Construction - Water quality deterioration

During construction, as activities are taking place adjacent to wetlands, there is a possibility that water quality can be impaired. Typically impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment within the wetlands. It is likely that hydrocarbons will be stored and used on site, as well as cement and other potential pollutants.

Mitigation

Ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are placed no closer than 50m from a wetland or water course. No abstraction of water from the wetlands or nearby streams should be allowed unless expressly authorized in the IWULA.

In order to reduce the potential impacts associated with the introduction of contaminants dissolved or suspended in the runoff from construction sites, where practically possible, no runoff should be introduced into wetlands directly. Introduction into dryland areas is preferred as the vegetation and soils provide an opportunity to limit the movement of contaminants and the environment is conducive for natural degradation.

Potential contaminants used and stored on site should be stored and prepared on bunded surfaces to contain spills and leaks. Sufficient spill clean-up material must be kept on site at all times to deal with minor spills. Larger spills should be reported to the Environmental Officer and the relevant authorities immediately, with specialists appointed to oversee the clean-up operations

8.2.3.5 Preconstruction & Construction - Habitat fragmentation

Although linear infrastructure developments can often contribute significantly to habitat fragmentation, the fact that all of the proposed infrastructure deviations will be located immediately adjacent to the proposed ADF will ensure that further habitat fragmentation will not be caused by the required linear infrastructure.

Mitigation

Position linear infrastructure as close as possible to the security fence around the ADF.

8.2.3.6 Preconstruction & Construction - Establishment and spread of alien species

Areas disturbed during the construction process will be susceptible to invasion by alien vegetation, e.g. *Acacia mearnsii* (black wattle). These alien species could spread to the adjacent wetland areas and result in decreased flows, increased erosion and decreased biodiversity in these systems.

Mitigation

An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.

8.2.3.7 Operation - Disturbance of wetland habitat

Regular operation and maintenance of the road and associated culverts and stormwater interventions (e.g. mitre drains) could result in localised disturbances to the wetland habitat adjacent to the road.

Maintenance, repair and inspection activities along the pipeline servitude could likewise result in localised disturbances to wetlands as vehicles and/or machinery need to access the wetland crossings.

Mitigation

All wetlands along the infrastructure servitudes should be clearly demarcated as sensitive habitats and staff/contractors made aware of the location and sensitivity of these habitats. No temporary laydown or stockpiling of material required for maintenance activities may take place in wetland areas.

All vehicular and machinery movement along the servitude must be restricted to defined service road. No off-road driving should be allowed.

If necessary to prevent wetland disturbance, the servitude should be fenced off with a 5 strand cattle fence to prevent vehicles and staff accessing wetlands outside the servitude area. A 5 strand cattle fence is preferred to a razor wire security fence as it allows for free movement of small mammals and reptiles under the fence. If electrification of the fence is required, the lowest electrical fence strand should be positioned to still allow for free movement of small mammals and reptiles under the fence without causing fatalities of these species.

8.2.3.8 Operation - Erosion and sedimentation due to storm water discharges from road

Culverts and stormwater drains associated with the road could become blocked/damaged during operation and lead to suboptimal functioning, possibly leading to flow impoundment or concentration and increased erosion risk.

Mitigation

Regular inspections and maintenance of all wetland crossings and stormwater management infrastructure should be undertaken and any damage repaired and flow obstructions cleared to ensure optimal functioning.

8.2.3.9 Closure - Disturbance of wetland habitat

The decommissioning and removal of linear infrastructures could result in the disturbance and destruction of wetland habitat, much as during the operational phase. In addition, vehicles accessing the route, turning, loading materials on site etc. could also contribute to disturbance and destruction of wetland habitat outside the servitudes. Disturbance of the wetland vegetation is also likely to provide opportunity for erosion and invasion by alien vegetation.

Mitigation

Limit disturbance to wetland habitat by limiting decommissioning activities to the actual disturbance footprint. No access to wetland areas should be allowed unless infrastructure to be decommissioned is located within a wetland area. Only make use of existing roads and tracks to access the site during decommissioning phase. Implement an alien vegetation management plan to prevent establishment and spread of alien species.

8.2.3.10 Closure - Increased risk of erosion in wetlands

The soils within the hillslope seepage wetlands affected by the identified crossings are generally fairly shallow. Such soils can be highly susceptible to erosion. The removal of infrastructure, together with the likely disturbance of the vegetation and soils, could pose an erosion risk, with eroded sediment transported downstream into adjacent wetland areas.

Mitigation

All disturbed areas should be landscaped to approximate the natural landscape profile, but should avoid steep slopes and concentrated run-off. Compacted soils should be ripped and scarified. The rehabilitated areas should be re-vegetated (using a mix of locally occurring indigenous species) as soon as possible following completion of the earthworks to minimise erosion. Regular long-term follow up of rehabilitated areas will be required to ensure the successful establishment of vegetation and to survey for any erosion damage on site. Erosion damage should be repaired immediately. The recommendations contained within the specialist vegetation and soils reports should be fully implemented to ensure successful rehabilitation

8.2.3.11 Closure - Sediment transport into wetlands

Sediment washed off the bare soil areas associated with the decommissioning and closure process will be deposited in wetland areas and eventually enter tributaries of the Wilge River. Sediment deposition in wetlands will lead to changes in wetland vegetation.

Mitigation

- Install erosion prevention measures and sediment barriers prior to the commencement of decommissioning and closure activities.
- Minimise the decommissioning and closure footprint within the wetland area. Clearly demarcate the required servitude and maintain all activities within the demarcated area.
- Make use of existing roads and tracks to access decommissioning and closure areas.
- Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible.
- Undertake decommissioning and closure during the dry season as far as possible.
- Re-vegetate and rehabilitate areas as soon as possible after completion of decommissioning and closure.
- Locate all stockpiles, laydown areas and temporary decommissioning and closure infrastructure at least 50m from the edge of delineated wetlands.

8.2.3.12 Closure - Establishment and spread of alien species

Areas disturbed during the decommissioning and closure process will be susceptible to invasion by alien vegetation, e.g. *Acacia mearnsii* (black wattle). These alien species could spread to the adjacent wetland areas and result in decreased flows, increased erosion and decreased biodiversity in these systems.

Mitigation

An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.

8.2.4 Impact Assessment Table – Linear Infrastructure Deviations

Refer to attached Excel spreadsheet.

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
PRE-CONSTRUCTION & CONSTRUCTION PHASE									
Servitude clearing & construction	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	§Method statements should be developed for each of the crossings. Such method statements should be commented on by a suitable wetland specialists. The extent of disturbance should be limited by limiting all construction activities to the servitude as far as practically possible. The servitude should be fenced off using a 5 strand cattle fence or other suitable fence/demarcation prior to the commencement of vegetation clearing or earthmoving activities. No materials should be stockpiled within the wetland areas along the routes and driving within the wetland areas should be kept to an absolute minimum. Clearly defined access routes should be used. As far as possible, the existing roads and farm tracks should be used to provide access during construction as this will reduce the extent of the disturbed area along the routes. In the case of the pipeline, which will likely be buried, it is important that the natural landscape profile be restored after construction to prevent the formation of preferential flow paths through the wetland. Post construction all alien invasive vegetation should be removed from the servitudes. This will also require long-term follow up to ensure establishment of natural vegetation in all disturbed areas. Ideally construction activities within wetlands should take place in winter (during the dry season).	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.
		Cumulative	2	3	4	5	3 - MOD		Linear infrastructures will have to cross wetland habitat. Construction activities will lead to disturbance. Habitat within the direct footprint will be lost.
		Residual	1	3	3	5	2.3 - MOD		Some wetland loss and disturbance is unavoidable. Mitigation measures aim to minimise impact
Servitude clearing & construction	Increased risk of erosion in wetlands	Existing	1	2	1	3	0.8 - VERY LOW	Minimise the construction footprints within the wetland areas. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks as far as possible to access the construction sites. Install erosion prevention measures and sediment traps/barriers prior to the onset of construction activities. Maintain surface flow connectivity in wetlands during the construction phase	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
		Cumulative	2	3	3	4	2.1 - MOD	by temporarily diverting streams around the construction area. Given that all affected wetlands are characterised by mostly subsurface seepage, this might not be necessary. Key to crossing structures should be the maintenance of flow connectivity across the crossings. Regular culverts should also be installed to accommodate surface flow and ensure flow connectivity across the full width of the crossing. Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands. In the case of the pipeline crossings, it is important that the pipeline does not form a preferential flow path in the subsurface. Where the pipeline runs down a slope, it is therefore recommended to place trench breakers at regular intervals to prevent this.	Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing risk of erosion. This will be exacerbated where flow concentration takes place
		Residual	1	3	2	3	1.2 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite
Servitude clearing & construction	Sediment transport into wetlands	Existing	1	2	2	4	1.3 - LOW	Install erosion prevention measures and sediment barriers prior to the commencement of construction activities. Minimise the construction footprint within the wetland area. Clearly demarcate the required construction servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks as far as possible to access construction areas. Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible. Undertake construction during the dry season as far as possible. Re-vegetate and rehabilitate areas as soon as possible after completion of construction. Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands.	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	3	2	4	1.6 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
Servitude clearing & construction	Water quality deterioration	Existing	1	2	2	4	1.3 - LOW	Ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are placed no closer than 50m from a wetland or water course. In order to reduce the potential impacts associated with the introduction of contaminants dissolved or suspended in the runoff from construction sites, where practically possible, no runoff should be introduced into wetlands directly. Introduction into dryland areas is preferred as the vegetation and soils provide an opportunity to limit the movement of contaminants and the environment is conducive for natural degradation. Potential contaminants used and stored on site should be stored and prepared on bunded surfaces to contain spills and leaks. Sufficient spill clean-up material must be kept on site at all times to deal with minor spills. Larger spills should be reported to the Environmental Officer and the relevant authorities immediately, with specialists appointed to oversee the clean-up operations	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	2	2	4	1.3 - LOW		Mitigation measures aim to minimise mobilisation of sediment on site and will reduce sediment transported offsite
Servitude clearing & construction	Habitat fragmentation	Existing	3	3	3	5	3 - MOD	Position linear infrastructure as close as possible to the security fence around the ADF.	Wetland habitat on site is already highly fragmented due to cultivation activities.
		Cumulative	3	3	3	5	3 - MOD		Proposed crossings will be located immediately downslope of the proposed ADF, limiting impact on habitat fragmentation
		Residual	3	3	3	5	3 - MOD		Proposed crossings will be located immediately downslope of the proposed ADF, limiting impact on habitat fragmentation
Servitude clearing & construction	Establishment and spread of alien species	Existing	1	3	1	3	1 - VERY LOW	An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.	Most wetlands show only minor alien vegetation invasions, with the exception of one hillslope seepage wetland
		Cumulative	3	4	3	3	2 - LOW		Disturbed areas could be colonised by alien vegetation. These infestations could form seed sources leading to infestations in adjacent wetlands.
		Residual	1	3	1	2	0.7 - VERY LOW		Alien vegetation management plan will control establishment and spread of aliens. Existing infestations will be cleared.
OPERATIONAL PHASE									
Operation	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	All wetlands along the infrastructure servitudes should be clearly demarcated as sensitive habitats and staff/contractors made aware of the location and sensitivity of these habitats. No temporary laydown or stockpiling of material required for maintenance activities may take place in wetland areas. All vehicular and machinery movement along the servitude must be restricted to defined service road. No off-road driving should be allowed. If necessary to prevent wetland disturbance, the servitude should be fenced	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
		Cumulative	2	4	3	5	3 - MOD	off with a 5 strand cattle fence to prevent vehicles and staff accessing wetlands outside the servitude area. A 5 strand cattle fence is preferred to a razor wire security fence as it allows for free movement of small mammals and reptiles under the fence. If electrification of the fence is required, the lowest electrical fence strand should be positioned to still allow for free movement of small mammals and reptiles under the fence without causing fatalities of these species.	Regular operation and maintenance of the road and associated culverts and stormwater interventions (e.g. mitre drains) could result in localised disturbances to the wetland habitat adjacent to the road
		Residual	1	4	3	5	2.7 - MOD		Limiting maintenance activities to the defined servitude will prevent unnecessary disturbances.
Operation	Erosion and sedimentation due to storm water discharges from road	Existing	1	2	2	4	1.3 - LOW	Regular inspections and maintenance of all wetland crossings and stormwater management infrastructure should be undertaken and any damage repaired and flow obstructions cleared to ensure optimal functioning.	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion
		Cumulative	2	4	3	4	2.4 - MOD		Culverts and stormwater drains associated with the road could become blocked/damaged during operation and lead to suboptimal functioning, possibly leading to flow impoundment or concentration and increased erosion risk
		Residual	1	4	2	3	1.4 - LOW		Regular inspections and maintenance activities will be undertaken to ensure optimal functioning of stormwater infrastructure. Damage will be repaired.
CLOSURE PHASE									
Decommissioning	Disturbance and degradation of wetland habitat	Existing	1	3	3	5	2.3 - MOD	Limit disturbance to wetland habitat by limiting decommissioning activities to the actual disturbance footprint. No access to wetland areas should be allowed unless infrastructure to be decommissioned is located within a wetland area. Only make use of existing roads and tracks to access the site during decommissioning phase. Implement an alien vegetation management plan to prevent establishment and spread of alien species.	Agricultural activities and other landuses have already significantly impacted on wetlands, with most of the wetlands on site considered largely modified under current conditions.
		Cumulative	2	3	3	5	2.7 - MOD		Linear infrastructures crosses wetland habitat. Decommissioning and removal activities will lead to disturbance.
		Residual	1	3	3	5	2.3 - MOD		Limiting decommissioning activities to the servitude footprint will prevent further disturbances to wetland habitat.
Decommissioning	Increased risk of erosion in wetlands	Existing	1	2	1	3	0.8 - VERY LOW	All disturbed areas should be landscaped to approximate the natural landscape profile, but should avoid steep slopes and concentrated run-off. Compacted soils should be ripped and scarified. The rehabilitated areas should be re-vegetated (using a mix of locally occurring indigenous species) as soon as possible following completion of the earthworks to minimise erosion. Regular long-term follow up of rehabilitated areas will be required to ensure the successful establishment of vegetation and to survey for any erosion damage	Most affected wetlands area hillslope seepage wetlands that currently show few signs of erosion
		Cumulative	3	4	3	4	2.7 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing risk of erosion. This will be exacerbated where flow concentration takes place

Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures	Interpretation
		Residual	1	2	2	3	1 - VERY LOW	on site. Erosion damage should be repaired immediately. The recommendations contained within the specialist vegetation and soils reports should be fully implemented to ensure successful rehabilitation	Stable, vegetated landforms resembling the natural landscape profile must be re-established after closure. This will prevent erosion.
Decommissioning	Sediment transport into wetlands	Existing	1	2	2	4	1.3 - LOW	Install erosion prevention measures and sediment barriers prior to the commencement of decommissioning and closure activities. Minimise the decommissioning and closure footprint within the wetland area. Clearly demarcate the required servitude and maintain all activities within the demarcated area. Make use of existing roads and tracks to access decommissioning and closure areas. Limit cleared areas to as small an area as possible at any one time, and to as short a time span as possible. Undertake decommissioning and closure during the dry season as far as possible. Re-vegetate and rehabilitate areas as soon as possible after completion of decommissioning and closure. Locate all stockpiles, laydown areas and temporary decommissioning and closure infrastructure at least 50m from the edge of delineated wetlands.	Most wetlands on site are surrounded by cultivated fields that form significant sediment sources to the wetlands
		Cumulative	2	3	3	4	2.1 - MOD		Bare soil areas and compaction of soils will increase surface runoff volumes and velocities, increasing sediment transport into wetlands. This will likely result in increased turbidity.
		Residual	1	2	2	4	1.3 - LOW		Stable, vegetated landforms resembling the natural landscape profile must be re-established after closure. This will prevent erosion and sediment transport into wetlands.
Decommissioning	Establishment and spread of alien species	Existing	1	3	1	3	1 - VERY LOW	An alien vegetation management plan should be compiled by an ecologist during the construction/operational phase of the ADF and should be kept in place for several years following closure (minimum of five years). All species of alien invasive vegetation should be controlled and removed from site. No spread of alien vegetation into any wetlands or adjacent properties should be allowed.	Most wetlands show only minor alien vegetation invasions, with the exception of one hillslope seepage wetland
		Cumulative	3	4	3	3	2 - LOW		Disturbed areas could be colonised by alien vegetation. These infestations could form seed sources leading to infestations in adjacent wetlands.
		Residual	1	3	1	2	0.7 - VERY LOW		Alien vegetation management plan will control establishment and spread of aliens. Existing infestations will be cleared.

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APPENDIX 1

