Wetland Delineation and Impacts Assessment Report for the Proposed Kusile 60-year Ash Dam

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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 author's 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 wetland delineation and impact assessment for the proposed Kusile 60-year ash disposal facility (ADF).

The requirement to establish the existence and/or extent of wetlands on the property is based on the legal requirements contained in both 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 around them to minimize any potential impacts.

The purpose of this document is to describe the wetlands within the study area, to identify expected impacts on the wetlands due to the proposed developments and to provide recommendations regarding appropriate mitigation and/or management measures to be implemented should the proposed activities be authorised.

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 6 proposed alternatives from a wetland perspective;
- Brief discussion of expected impacts;
- Compilation of all the findings in a specialist report.

Impact Assessment:

- Identify all the impacts on wetland systems resulting from the proposed developments;
- Evaluate all identified impacts based on a significance rating scale embracing notions such as extent, magnitude, duration and significance of impacts;
- Recommend suitable mitigation and management measures, where applicable, to minimise any potential impacts; and
- Provide a comprehensive impact assessment report detailing all the information.

3. LIMITATIONS & ASSUMPTIONS

While an effort was made to visit every wetland within the study area, 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.

Further to this, 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 15m 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.

Field work for the wetland delineation and assessment was undertaken over several days in December 2012 and January 2013.

4. STUDY AREA

5 alternative sites were identified, all located within a 15 km radius of the Kusile Power Station and between the N4 in the north and the N12 in south, for assessment during the site selection process. The sites as provided by Zitholele Consulting, illustrated in Figure 1 below, are as follows:

- Site A
- Site B
- Site C
- Site F
- Site G

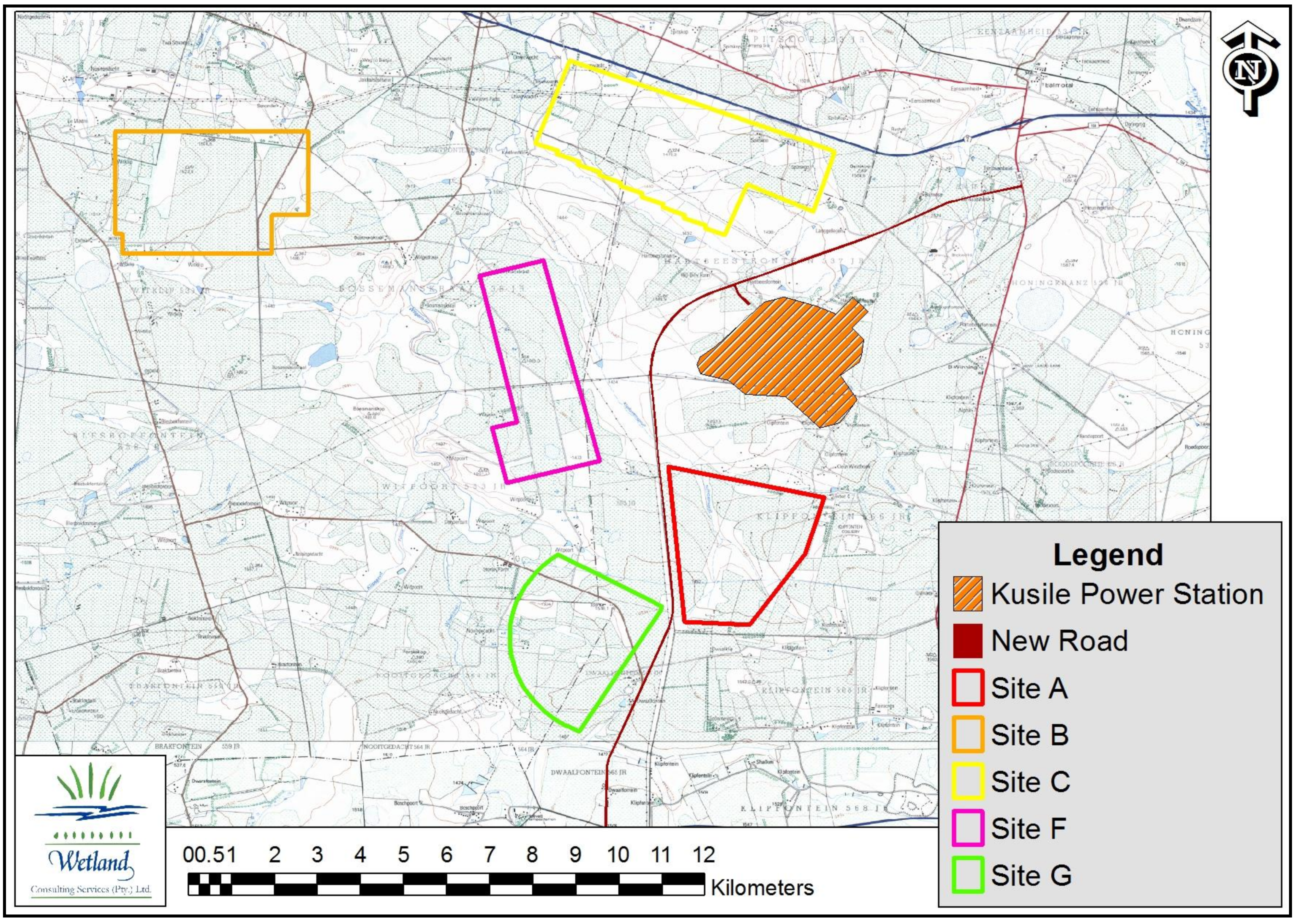


Figure 1. Map showing the 5 alternative sites investigated as part of the site selection process.

Table 1. Table showing the sizes, in hectares, of the various solutions investigated. Each of the solutions falls entirely within the 5 sites investigated.

Solution	Area (ha)
A	826.54
B	1078.2
C	1489
GA	1445.33
FA	1417.58
FG	1546.69

6 potential ADF solutions were identified within the 5 sites investigated, with the 6 solutions detailed in Table 1 above. Solutions GA and FA are combinations of part of site A (so called "small A") and G and F respectively. "Small A" falls within the larger Site A, but excludes the northern valley bottom wetland from its footprint. Note that Site C requires a borrow pit that will be located within the Site A area, as indicated in yellow outline in Figure 1 above.

Site B is the only alternative located to the west of the Wilge River and as such will require the services corridor (including conveyors, service roads, powerlines etc.) to cross the river. The routes for the required services corridors to the various alternative sites are illustrated in Figure 2.

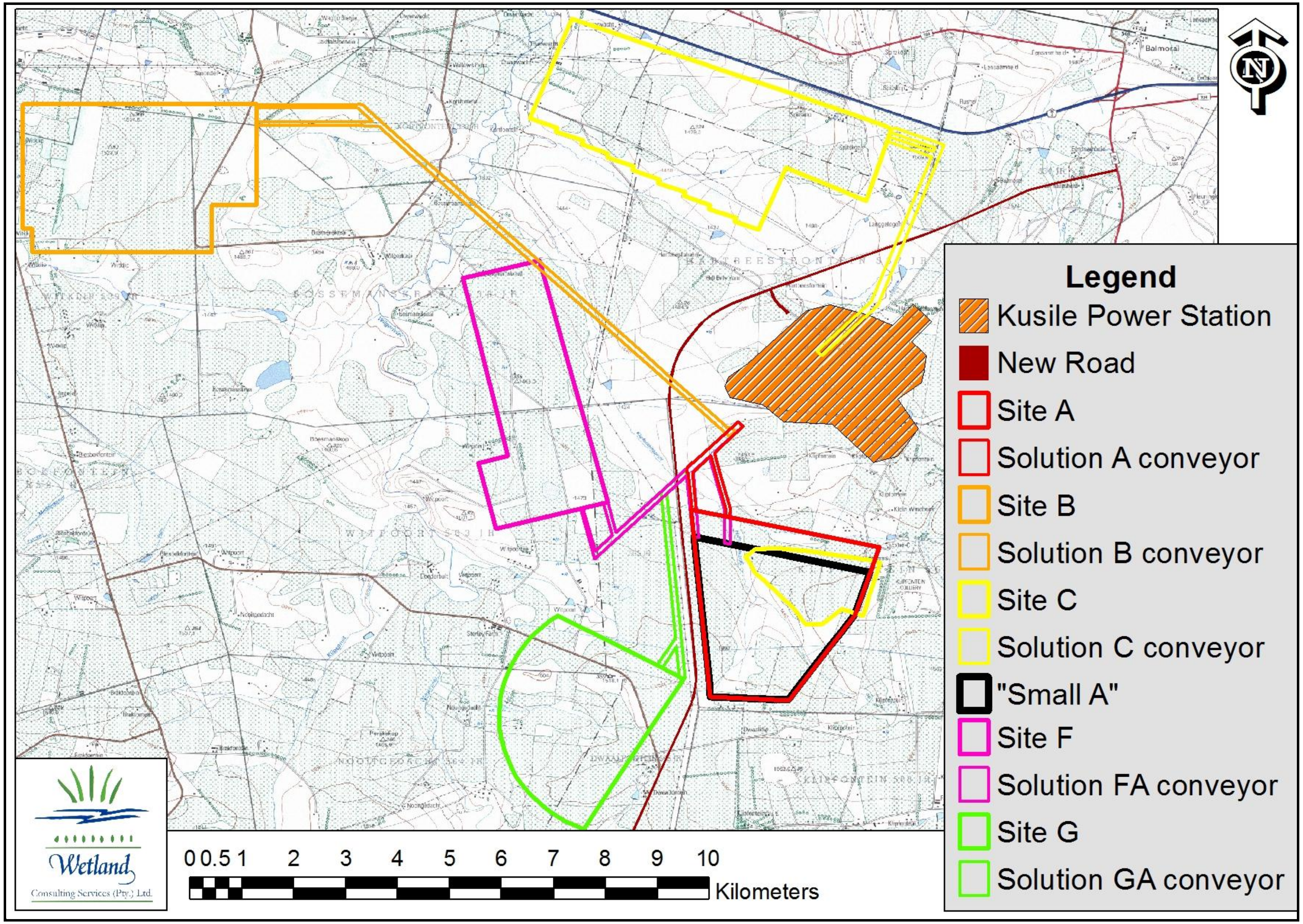


Figure 2. Map showing the approximate areas where service corridors to the various alternatives will run.

4.1 Catchments

The study area is located within the Olifants River Catchment (Primary Catchment B), with most of the sites located within quaternary catchment B20F, the same catchment that the Kusile Power Station is located in. Only Site B extends into quarternary catchment B20D.

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, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
B 20 F	45 443	666.79	33.3	4.99 %
B 20 D	43 243	676.99	36.1	5.33 %

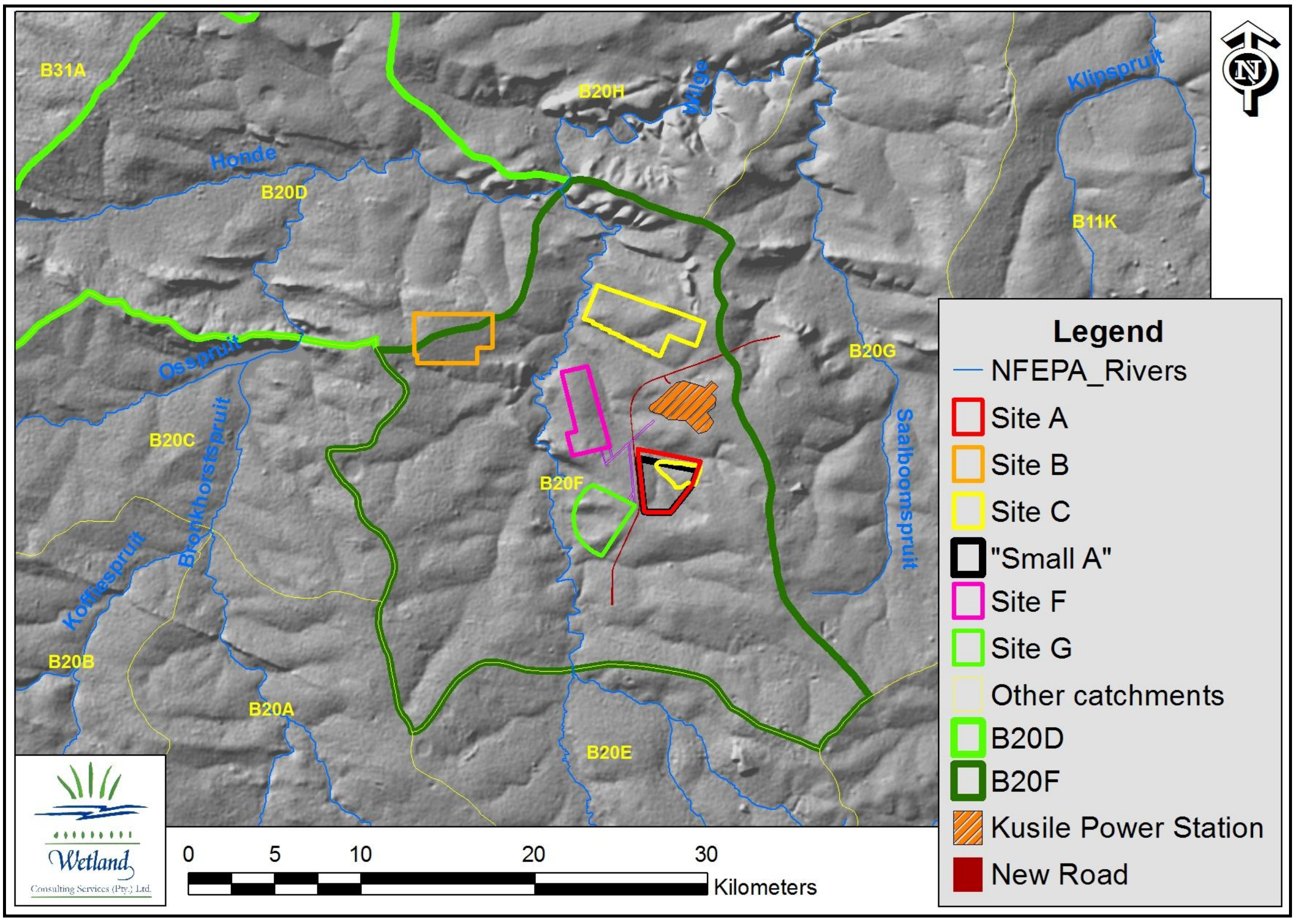


Figure 3. Map showing the study areas in relation to the quaternary catchments.

4.2 Landtypes

4 land types are indicated as occurring on site, as detailed in Figure 4 and Table 4 below. The deepest, most well-drained soils occur within sites B and G, while shallower soils with more impeded drainage, and thus more conducive to wetland formation, occur within sites A, the eastern half of site F and portions of site C. Extensive shallow, rocky soils also occur on site, specifically in sites C and F, as well as portions of site G1.

Table 3. Landtypes of the study area.

Land type	General characteristics
Ba5	Mainly moderately deep to deep, red to yellow-brown (occasionally grey-brown), sandy loam to sandy clay loam soils, on rock and soft plinthite.
Ba6	Mainly moderately deep, red to yellow-brown (occasionally grey-brown), sandy loam to sandy clay loam soils, on rock and soft plinthite.
Bb11	Mainly moderately deep to deep yellow-brown (occasionally grey-brown or red), sandy loam to sandy clay loam soils, on rock and soft plinthite.
Bb12	Mainly moderately deep to deep yellow-brown (occasionally grey-brown or red), sandy loam to sandy clay loam soils, on rock and soft plinthite.

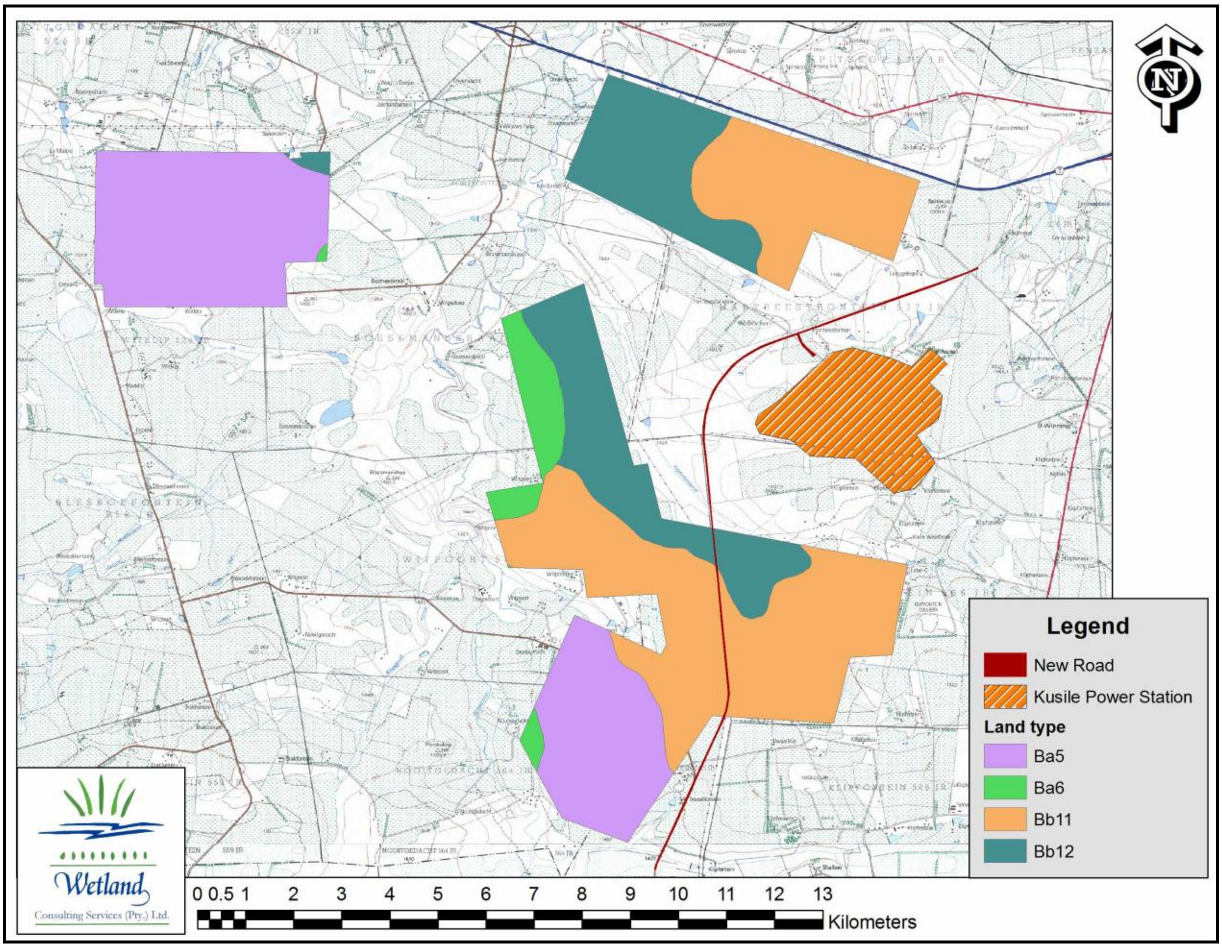


Figure 4. Map of the land types occurring in the study area.

4.3 Vegetation

According to the most recent vegetation classification of the country, "*The Vegetation of South Africa, Lesotho and Swaziland*" (Mucina and Rutherford, 2006), the study area falls 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, though patches of Eastern Temperate Freshwater Wetlands vegetation is indicated as occurring associated with the larger pans of the area.

Rand Highveld Grassland and Eastern Temperate Freshwater Wetlands are listed as ***Vulnerable*** on the National List of Threatened Ecosystems (GN 1002 of 2011) for Mpumalanga Province, while Eastern Highveld Grassland is listed as ***Vulnerable*** on a national scale.

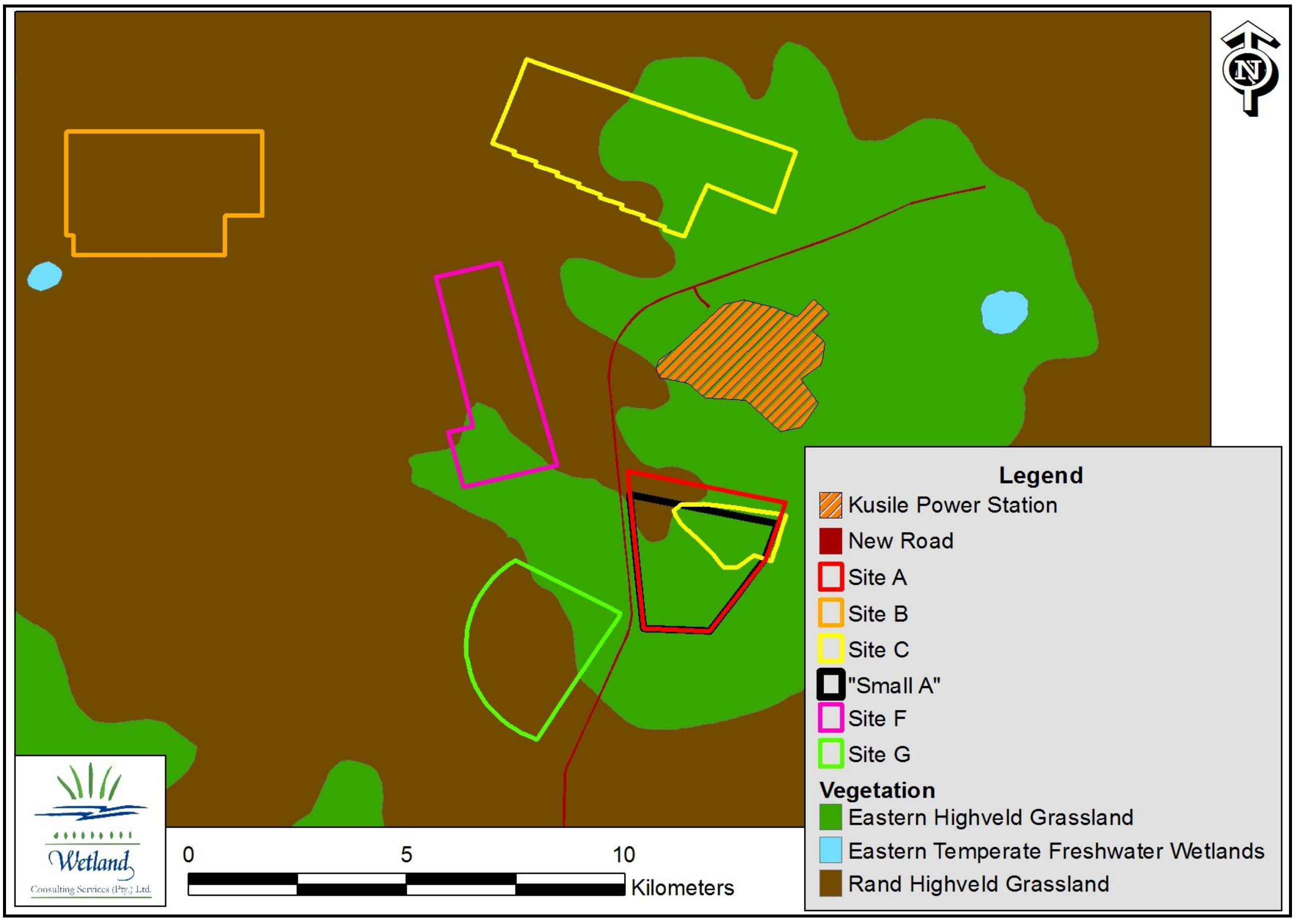


Figure 5. Map showing the vegetation of the area.

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. 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 4 below.

Table 4. 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 (WT)	Threat Status of WT	Protection level of WT	Wetland Vegetation Group (WVG)	Threat Status of WVG
Mesic Highveld Grassland Group 4_Floodplain wetland	Floodplain	CR	Zero protection	Mesic Highveld Grassland	CR
Mesic Highveld Grassland Group 4_Seep	Seep	EN	Zero protection	Mesic Highveld Grassland	CR
Mesic Highveld Grassland Group 4_Depression	Depression	CR	Hardly protected	Mesic Highveld Grassland	CR
Mesic Highveld Grassland Group 4_Channelled valley bottom	Channelled valley bottom	CR	Hardly protected	Mesic Highveld Grassland	CR

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

4.4 National Freshwater Ecosystem Priority Areas

The recently published Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011) (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 (SANBI, 2011) to provide information on the distribution and extent of wetland areas. An extract of the NFEPA database is illustrated in Figure 6 below.

The NFEPA database indicates a wetland FEPA as occurring along the Klipfonteinspruit and an unnamed eastern tributary that drains from the Kusile Power Station. However, it is likely that this assessment was based on data collected prior to the onset of construction activities at Kusile, as the upper reaches of the eastern tributary fall within the construction footprint and the wetland in this area has been replaced by a river diversion. In addition a significant portion of the surface runoff generated by the Kusile site is discharged into this system, runoff which is currently also very sediment rich and highly turbid. A further point to note is that the 10-year ash dam is currently being constructed on the piece of land between the Klipfonteinspruit and its unnamed eastern tributary.

An important wetland cluster is indicated as occurring within Site C.

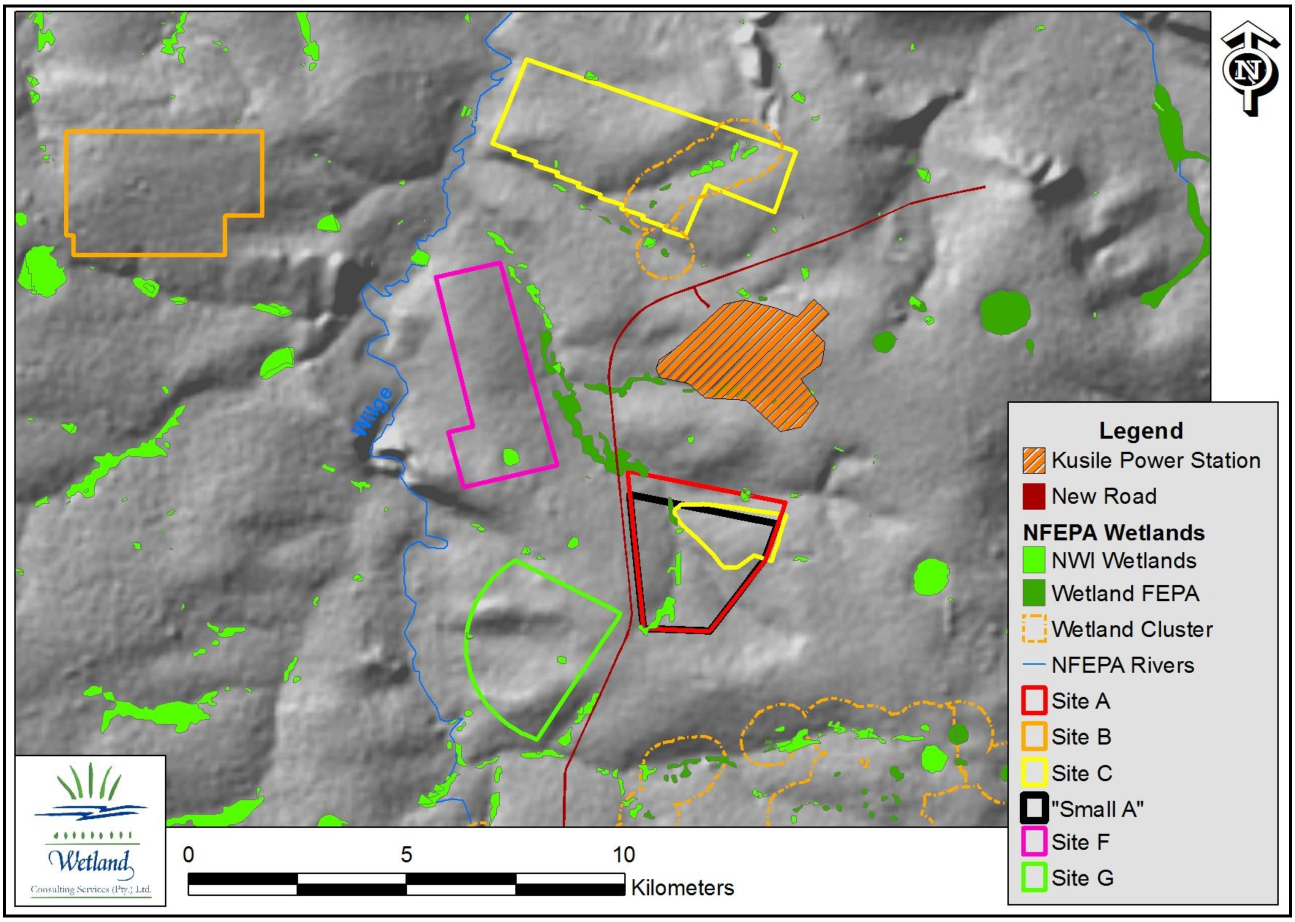


Figure 6. Extract of the Atlas of Freshwater Ecosystem Priority Ares in South Africa (Nel *et al*., 2011).

4.5 Provincial Conservation Plans

Agricultural activities have resulted in extensive transformation of the natural habitats within the study area, as portrayed in the Mpumalanga Biodiversity Sector Plan 2013 (MBSP 2013) and Gauteng C-Plan Version 3 terrestrial biodiversity assessments which classify large parts of the study area as having no natural habitat remaining.

Site C contains significant areas that have been classified as Critical Biodiversity Areas (Mpumalanga) and Irreplaceable (Gauteng). Further Irreplaceable areas occur on Site F and marginally into Site B, while Sites B, C and G also contain areas classified as Important and Ecological Support Areas. Site A has been classified as mostly Heavily Modified, though with some Other Natural Areas.

In terms of wetlands and aquatic biodiversity, the Mpumalanga Biodiversity Sector Plan mirrors the NFEPA database detailed in Section 4.4 above.

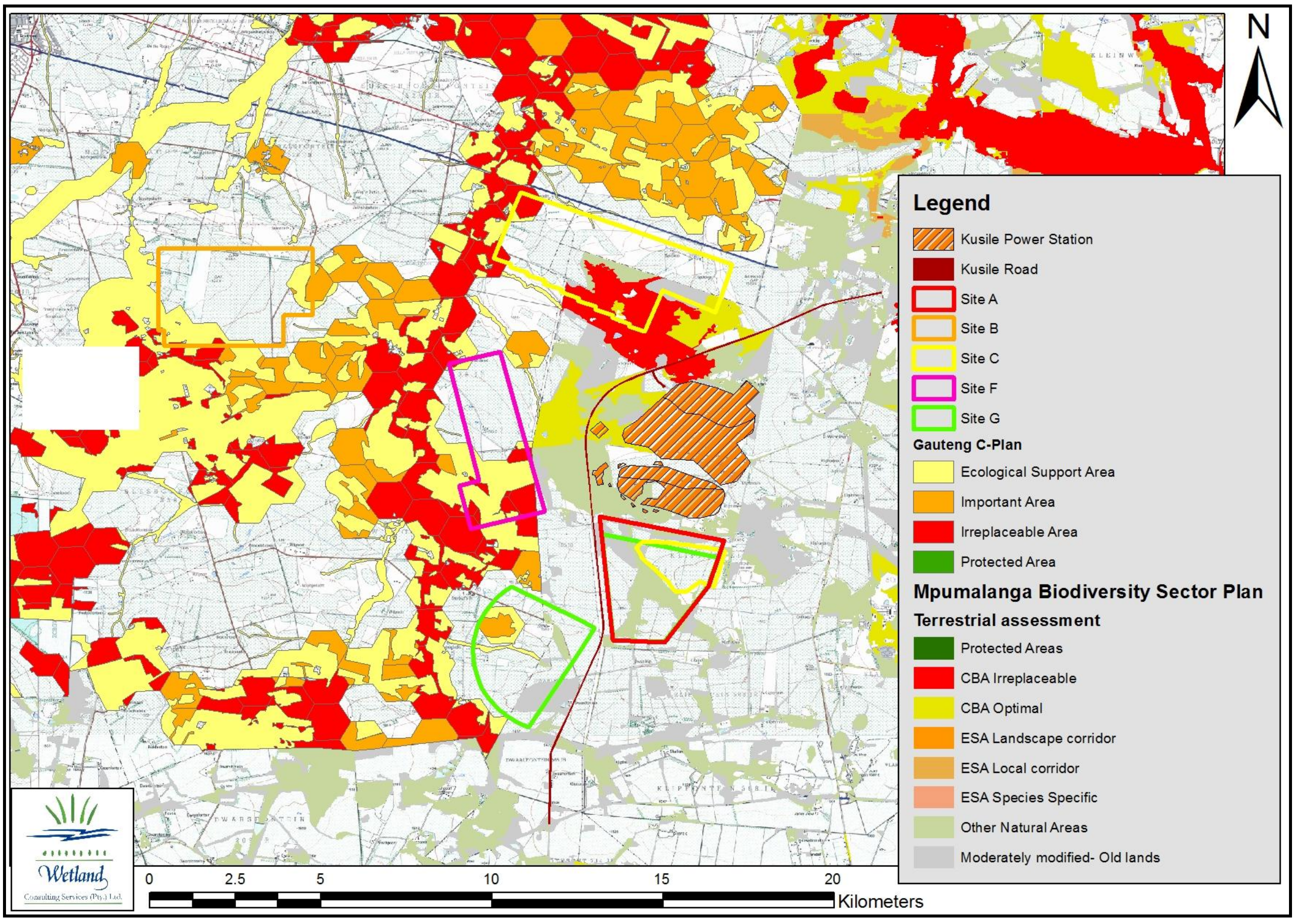


Figure 7. Map showing extracts of the provincial conservation plans for the study area.

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.

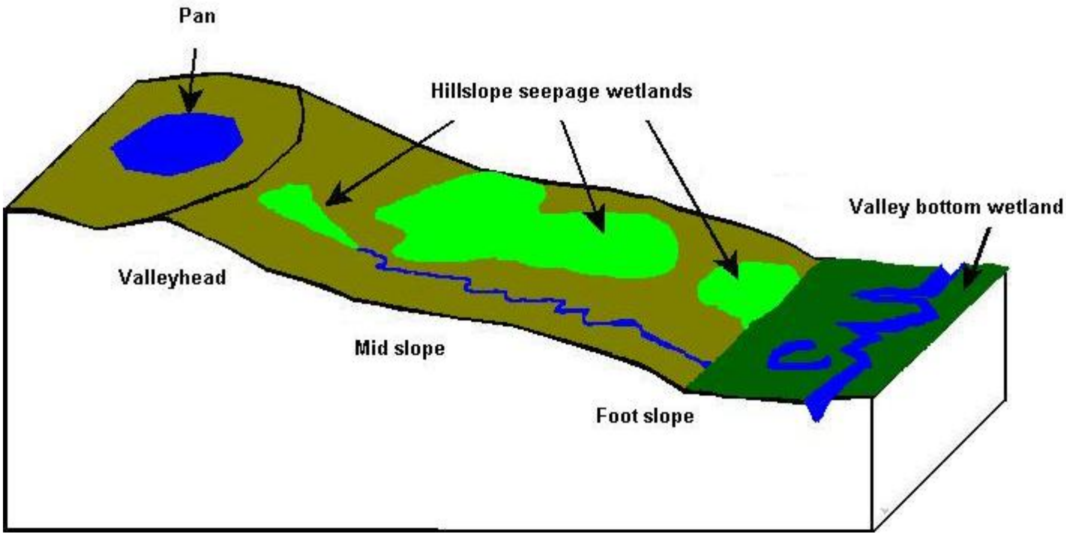


Figure 8. Diagram illustrating the position of the various wetland types within the landscape.

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 "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" 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 "Wet-EcoServices" (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 "*Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems*" (DWAF, 1999) was applied for the determination of the PES.

6. FINDINGS

6.1 Wetland Delineation and Classification

The delineated wetlands within the affected areas are shown in Figure 8. The wetlands and water resources of the area are dominated by the Wilge River that drains from south to north just 5 km west of the Kusile Power Station. With the exception of site B, all proposed alternatives are located east of the Wilge River.

The upper section of the affected reach of the Wilge River is confined by a number of rocky ridges and outcrops, and the river is associated with a channelled valley bottom wetland and a narrow riparian zone. To the north of the rocky ridges the Wilge River is characterised by a floodplain wetland with numerous large cut-off meanders and a narrow riparian fringe along the channel. At it's widest (the confluence with the Klipfonteinspruit), the floodplain is more than 600m across.

In addition to the Klipfonteinspruit and its tributaries, a number of further unnamed streams drain towards the Wilge River from the east, though the Klipfonteinspruit is the largest of these.

The wetlands of each of the 6 alternatives will now be discussed individually. Thereafter a summary is presented comparing the wetland coverage between all of the 6 proposed alternatives.

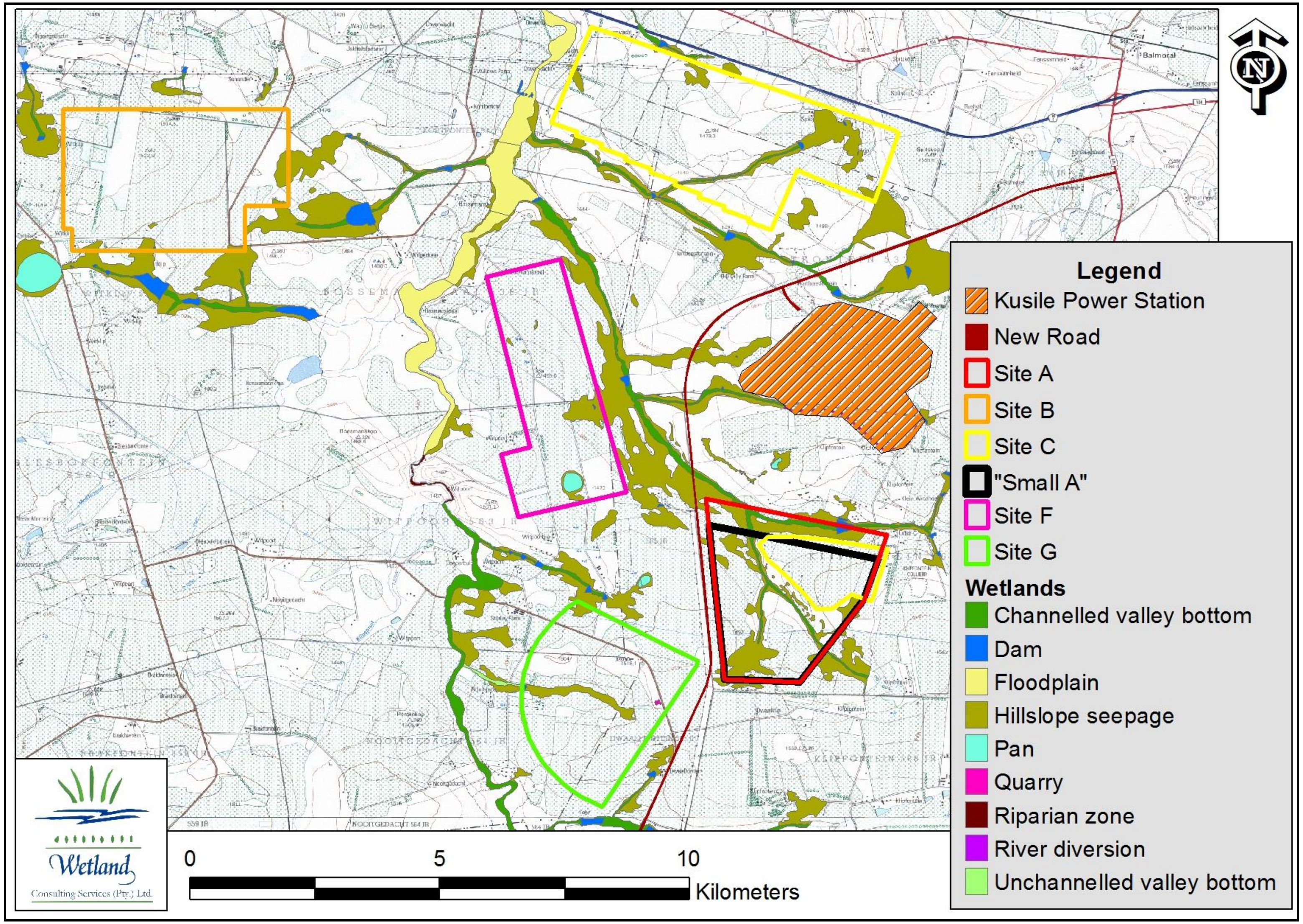


Figure 9. Map of the delineated wetlands on site.

6.1.1 Solution A Wetland Delineation

Approximately 227.67 hectares of wetland occur within the footprint of solution A, making up 27.5 % of the surface area. The wetlands on site make up the headwaters of the Klipfonteinspruit. The 60 year co-disposal facility, currently under construction, is located immediately to the north of site A, while the New Largo mining area is located immediately upstream and to the east of the site.

The wetlands on site A are dominated by extensive hillslope seepage wetlands, which cover 187.94 hectares and make up more than 82 % of the wetland extent on site. The seepage wetlands on site can be broadly categorised as follows:

- **Footslope seeps –** seepage wetlands located along the foot of the slope adjacent to the valley bottom wetlands. Soils are generally somewhat deeper and an E horizon is usually present.
- **Midslope seeps** – generally small, seemingly isolated seepage wetlands located higher up the slope. Generally characterised by shallow soils showing few, if any, hydromorphic features. Thought to be associated with geological features where these pinch out on the side slopes.
- **Valleyhead seeps** – seepage wetlands located at the head of drainage lines/valley bottoms. Soils variable

The seepage wetlands within solution A have been extensively impacted by cultivation, specifically the wetlands within the western and southern sections of the site. Although many of these wetlands are no longer under cultivation, they are characterised by secondary vegetation with a high occurrence of weeds and ruderal species (Figure 9, left photo).

Figure 10. Photos of the wetlands observed within Site A: previously cultivated wetland left and largely natural wetland right.

Exceptions to this are the series of small, seemingly isolated wetlands within the central sections of the site (eastern side of the valley bottom wetland). These wetlands are located within an area of natural grassland and are thus still characterised by primary vegetation

(Figure 9, right photo). The shallow soils of this area are presumed to be the reason that cultivation has been excluded.

Three valley bottom wetlands occur on site. The northern valley bottom, associated with the Klipfonteinspruit, has been dammed and water is abstracted for centre-pivot irrigation as well as for construction purposes. The valley bottom is somewhat incised, but the disturbed nature of the vegetation (high prevalence of weedy species) points to past disturbance. The southern two valley bottom wetlands are highly incised, presumably due to the impacts of altered landuse within the catchment and the flow concentrating effects of farm road crossings.

The required conveyor to access solution A will require two crossings of the Klipfonteinspruit, as illustrated in Figure 10.

Table 5. Table showing the extent (in hectares) of the wetlands recorded within site A.

Solution A

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	35.49	1.12	--	36.61
Hillslope seepage	179.48	4.21	4.24	187.94
Dam	3.11	--	--	3.11
TOTAL	**214.98**	**5.33**	**4.24**	**227.67**

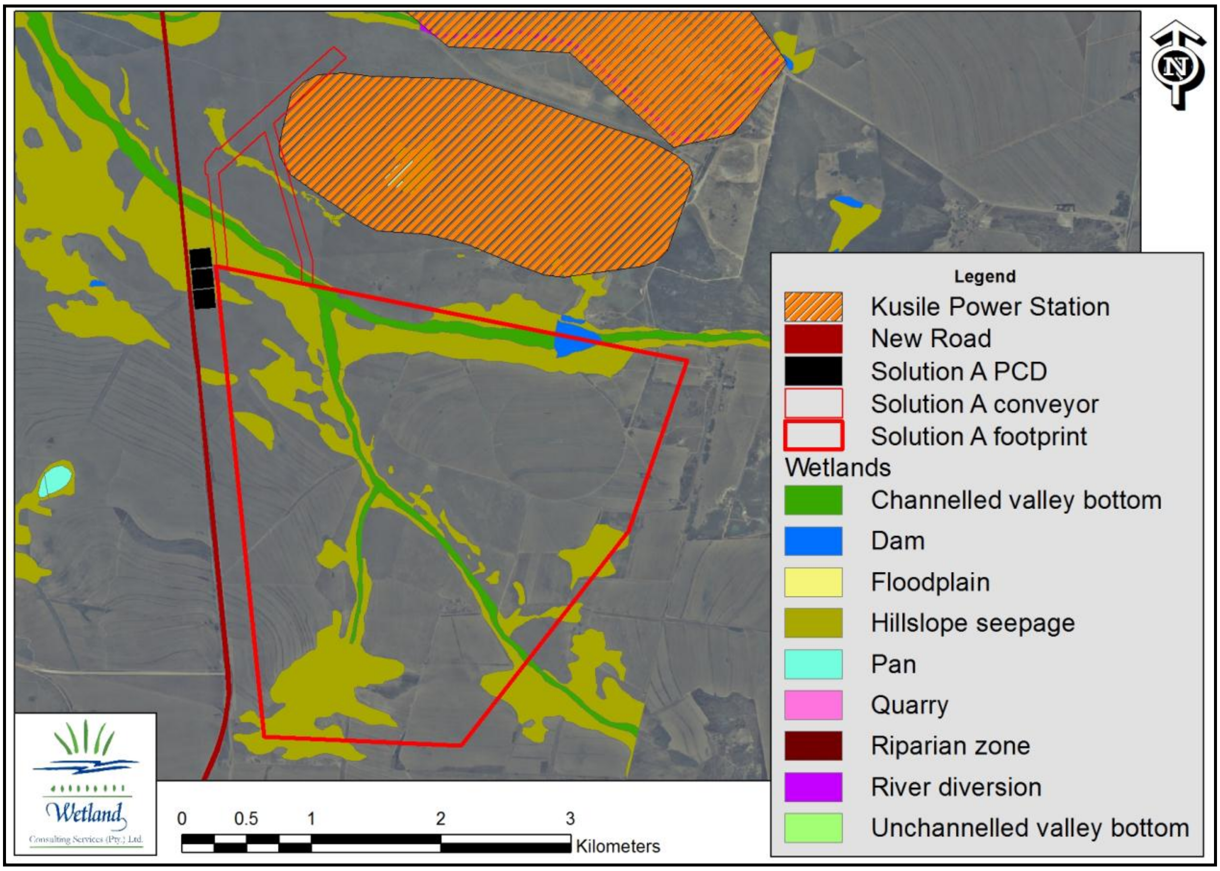


Figure 11. Map of the delineated wetlands within solution A.

6.1.2 Solution B Wetland Delineation

Only 52.7 hectares of wetland were delineated within solution B. This low figure is attributed to the location of the site on a crest within the landscape, and to the presence of deep, well drained soils on site.

Site B is the only site located to the west of the Wilge River, which presents two immediate concerns:

- The conveyor corridor, expected to be a servitude approximately 100m wide, will be required to cross the Wilge River; and
- A number of sub-catchments otherwise unaffected by Kusile or the associated mining activities will be impacted by the ash dam should the ADF be located on site B, considerably increasing the impact footprint.

As indicated, solution B is located on a crest in the landscape and water drains away from the site in all 4 directions. The northern and western reaches drain towards the Bronkhorstspruit (quarternary catchment B20D) while the southern and eastern portions drain towards the Wilge River (quarternary catchment B20F).

Solution B is characterised by extensive agricultural activities, specifically cultivation, with at least 6 centre-pivot irrigation systems on site. The impact of irrigation is evident within the hillslope seepage wetlands draining the site (specifically the wetlands draining east and south) which showed signs of increased and extended soil saturation. Wetland species such as *Typha capensis*, *Schoenoplectus corymbosus* and *Leersia hexandra*, species more commonly associated with permanently saturated valley bottom wetlands were observed within the hillslope seepage wetlands; in some cases immediately adjacent to the cultivated fields.

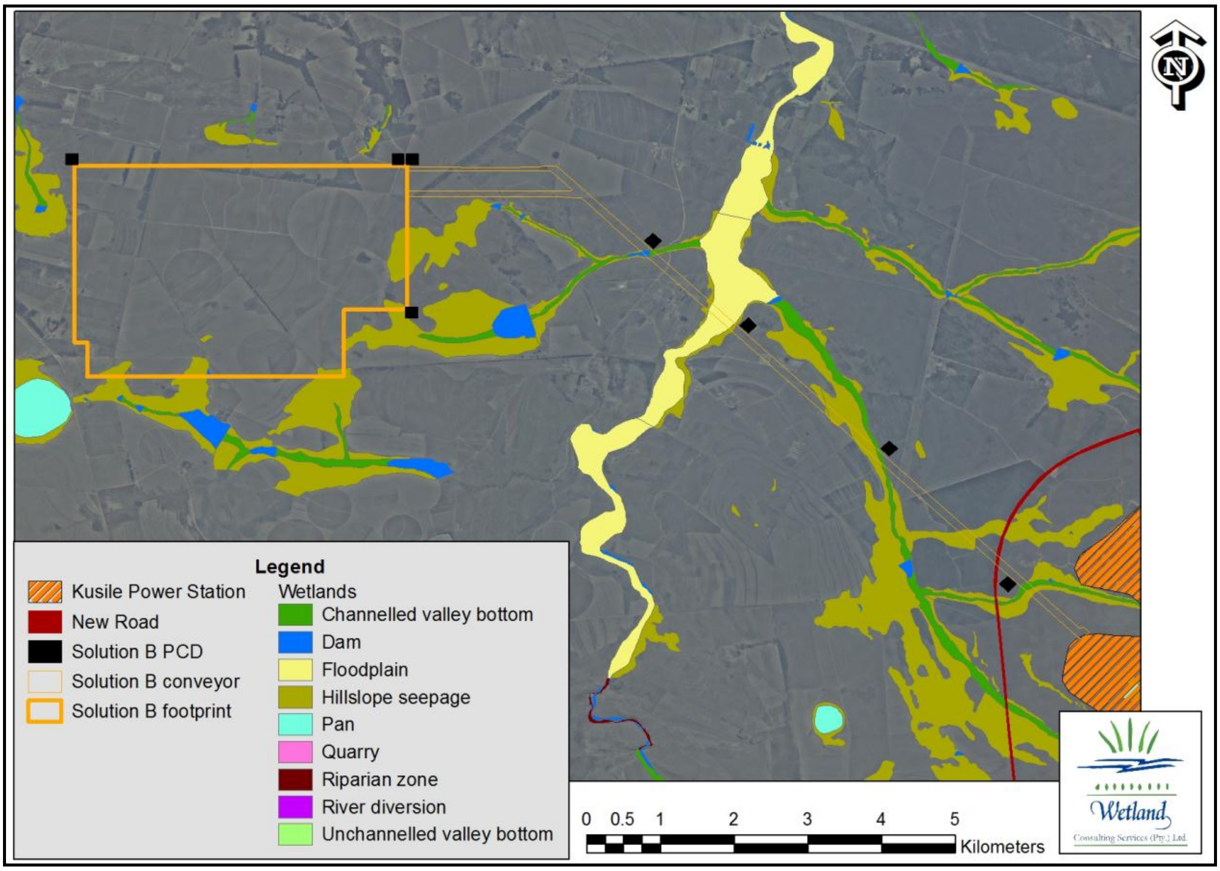


Figure 12. Map of the delineated wetlands within solution B.

A number of springs occur within the hillslope seepage wetlands draining away from solution B, specifically the wetlands draining in a northerly direction. These springs provide an important source of water to agricultural activities in the area. A spring located just outside the study area in the north eastern corner of the site on the farm Jakhalsfontein 328 JR provides the sole source of irrigation and process/packaging water for the Bioselect berry farm, one of the largest berry producers in the country (Andreas Moll, pers. comm., Meeting on 17 October 2013). The quality of the water from the spring was indicated as being such that no treatment of any sort is required prior to the use of the water within the berry packaging facility and for human consumption. Further springs occur within a number of the wetlands on site, while the centre-pivot irrigation systems are also supplied by water from the southerly farm dams, of which a large part of the catchment of these dams falls within the solution B footprint, and not from the Wilge River.

It is clear that the wetlands on and adjacent to the site play a very important role in water provision. The deep, well-drained agricultural soils within the solution B footprint are thought to play a key role in regulating flows to the hillslope seepage wetlands. The sandy soils allow easy infiltration of rain water, while the depth of the soils allows for storage of large volumes of water, much greater volumes than in the shallow soils of the hillslope seepage wetlands themselves. Water is then expected to percolate laterally through the soil profile towards the hillslope seepage wetlands. The flow regulation provided by the terrestrial soils together with the hillslope seepage wetlands is reflected in many of the springs feeding the hillslope seepage wetlands being considered permanent.

A large seasonal pan is also located just outside the solution B boundaries to the south west on the farm Witklip. The pan is a freshwater pan (EC 32 mS/m; TDS 176 mg/L) and still unimpacted by mining activities (SO_4 <5 mg/L). The pan was visited on two occasions, once in December 2012 and once in January 2013. On each visit the importance of the pan as avifauna habitat was immediately apparent with large numbers and diversity of species observed. Two Red Data listed species were seen, namely Greater Flamingo and Black-winged Pratincole.

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

Solution B

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	--	2.36	--	2.36
Floodplain	--	3.80	--	3.80
Hillslope seepage	32.34	12.91	0.29	45.55
Dam	0.44	0.60	--	1.04
TOTAL	**32.34**	**19.07**	**0.29**	**52.74**

The required conveyor will be required to cross the Wilge River, as well as a further 4 wetland systems, including the Klipfonteinspruit.

The proposed conveyor alignment was chosen based mainly on suitable crossing points identified over the Wilge River. A site visit was undertaken on the 13 December 2012 during which a 3km length of the Wilge River within which the conveyor could conceivably be located was walked/driven with the aim of identifying suitable crossing points and no-go areas in terms of infrastructure servitude crossing.

Features identified *that should be avoided* included:

- Any oxbows and cut-off meanders along the floodplain that are still regularly inundated and not significantly degraded;
- Areas of structured channel (e.g. terraces, levees, multiple channels etc.) or strongly meandering channel sections
- Areas in close proximity to the confluence of tributaries with the Wilge River

- Sensitive areas in terms of vegetation (e.g. high numbers of protected species such as *Erythrina zeyheri*, *Crinum bulbispermum* etc.)
- Large footslope seepages feeding onto the floodplain edge
- River sections characterised by a well-developed riparian zone dominated by indigenous species
- Floodplain sections with extensive areas of seasonal to permanent saturation
- The widest portions of the floodplain, i.e. those resulting in the longest crossings, should also be avoided

Potentially suitable crossing points were identified based on the following characteristics:

- Reaches with a single thread channel
- Narrower sections of the floodplain
- Floodplain sections characterised by existing disturbances such as road crossings, drains, excavations
- Floodplain sections not characterised by sensitive vegetation features

Only 2 potential crossing points were identified, as indicated in Figure 11. Both crossings are associated with existing farm road crossings and are located along reaches of the floodplain were the channel consists of a single thread channel and no oxbows or cut-off meanders occur. The southern crossing would at first glance appear to be the more suitable crossing. However, due to engineering constraints and in an attempt to limit the number of transfer stations along the conveyor, the northerly crossing was chosen as the proposed crossing point.

Both proposed crossing alternatives will however require crossing of footslope seepage wetlands and the engineering designs for the crossings will need to accommodate this seepage and aim to allow flows to continue to pass under the infrastructure servitude. Both crossings will also impact on habitat supporting protected species (including *Crinum bulbispermum, C. graminicola, Gladiolus* sp., and *Erythrina zeyheri*).

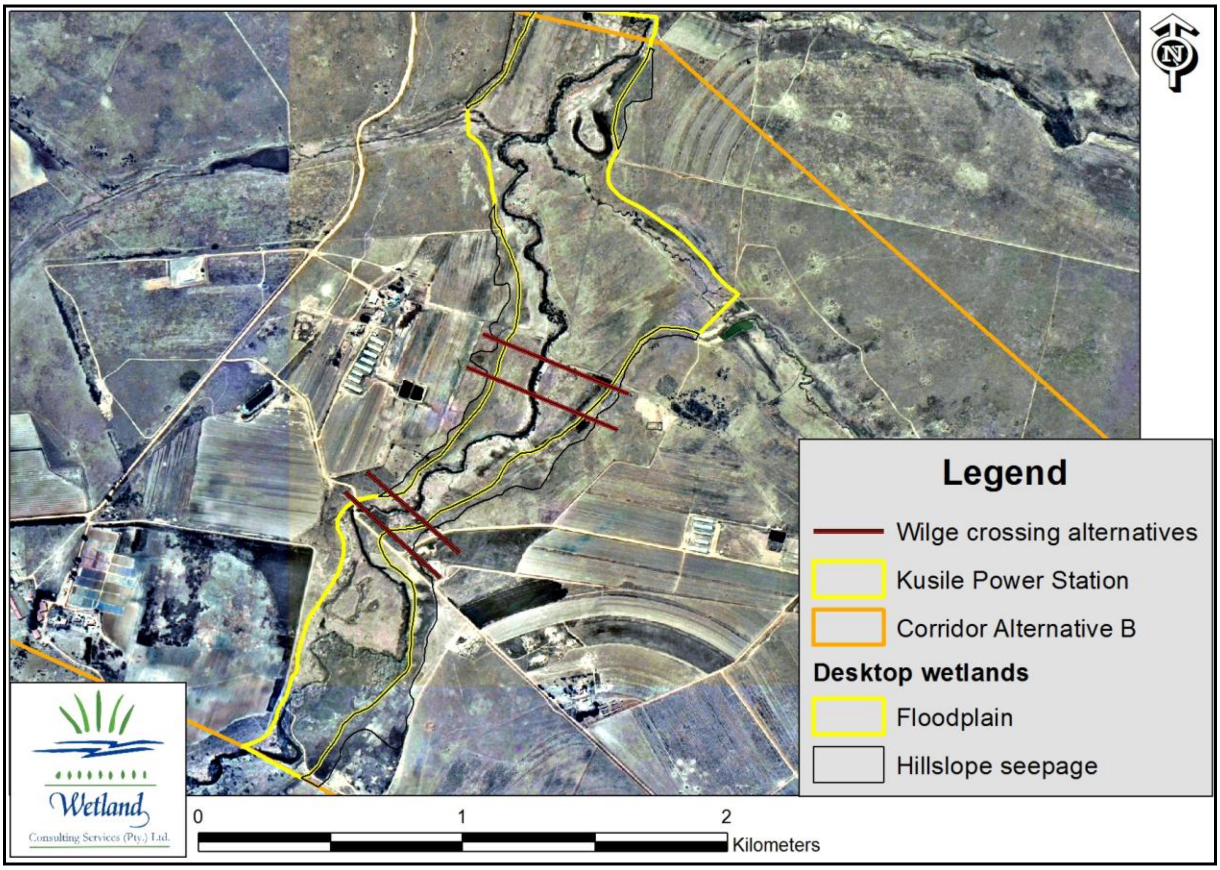


Figure 13. Map showing the two identified potential crossing points.

6.1.3 Solution C Wetland Delineation

Approximately 125.34 ha of wetlands were delineated within solution C.

The western end of solution C is located in close proximity to the Wilge River floodplain – at its closest point the indicated site boundary lies only 50m from the edge of the Wilge floodplain. However, it is understood that the rail link to Kusile passes through in this vicinity and that the site C footprint would need to be withdrawn further eastwards to allow space for the rail link. The actual distance to the Wilge floodplain is thus likely to be greater.

To the south of site C an unnamed tributary to the Wilge runs parallel but just outside the site boundary. 3 Blue Cranes, listed as *Vulnerable* on the Red Data List, were observed within this area, and conversations with the local landowner (Wessel Badenhorst, *pers. comm*.) indicate that this valley bottom wetland represents a breeding site for the Blue Cranes. Secretarybird, also listed on the Red Data List (*Vulnerable*), were also observed on this site.

A further tributary of this stream originates within site C. This wetland was highlighted within the NFEPA database as an important wetland cluster ***and has been earmarked for rehabilitation, with an initial rehabilitation report and costing compiled by Working for Wetlands***.

A number of further hillslope seepage wetlands that form the headwaters of small drainage lines occur within site C. One of these drains in a northerly direction under the N4. Most of these seepage wetlands have been impacted by past cultivation and, though now characterised by secondary grassland, still show signs of contour lines as well as erosion scars that are expected to have formed as a consequence of cultivation.

Solution C will require a borrow pit to provide clay material for the required lining system. This borrow pit will be located as indicated in Figure 12 below. Although no wetlands fall within the borrow pit boundaries, the borrow pit will be located immediately adjacent to the wetland areas and remove the deep soils upslope of the wetland that likely play an important role in maintaining the wetlands through the temporary storage of water.

The required conveyor will cross two hillslope seepage wetland systems.

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

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	7.95	--	0.55	8.50
Hillslope seepage	105.43	7.73	2.07	115.23
Dam	1.61	--	--	1.61
TOTAL	**113.38**	**7.73**	**2.61**	**125.34**

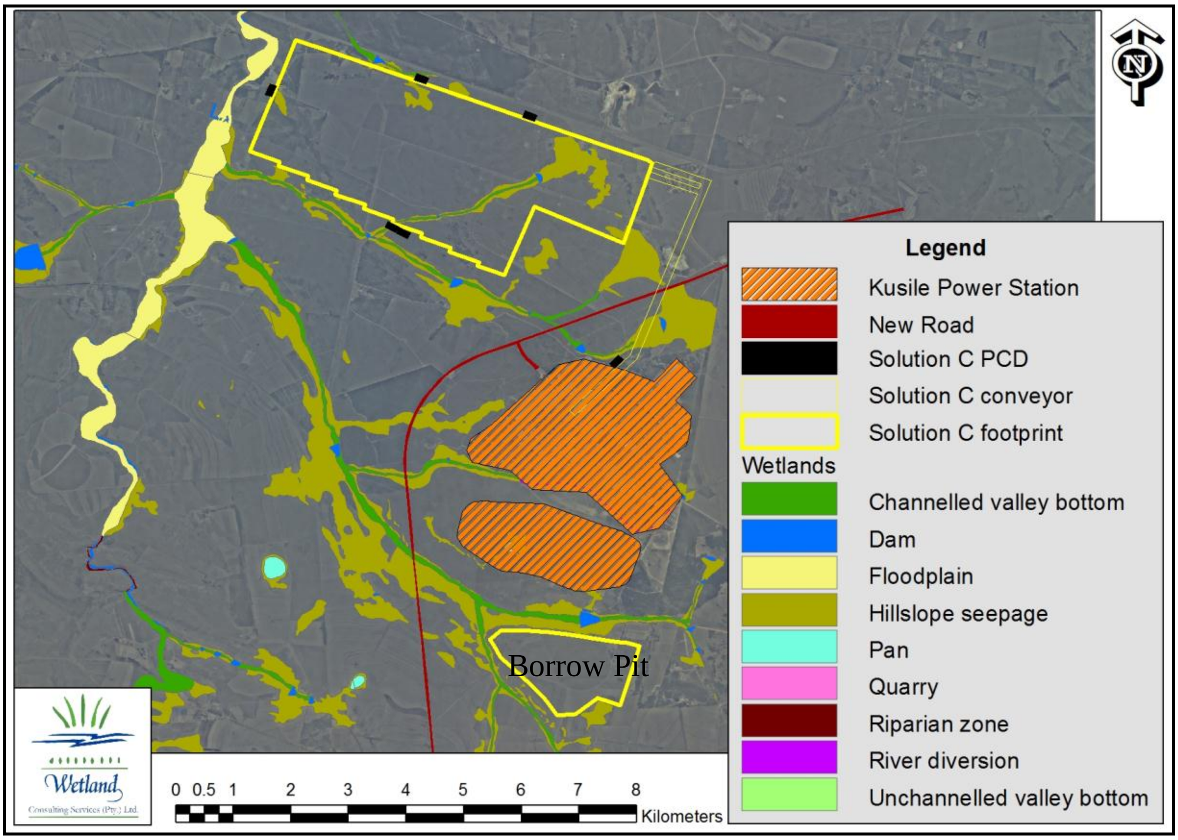


Figure 14. Map of the delineated wetlands within site C.

6.1.4 Solution FA Wetland Delineation

Solution FA represents a combination of sites F and “small A”, as indicated in Figure 13 below. Approximately 210.93 hectares of wetland were identified within solution FA (made up of site F and “small A”.

Within site F (north western area) a large pan, considered to be seasonal in nature (i.e. the pan is expected to dry up during some years, but can hold water throughout the winter during wet years) is located within the central portions of site F. A water quality sample collected from the pan indicates a somewhat saline system, with recorded EC and TDS values of 159 mS/m and 974 mg/L respectively. Saline pans typically play an important role in providing habitat for the Red Data listed flamingo species, and over 80 flamingos, both Greater and Lesser Flamingos, were recorded within the pan in both December 2012 and January 2013, indicating that the birds are likely to make regular use of the habitat provided. The pan perimeter, characterised by a hillslope seepage wetland, has been somewhat disturbed by the dumping of rocks and heavy grazing pressure.

Extensive hillslope seepage wetlands were also delineated on site, with most of these associated with the Klipfonteinspruit that flows past to the east of the site. Many of these wetlands have been cultivated in the past and are now characterised by secondary vegetation, with typical wetland indicator species being *Andropogon eucomis*, *Imperata cylindrica* and *Cyperus denudatus*.

The longitudinal axis of the proposed site F is aligned from north to south, parallel to the Wilge River, which is located in close proximity to the site boundary. The north western corner is less than 160 m from the edge of the Wilge floodplain, while the south western corner is less than 150 m from the Wilge valley bottom wetland.

The wetlands falling within “small A” consists of two tributaries of the Klipfonteinspruit; the western one known as the Holfonteinspruit and the eastern one being unnamed. Both these tributaries are also associated with extensive seepage wetlands. These wetlands were described under section 6.1.1 above.

3 crossings of the conveyor over the Klipfonteinspruit would be required as part of this solution.

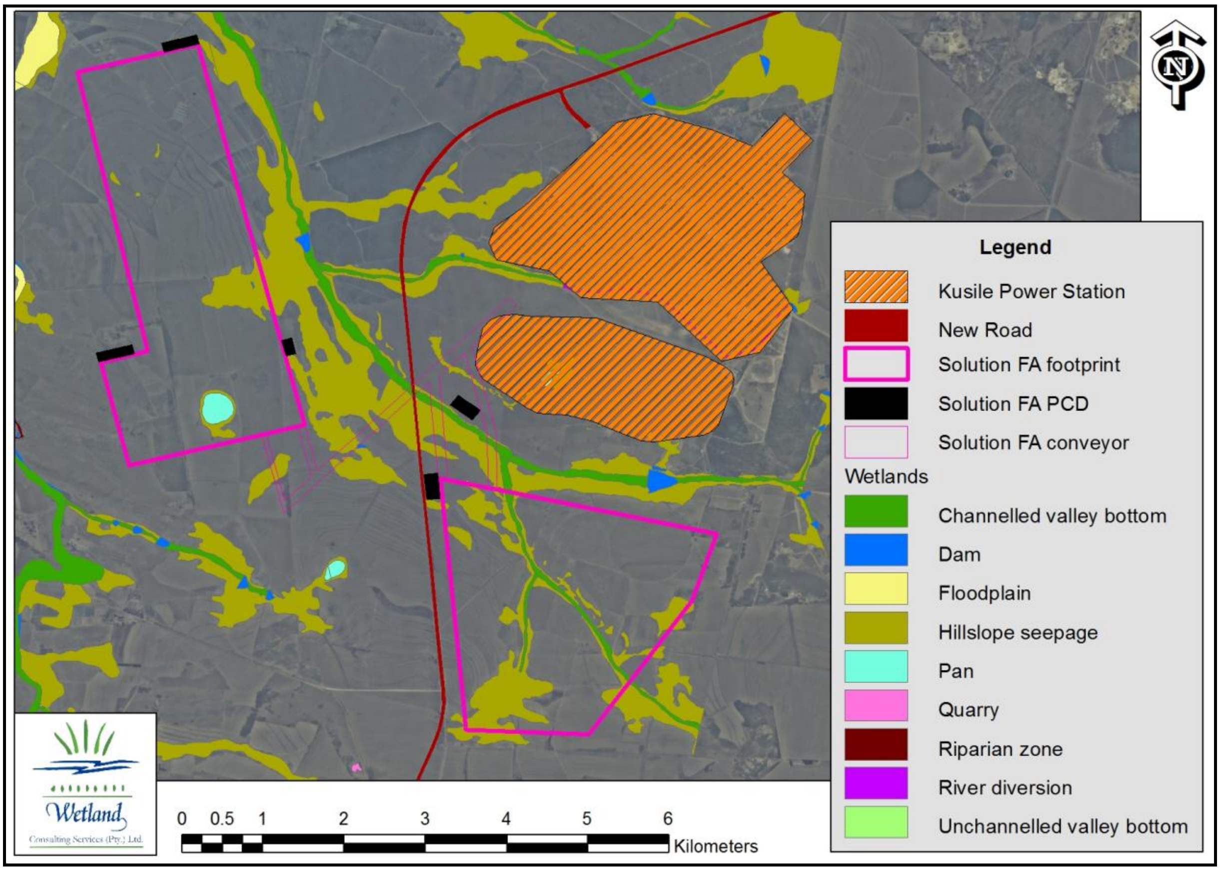


Figure 15. Map of the delineated wetlands within solution FA.

Table 8. Table showing the extent (in hectares) of the wetlands recorded within solution FA.

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	16.57	3.07	--	19.64
Pan	10.57	--	--	10.57
Hillslope seepage	158.82	21.23	0.44	180.49
Dam	0.16	0.06	--	0.22
TOTAL	**185.97**	**24.30**	**0.44**	**210.93**

6.1.5 Solution GA Wetland Delineation

Solution GA represents a combination of sites G and “small A”, as indicated Figure 14 below.

197.56 hectares of wetland were delineated within solution GA.

Within the western section of solution GA the main wetland on site consists of a hillslope seepage wetland and associated valley bottom wetland that drains west into the Wilge River. Past cultivation has also impacted significantly on the vegetation composition of the wetland, with the 1:50 000 topographical maps indicating that cultivation used to extend right across the wetland. The extreme upper reach of the wetland also shows signs of very heavy grazing.

The southern corner of the site boundaries also extends across a valley bottom wetland draining into the Wilge River. However, the actual ash dam footprint within site G is likely to exclude this drainage line. A further three hillslope seepage wetlands extend into the site boundaries while the Wilge River valley bottom is located just to the west and, at its closest point, less than 600 m from the indicated site boundary.

The wetlands falling within "small A" consists of two tributaries of the Klipfonteinspruit; the western one known as the Holfonteinspruit and the eastern one being unnamed. Both these tributaries are also associated with extensive seepage wetlands. The wetlands falling within "small A" were described under section 6.1.1 above. Once again, 3 crossings of the conveyor over the Klipfonteinspruit would be required as part of this solution.

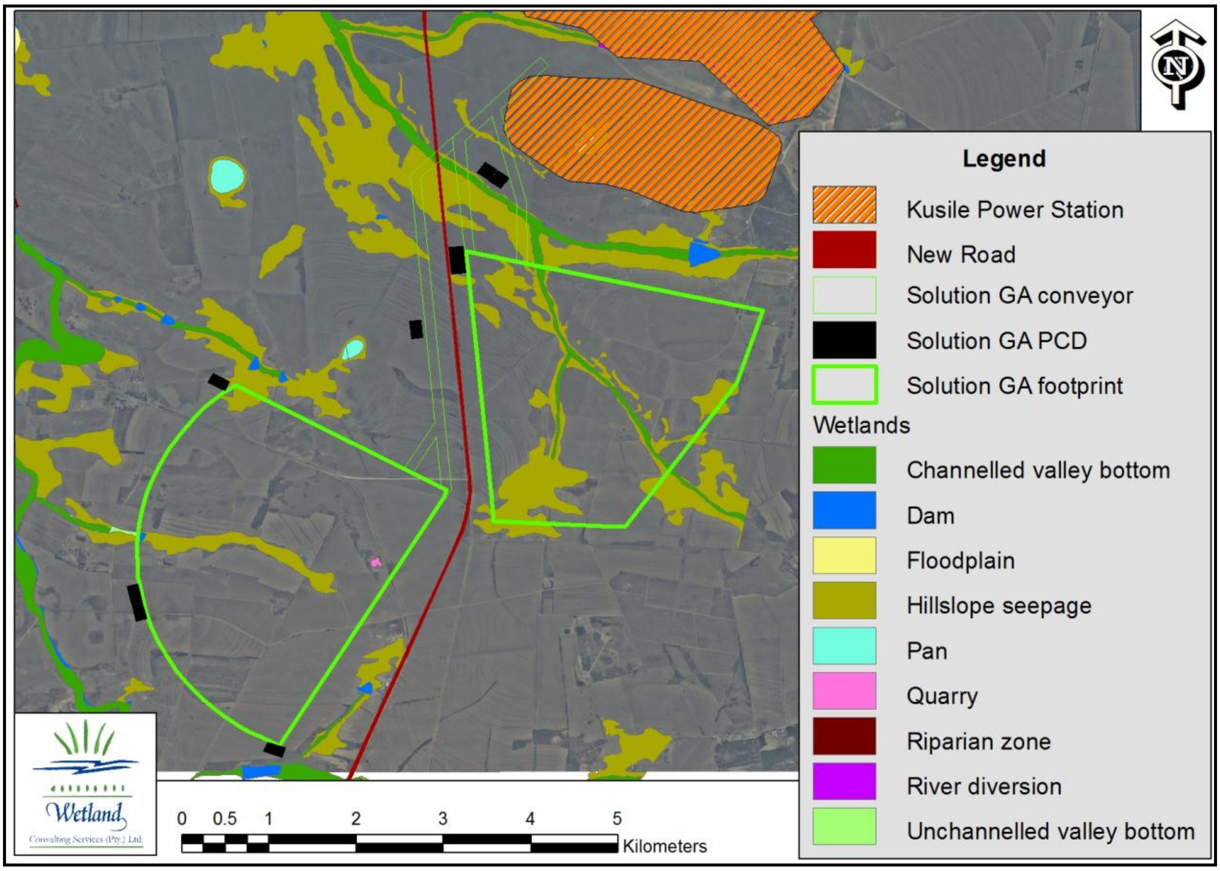


Figure 16. Map of the delineated wetlands within solution GA.

Table 9. Table showing the extent (in hectares) of the wetlands recorded within Solution GA.

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	16.57	2.53	--	19.10

Unchannelled valley bottom	0.10	--	--	0.10
Hillslope seepage	158.11	19.10	0.49	177.70
Dam	0.67	--	--	0.67
TOTAL	**174.77**	**21.63**	**0.49**	**197.56**

6.1.6 Solution GF Wetland Delineation

Solution GF represents a combination of sites G and F, as indicated Figure 15 below.

104.86 hectares of wetland were delineated within solution GF.

The wetlands falling within solution GF were briefly described in Sections 6.1.4 and 6.1.5 above.

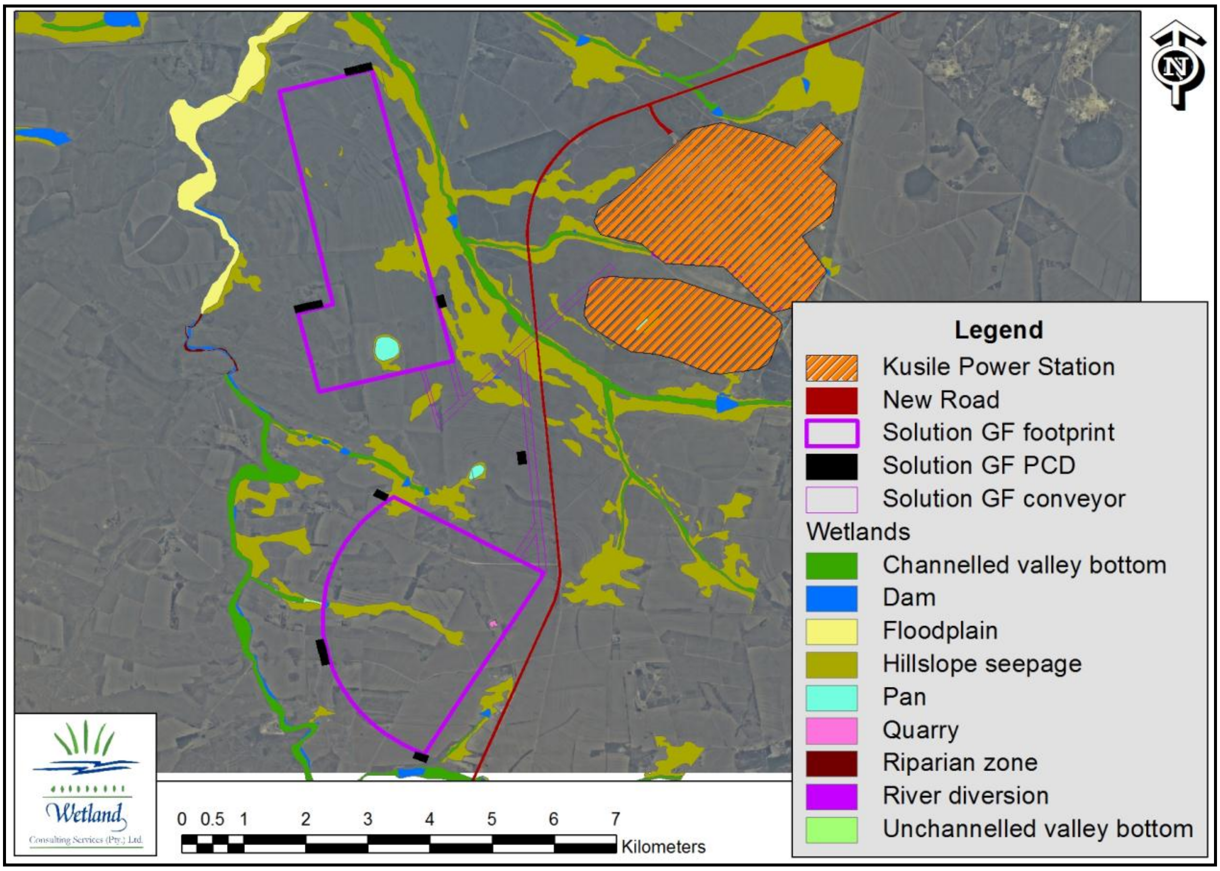


Figure 17. Map of the delineated wetlands within solution GF.

Table 10. Table showing the extent (in hectares) of the wetlands recorded within Solution GF.

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	--	1.27	--	1.27

Unchannelled valley bottom	0.10	--	--	0.10
Pan	10.57	--	--	10.57
Hillslope seepage	77.84	13.30	0.89	92.03
Dam	0.83	0.06	--	0.90
TOTAL	**88.51**	**14.57**	**0.89**	**104.86**

6.1.7 Summary of proposed alternatives

From the sites investigated and briefly described above, six alternatives are being assessed for the proposed 60-year ash dam. The table below indicates the wetland types and extent (in hectares) of wetlands recorded within each of the proposed alternatives.

In decreasing order of wetland extent (highest to lowest), the six alternatives rank as follows:

- Site A
- Site FA
- Site GA
- Site C
- Site FG
- Site B

Table 11. Table summarising the wetland types and extent recorded in each of the six proposed alternative solutions. Figures include all wetlands to be directly impacted by the proposed ash dam, its associated conveyor, and PCD's.

Footprint	Channelled valley bottom	Unchannelled valley bottom	Floodplain	Pan	Hillslope seepage	Dam	TOTAL WETLAND EXTENT IN FOOTPRINT
A	36.61				187.94	3.11	227.67
B	2.36		3.80		45.55	1.04	52.74
C	8.50				115.23	1.61	125.34
GA	19.10	0.10			177.70	0.67	197.56
FA	19.64			10.57	180.49	0.22	210.93
FG	1.27	0.10		10.57	92.03	0.90	104.86

Table 12. Table summarising the wetland extent for each of the six proposed alternative solutions in terms of ash dam footprint, conveyor footprint and PCD footprint. Solution B, which has the lowest overall wetland extent, is highlighted in yellow.

	Solution A	Solution B	Solution C	Solution GA	Solution FA	Solution FG
Ash Dam Footprint	214.98	32.78	114.99	175.45	186.13	89.34
Conveyor Route	5.33	19.67	7.73	21.63	24.36	14.63
Pollution Control Dams	4.24	0.29	2.61	0.49	0.44	0.89
TOTAL	**227.67**	**52.74**	**125.33**	**197.57**	**210.93**	**104.86**

As the expected impact of the proposed ash dam on wetlands is not expected to be restricted only to the wetlands, the wetlands within the immediate vicinity of the ash dams were also considered. In this regard a buffer of 500m was utilised due to its applicability to Section 21 C and I water uses. Solution C has the highest wetland extent within its direct vicinity, while solution A has the least.

Table 13. Table indicating the wetland extent (in hectares) located within 500m of the proposed alternative solutions. Highest values are highlighted in red, and lowest values in green.

	AFD Footprint			Conveyor Footprint			Combined Footprint		
Footprint	TOTAL IN FOOTPRINT	Within 500m of footprint	Combined	TOTAL IN FOOTPRINT	Within 500m of footprint	Combined	TOTAL IN FOOTPRINT	Within 500m of footprint	Combined
A	214.98	126.35	341.33	5.33	95.36	100.69	220.31	221.71	442.02
B	32.34	189.6	221.94	19.07	229.87	248.94	51.41	419.47	470.88
C	113.38	321.46	434.84	7.73	75.46	83.19	121.11	396.92	518.03
GA	174.77	218.2	392.97	21.63	150.06	171.69	196.4	368.26	564.66
FA	185.97	284.74	470.71	24.3	190.87	215.17	210.27	475.61	685.88
FG	88.51	246.23	334.74	14.57	137.3	151.87	103.08	383.53	486.61

6.2 Fauna & Flora

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

A total of 104 plant species were recorded within the wetlands of the study area. This list is by no means considered complete and is included purely to provide an indication of the most common and dominant species within the wetlands. The list is provided in Table 13. 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 also 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.

Extensive areas of hillslope seepage wetland have been impacted by historical cultivation and are characterised by relatively species poor secondary grassland under current conditions. Species such as *Agrostis lachnantha, Andropogon eucomis, Cynodon dactylon, Cyperus denudatus, Eragrostis curvula, Hyparrhenia hirta, Kyllinga erecta, Paspalum dilatatum, Stoebe vulgaris* and *Verbena bonariensis* typified these areas.

Table 14. List of plant species recorded within the wetlands on site.

Species Name	Site A Hillsope seepages	Site A Valley bottoms	Site B Hillsope seepages	Site C Valley bottoms	Site C Hillsope seepages	Site F Hillsope seepages	Site F Pan	Site G Hillsope seepages
Acacia mearnsii			1					
Agrostis lachnantha	1	1	1	1	1	1		1
Agrostis montevidensis	1		1		1			1
Andropogon eucomis					1	1		
Andropogon huillensis			1					
Aristida congesta	1							
Aristida junciformis			1	1	1			
Arundinella nepalensis				1				
Asclepias fruticosa					1			1
Berkheya radula	1	1						1
Bidens formosa		1	1					
Bidens pilosa		1	1					
Bothriochloa insculpta	1		1					
Brachiara brizantha						1		
Bulbostylus sp.	1							
Campuloclinum macrocephalum	1		1		1			
Carex glomerabilis			1					
Carex sp.			1					
Carpha sp.			1					
Centella asiatica	1	1	1	1		1		
Chamaecrist mimosoides			1					
Chironia purpurascens	1							1
Cirsium vulgare		1		1	1			1
Conyza albida		1	1					
Crinum bulbispermum								
Crinum graminicola								
Cymbopogon excavatus				1				
Cynodon dactylon	1		1		1		1	1
Cypers digitatus				1				
Cyperus denudatus	1		1		1	1		
Cyperus esculentus	1		1			1		
Cyperus fastigiatus				1				
Cyperus sp.	1	1	1					
Disa woodii			1					
Echinochloa holubii							1	
Eleocharis dregeana			1					
Eragrostis capensis	1				1			
Eragrostis chloromelas					1			
Eragrostis curvula	1	1	1	1				
Eragrostis gummiflua	1				1	1		
Eragrostis plana	1	1	1	1	1	1		1
Erica alopecurus			1	1				
Erythrina zeyheri								
Euphorbia striata				1				1
Fimbrostylis complanata	1		1	1	1	1		
Fuirena pubescens	1	1	1		1			
Galdiolus crassifolius								
Gerbera ambigua			1					
Gladiolus eliottii					1			
Haplocarpha lyrata					1			
Harphochloa falx	1		1					
Helichrysum aureonitens	1		1	1	1	1		1
Helicototrichon turgidulum								1
Hemarthria altissima	1	1		1				
Hermannia transvaalensis								1
Hyparrhenia hirta	1			1	1			

Hyparrhenia tamba		1	1	1				1
Hypoxis hemerocallidea					1			
Imperata cylindrica	1	1	1	1	1	1		1
Isolepis sp.			1					
Juncus dregeana	1							1
Juncus effusus	1	1	1		1	1		1
Juncus lomatphyllus			1					
Juncus oxycarpus			1	1	1			1
Kyllinga alba			1					
Kyllinga erecta	1		1	1	1	1	1	1
Ledebouria sp.		1		1				
Leersia hexandra		1	1					1
Monopsis decipiens			1	1	1	1		1
Nidorella anomala	1			1	1			
Oenothera rosea	1	1		1				1
Oxalis depressa			1	1				1
Panicum repens							1	
Paspalum dilatatum			1	1	1	1		1
Paspalum distichum			1					1
Paspalum urvillei	1	1	1	1		1		
Pennisetum sphacelatum	1							
Phragmites australis				1				
Polygala hottentotta				1				
Potamogeton sp.								1
Pseudognaphalium luteo album	1			1		1		1
Pycreus macranthus	1		1			1		1
Pycreus nitidus			1					
Ranunculus multifidus		1						1
Schizachyrium sanguineum				1	1			
Schoenoplectus corymbosus		1	1	1				1
Schoenoplectus decipiens							1	
Scirpoides burkei	1			1				
Senecio inornatus					1			
Senecio sp.				1				
Setaria pallide-fusca		1			1			
Setaria sphacelata	1			1				1
Sium repandum				1				
Sonchus willmsii	1							
Sporobolus africanus					1			1
Stoebe vulgaris	1		1	1	1	1		1
Tagetes minuta	1		1					
Themeda triandra		1	1	1	1			1
Tristachya leucothrix			1					
Typha capensis	1	1	1					1
Verbena bonariensis	1	1	1	1	1	1		1
Wahlenbergia calendonica	1		1					1
Xyris capensis	1		1					
Zea mays			1					
TOTAL	**42**	**25**	**55**	**39**	**34**	**20**	**5**	**36**

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

- *Crinum bulbispermum*
- *Crinum graminicola*
- *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. Of special concern are the species *Campuloclinium macrocephalum* (Pompom weed), which occurs in small, scattered stands throughout the study area, and the grey popular, *Populus canescens*, which occurs in small, dense stands within various wetlands within the area.

Pompom weed is a serious threat to grassland and wetlands (SANBI, http://www.sanbi.org/information/infobases/invasive-alien-plant-alert/campuloclinium-macrocephalum-pom-pom-weed) and spreads rapidly through wind dispersal of its fluffy seeds. Given the difficulty in controlling the weed, it is recommended that a management plan for the pompom weed be compiled and implemented as soon as possible. Once widespread and established, the weed will be extremely difficult to control and eradicate.

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.

Numerous Red Data listed bird species were encountered, namely:

- **Blue Crane** – was observed within site C, and also within the vicinity of sites F and G (Albert Froneman, *pers. comm*.). Based on communication with the local landowner (Wessel Badenhorst, *pers. comm*.), the Blue Cranes appear to have successfully bred within the valley bottom wetland immediately to the south of site C in the past.
- **Greater Flamingo** – was observed at the pan within site F and the pan adjacent to site B. They are expected to frequently utilise these pans.
- **Black-winged Pratincole** – was observed in large numbers at the pan adjacent to site B and over the planted pastures surrounding site B.
- **Secretarybird** – was observed to the south of site C and is believed to breed in the vicinity (Wessel Badenhorst, *pers. comm*.).

In addition, the Lesser Flamingo is known to occur on site (Norma Sharratt, *pers. comm*.) while the African Grass Owl is expected to occur in numerous of the wetland habitats on site. Although no African Grass Owl was observed on site, the suitability of the habitat available would suggest they do occur.

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.

The Mpumalanga Biodiversity Conservation Handbook (Ferrar & Lotter, 2007) emphasises the importance of wetlands in terms of biodiversity and water conservation and highlight them as South Africa's most important ecosystems. The following functions are highlighted:

- Their role as water management and storage areas;
- Maintenance of water quality through their role in filtration and purification of water;
- Flow regulation, including flood attenuation and the delayed release of water;
- Biodiversity support; and
- Direct human benefits such as grazing, food, medicinal plants, recreation etc.

6.3.1 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 (McCartney, 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.

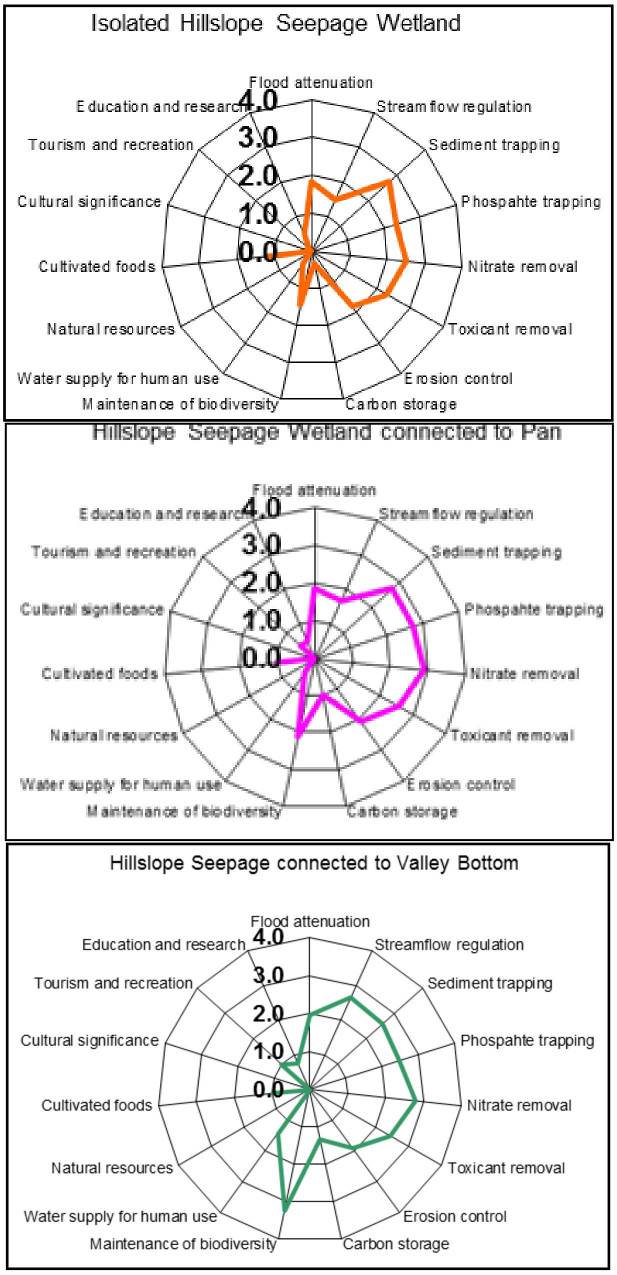


Figure 18. Radial plots showing the results of the WET-EcoServices assessment.

6.3.2 Valley bottom wetlands

The linear nature of valley bottom wetlands within the landscape and their connectivity to the larger 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. Although modified in certain respects, the wetlands still provides a natural refuge for biodiversity, and within the study area and surroundings, the large 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 are significantly eroded (e.g. the Holfonteinspruit within site A, a tributary to the Klipfonteinspruit), presumably as a result of changes in landuse (conversion to cultivated fields) and altered hydrology due to farm road crossings and dams. The Klipfonteinspruit is also currently considered a significant erosion risk due to the increased flows this system is receiving via stormwater from the Kusile construction site. At the same time however, the wetland is currently likely playing an important role in sediment trapping as runoff from the Kusile construction site is extremely sediment rich. However, as flows become more channel bound through further 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 – the temporary storage of flood waters within the wetland.

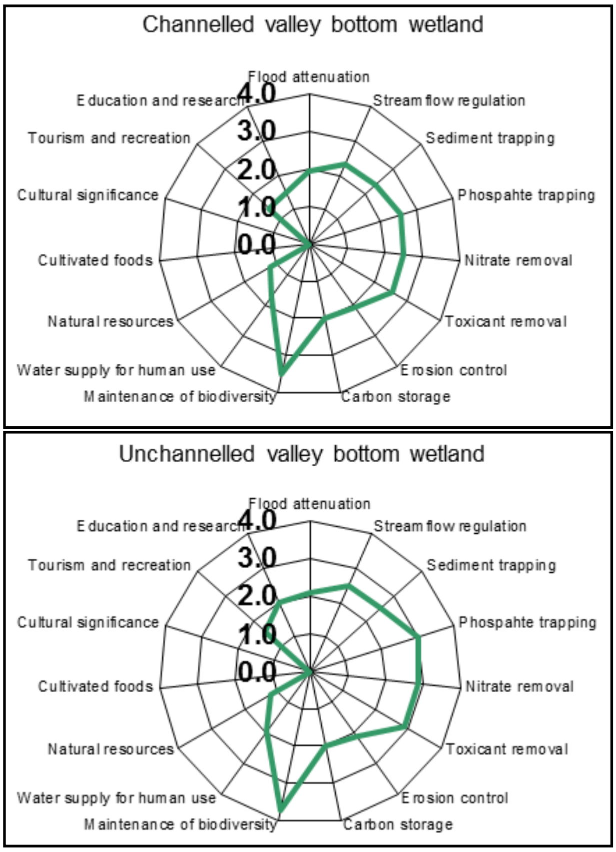
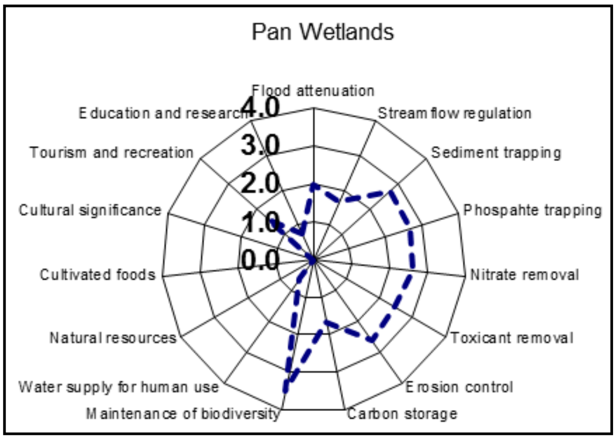


Figure 19. Radial plots showing the results of the WET-EcoServices assessment.

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.

An important function usually performed by pans is the support of faunal and floral biodiversity, which is enhanced by the diversity in habitat types offered by different pans. Within the study area however, the small size of most of the pans, together with their seasonal nature and the disturbed vegetation, the biodiversity support of these pans individually is expected to be limited. All of the pans are seasonal systems, though the differences in pan basin size and depth, as well as catchment size and catchment soil characteristics results in pans that fill up and drain at different rates and times. As a consequence a great diversity of habitat is provided by the pans on site and in the surrounding area, and though they are all seasonal systems, the differing hydroperiods result in the fact that at least some of the pans are likely to have water at any one time.



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.

Solution A: These wetlands have been mostly impacted by agricultural activities, most notably cultivation within and adjacent to the wetland areas. Significant channel erosion incision has occurred within some of the valley bottom wetlands (e.g. the Holfonteinspruit), while abstraction for centre-pivot irrigation as well as construction purposes occurs from the upper reaches of the Klipfonteinspruit. Livestock grazing occurs within the wetlands as well.

Solution B: Site B wetlands have been impacted by cultivation and centre-pivot irrigation. 6 centre-pivots are located within the study area boundaries and virtually all of the wetlands show signs of increased wetness due to irrigation. Numerous farm dams are located within the wetlands and in many cases trenches have been excavated to channel flows into these dams. A number of the wetlands have also been previously cultivated. Livestock grazing appears to be less severe in these wetlands.

Solution C: Heavy livestock grazing appears to be a significant impact in the wetlands of site C. Cultivation within and adjacent to the wetland areas is not as significant an impact as in the other sites, though historical cultivation within the wetlands was also extensive. The valley bottom wetland immediately to the south of site C has been heavily impacted by stormwater runoff from Kusile that has increased erosion and turbidity. A number of breached farm dams were also observed.

<u>Solution FA:</u> Past cultivation has impacted significantly on some of the hillslope seepage wetlands within site F, while cultivation also still takes place within one of the delineated wetlands. Poor grazing management practices as evidenced in the increase in species such as *Stoebe vulgaris* were also observed on site. Stones presumably removed from agricultural fields have been dumped around the pan perimeter.

<u>Solution GA:</u> Agricultural activities have also been the overriding impact on the wetlands at site G. Extensive historical cultivation within the wetlands has altered species composition and structure and resulted in erosion. Current heavy grazing by livestock in especially the upper reach of the main wetland area pose an erosion risk.

<u>Solution GF:</u> Sites F and G have been heavily impacted by agricultural impacts, both cultivation immediately adjacent to wetlands and within their temporary zones, as well as heavy livestock grazing within the remaining wetland areas.

Table 15. Summary of the PES assessments undertaken for the wetlands within the various alternatives.

PES category	SOLUTIONS						
	A	B	C	FA	GA	FG	TOTAL
A	1.68	0.00	0.00	2.47	2.47	0.88	6.63
A/B	9.85	0.00	0.00	9.85	9.85	0.00	29.56
B	6.37	14.89	22.69	6.21	16.78	10.57	66.93
C	173.31	18.43	43.04	152.30	153.34	90.31	540.41
D	33.34	17.57	58.00	26.05	27.71	1.66	162.68
E	0.00	0.82	0.00	0.00	0.00	0.00	0.82
TOTAL	**224.55**	**51.70**	**123.73**	**196.89**	**210.16**	**103.42**	**807.03**

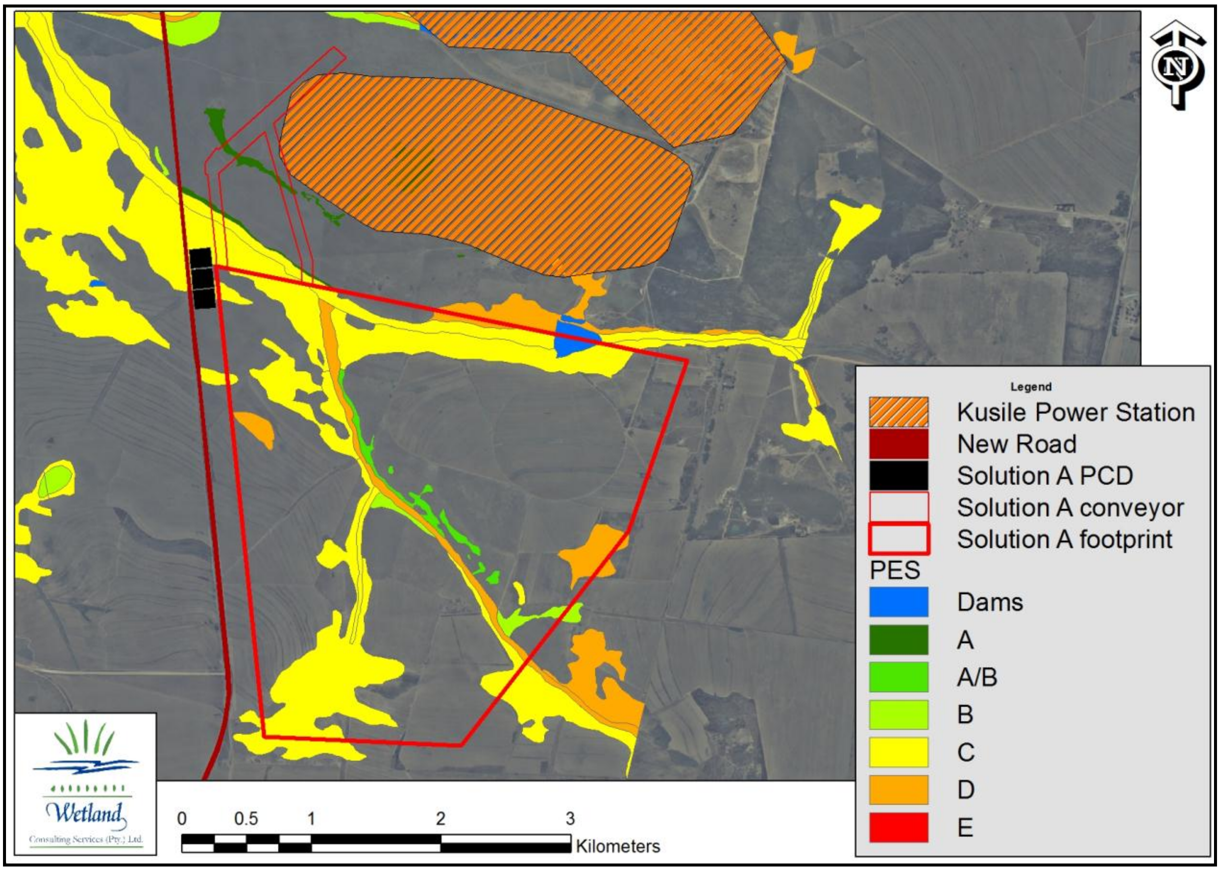


Figure 20. Map of PES results for solution A.

Table 16. Summarised PES results for solution A.

Wetland Type	A	A/B	B	C	D	TOTAL
Channelled valley bottom	-	-	-	20.31	16.30	36.61
Hillslope seepage	1.68	9.85	6.37	153.00	17.04	187.94
TOTAL	**1.68**	**9.85**	**6.37**	**173.31**	**33.34**	**224.55**
% of total wetlands on site	0.75%	4.39%	2.84%	77.18%	14.85%	100.00%

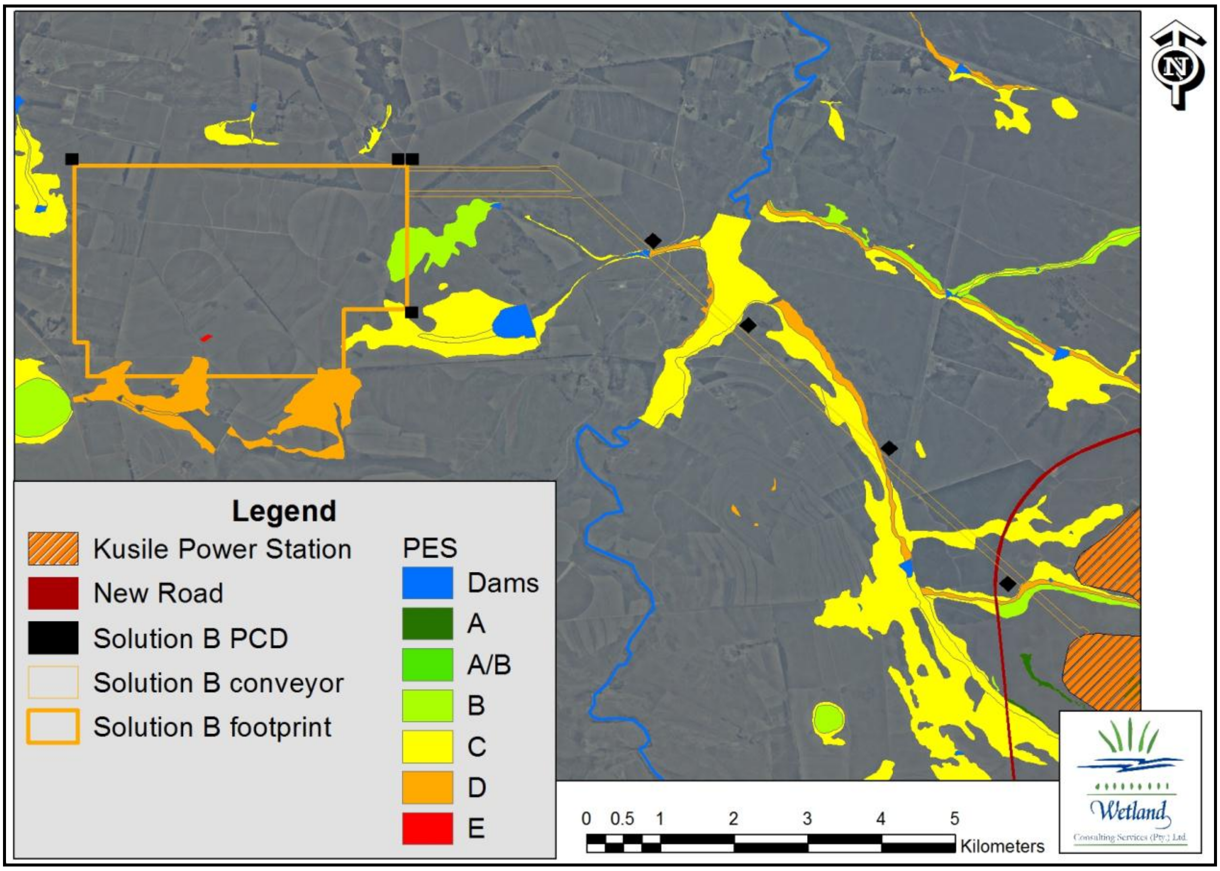


Figure 21. Map of PES results for solution B.

Table 17. Summarised PES results for solution B.

Wetland Type	B	C	D	E	TOTAL
Channelled valley bottom	-	-	2.36	-	2.36
Floodplain	-	3.80	-	-	3.80
Hillslope seepage	14.89	14.63	15.21	0.82	45.55
TOTAL	**14.89**	**18.43**	**17.57**	**0.82**	**51.70**
% of total wetlands on site	28.79%	35.64%	33.98%	1.59%	100.00%

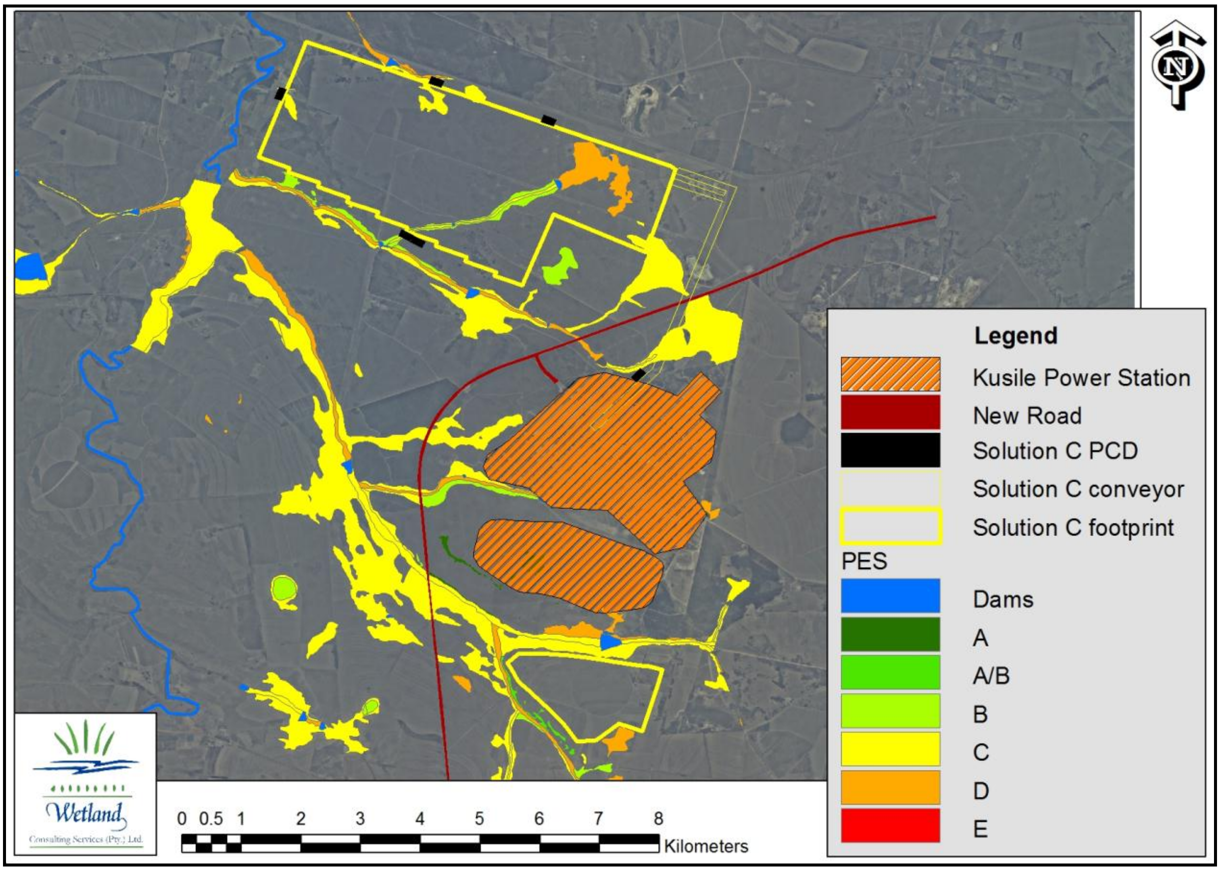


Figure 22. Map of PES results for solution C.

Table 18. Summarised PES results for solution C.

Wetland Type	B	C	D	TOTAL
Channelled valley bottom	-	8.41	0.09	8.50
Hillslope seepage	22.69	34.63	57.91	115.23
TOTAL	**22.69**	**43.04**	**58.00**	**123.73**
% of total wetlands on site	18.34%	34.78%	46.88%	100.00%

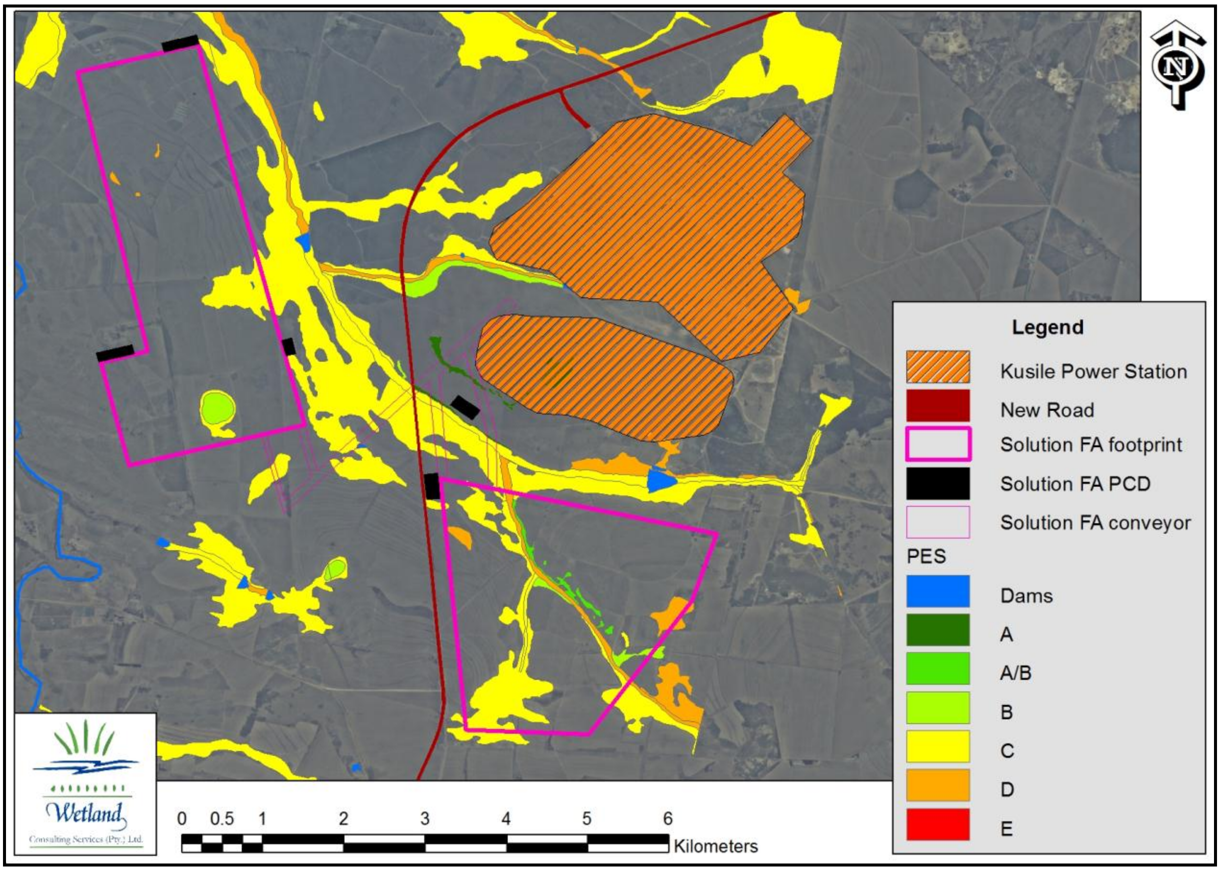


Figure 23. Map of PES results for solution FA.

Table 19. Summarised PES results for solution FA.

Wetland Type	A	A/B	B	C	D	TOTAL
Channelled valley bottom	-	-	-	6.42	12.67	19.10
Pan	-	-	10.57	-	-	10.57
Hillslope seepage	2.47	9.85	6.21	146.91	15.04	180.49
TOTAL	**2.47**	**9.85**	**16.78**	**153.34**	**27.71**	**210.16**
% of total wetlands on site	1.18%	4.69%	7.98%	72.96%	13.19%	100.00%

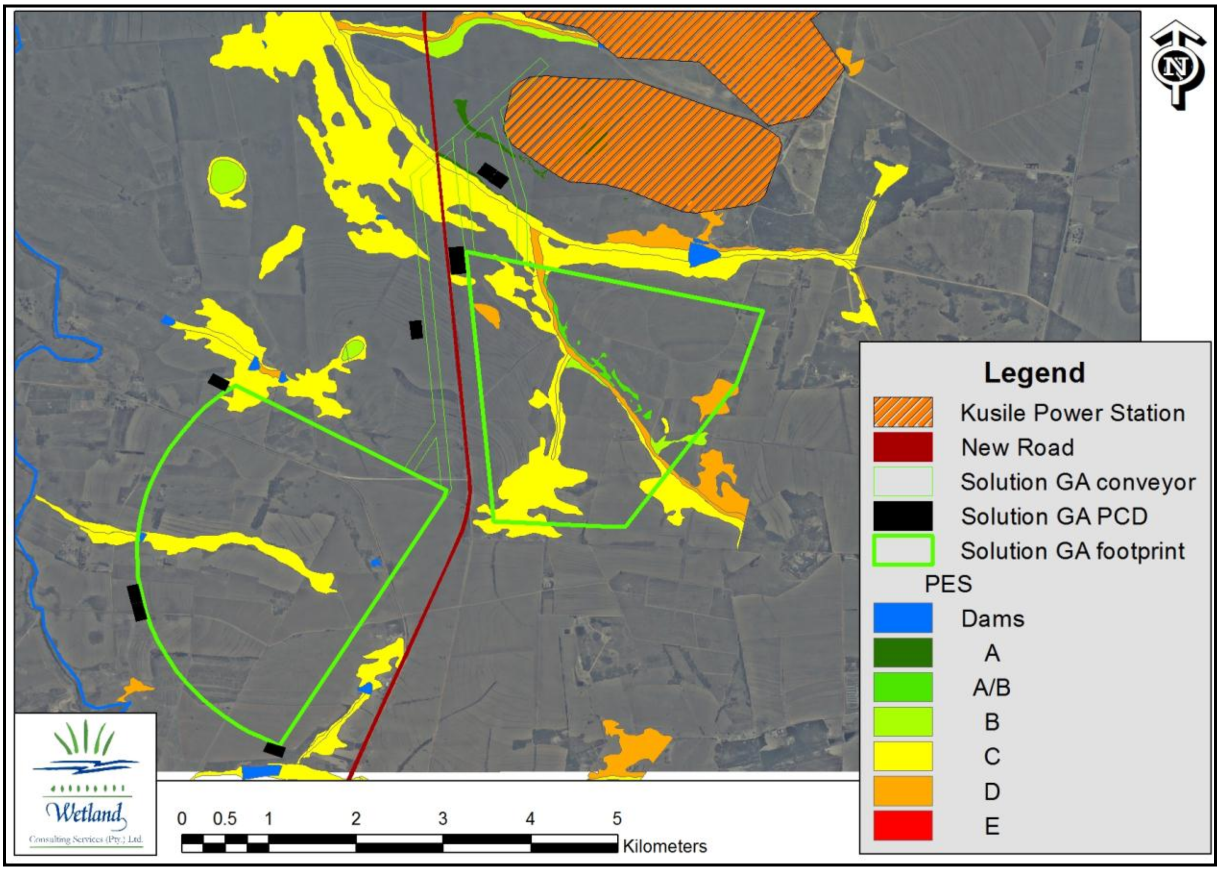


Figure 24. Map of PES results for solution GA.

Table 20. Summarised PES results for solution GA.

Wetland Type	A	A/B	B	C	D	TOTAL
Channelled valley bottom	-	-	-	6.43	12.67	19.10
Unchannelled valley bottom	-	-	-	0.10	-	0.10
Hillslope seepage	2.47	9.85	6.21	145.78	13.38	177.70
TOTAL	**2.47**	**9.85**	**6.21**	**152.30**	**26.05**	**196.89**
% of total wetlands on site	1.26%	5.00%	3.15%	77.35%	13.23%	100.00%

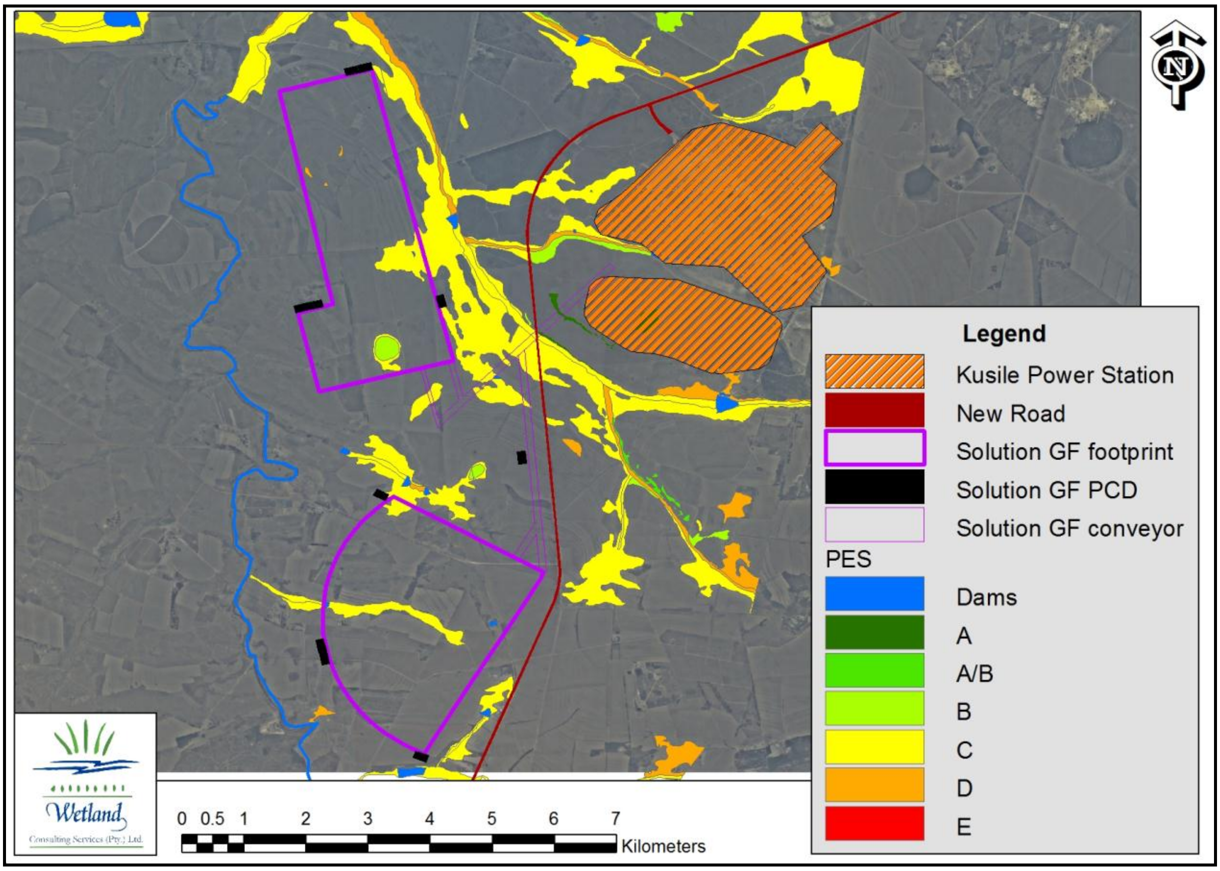


Figure 25. Map of PES results for solution FG.

Table 21. Summarised PES results for solution FG.

Wetland Type	A	B	C	D	TOTAL
Channelled valley bottom	-	-	0.72	-	0.72
Unchannelled valley bottom	-	-	0.10	-	0.10
Pan	-	10.57	-	-	10.57
Hillslope seepage	0.88	-	89.49	1.66	92.03
TOTAL	**0.88**	**10.57**	**90.31**	**1.66**	**103.42**
% of total wetlands on site	0.85%	10.22%	87.32%	1.60%	100.00%

Table 22. 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.*

6.5 Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al (2008) on the assessment of wetland ecological goods and services (the WET-EcoServices tool). Based on this methodology, an EIS assessment was undertaken for all the delineated wetlands on site, with the result discussed and illustrated below.

Considering all of the wetlands delineated across all of the various sites, roughly 77 % of the wetlands assessed are considered to of *Moderate* ecological importance and sensitivity (EIS category C), with roughly half the remaining wetlands considered to be of *High* importance and sensitivity (EIS category B).

Most of the wetlands rated within EIS category B are hillslope seepage wetlands that are still characterised by primary vegetation and are located within catchments consisting mostly of natural grasslands. Both the pans, in site F and adjacent to site B, were also rated as *High* importance and sensitivity due to the role they play in supporting Red Data bird species especially.

The wetlands rated as category D are also mostly hillslope seepage wetlands, though wetlands that have been significantly impacted by previous cultivation and, in the case of the wetlands around site B, have also been impacted by increased wetness derived from the centre-pivot irrigation systems in their catchments.

Table 23. Summarised results of the EIS assessment.

Alternative	EIS category		
	B	C	D
Site A	5.93	294.61	30.93
Site B	22.77	1.68	43.17
Site C	80.25	80.25	33.29
Site F & G1	10.57	146.24	3.52
Site F & G2	13.58	214.16	8.90
Site G1 & G2	3.01	153.18	9.10

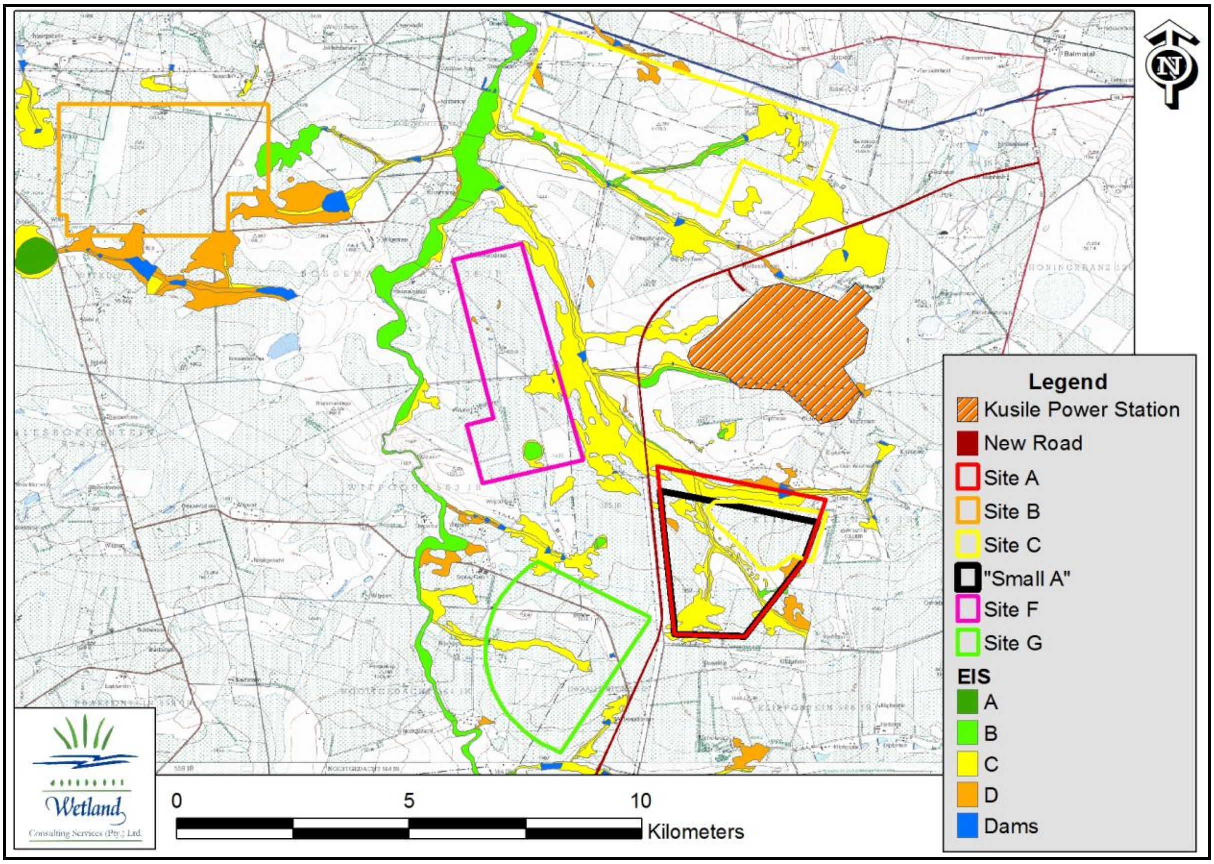


Figure 26. Results of the EIS assessment.

Table 24. 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

7. COMPARISON OF ALTERNATIVES

In comparing the 6 proposed alternatives, a number of aspects were considered:

- ***Wetland extent directly impacted*** – all wetlands falling within the footprint of the proposed ADF will be permanently lost, as will the functions and biodiversity supported by those wetlands.
- ***Wetland extent indirectly impacted*** – impacts associated with the development will not be restricted to the development footprint, but will affect adjacent wetlands, specifically those located downslope of the development.
- ***Present Ecological Status*** – the more degraded a wetland system, the less likely that such a system can be rehabilitated and the less likely it is that the wetland can still successfully perform a range of functions. It is therefore considered preferable to locate the proposed ash dam on wetlands already degraded than on natural wetlands.
- ***Ecological importance and sensitivity & Red Data species*** – as indicated, all wetlands within the footprint of the ADF will be lost. Biodiversity associated with these wetlands will also be lost or displaced. Priority is placed on those wetland habitats known to support Red Data species.
- ***Proximity to the Wilge River*** – the Wilge River is considered the highest priority water resource within the affected area, and preventing water quality deterioration within the Wilge should be one of the top priorities. The greater the distance between the pollution source and the Wilge, the greater the opportunities to implement mitigation measures and contain contaminants. In addition, any wetland habitat

between the ADF and the Wilge River could potentially act as a buffer to the Wilge River in terms of water quality deterioration through trapping and assimilating some of the pollutant load.

- ***Impact on affected/unimpacted wetlands*** - it is considered preferable to place the ADF within sub-catchments that have already been impacted by other activities within the area rather than in unimpacted sub-catchments, and thus spreading the impact footprint. Other activities occurring in the area and affecting the wetlands that have been considered include the Kusile Power Station, the 10-year ash dam and the adjacent New Largo opencast mining, which is yet to commence. Sub-catchments affected by these activities will already require extensive interventions in terms of water quality and wetland management.
- ***Cumulative impact of other activities in the area*** – a number of developments are taking place within the vicinity of the proposed ash dam location, including the Kusile Power Station, the 60 year co-disposal facility and the New Largo mining developments. These activities will also impact on the wetlands of the area and will need to be considered when deciding which wetlands should be excluded from the ash dam footprint.
- ***Service corridor*** – each of the proposed alternatives will require a service corridor constituting a servitude roughly 135 m wide and including conveyors, powerlines, pipelines, service roads etc. Each of these service corridors will be of different length and will be required to cross various wetlands. The service corridor is likely to increase the pollution footprint of the proposed development and have a significant impact on habitat fragmentation.

7.1 Solution A

SOLUTION A		
Wetland extent directly impacted	227.67 ha	Solution A has the highest wetland extent within the direct footprint of the proposed ash dam, consisting of the upper reaches of the Klipfonteinspruit.
Wetland extent indirectly impacted	126.35 ha	Solution A has the least wetlands within 500m of the proposed ash dam footprint. Only a single wetland system, the Klipfonteinspruit, drains away from the site.
PES	17.9 ha	17.9 ha of wetlands in PES categories A and B occur on site, all being small hillslope seepage wetlands.
EIS	--	No Red Data species were confirmed on site, though species such as the African Grass Owl are expected to occur within all of the sites.
Proximity to Wilge River	3.8 km 7 km	The site is located more than 3.8 km from the Wilge River as the crow flies, and 7 km along the Klipfonteinspruit. These 7 km of wetland could act as a buffer to the Wilge River in terms of water quality deterioration.
Affected / Unimpacted	Affected catchment	This sub-catchment is already significantly impacted by the Kusile Power Station, half of which falls within

catchment		the sub-catchment. Stormwater from the power station is discharged into the Klipfonteinspruit. The 60 year co-disposal facility will be located within this catchment, while more than 18 % of the catchment is likely to be mined by opencast mining methods at New Largo. The catchment will thus require significant management interventions even in the absence of any further developments.
Service corridor	2 crossings	This solution has the shortest conveyor route. Two crossings over the Klipfonteinspruit will be required along a reach that will be heavily impacted.

In addition to the above, a number of further advantages exist in terms of solution A from a wetland perspective:

- The entire site is located within a single sub-catchment and drains towards a single point. This will simplify water management significantly; specifically in terms of mitigating against water quality deterioration as all contaminants will drain towards a point. All pollution control dams will also be located in the same area.
- The wetland associated with the Klipfonteinspruit, if rehabilitated and managed, could act as a buffer to the Wilge River in terms of sedimentation, turbidity and other water quality concerns.

A number of risks should however also be considered:

- The Klipfonteinspruit is already incised and receiving concentrated stormwater discharges from Kusile Power Station that will likely further erode the system. As the system erodes, the buffering capacity of the system and its role in water quality maintenance will decrease, negating its potential in buffering the Wilge River from water quality degradation. An active management plan will need to be implemented for the system, whether or not the 60 year ash dam is located at site A or not.
- A number of river diversions will be required to make solution A feasible. The streams requiring diversion will all be affected by New Largo as well.

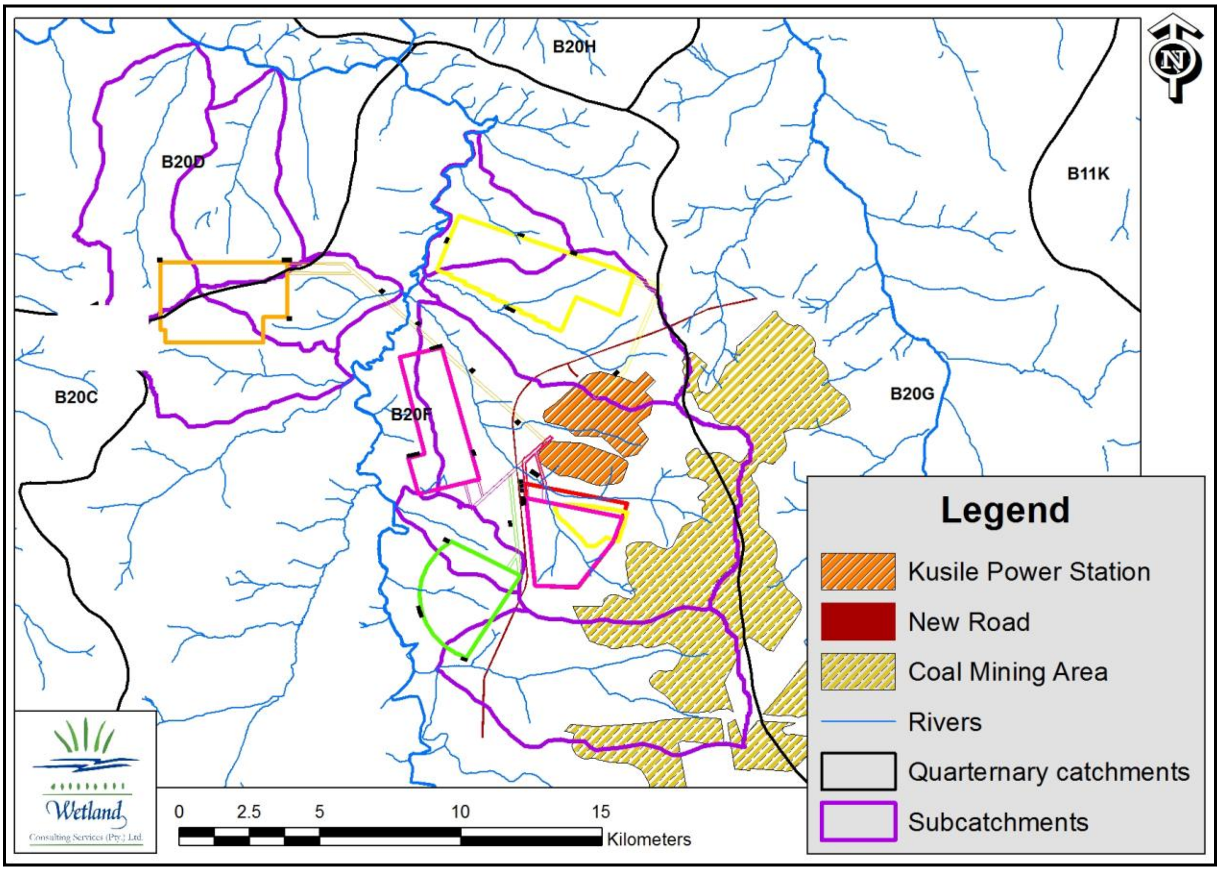


Figure 27. Map showing the various alternatives in relation to sub-catchments and surrounding activities.

7.2 Solution B

SOLUTION B		
Wetland extent directly impacted	52.74 ha	Smallest wetland extent within the direct footprint of the ash dam of all sites investigated.
Wetland extent indirectly impacted	189.60 ha	Large extent of wetlands immediately adjacent to the proposed site. The deep soils of the site are expected to play an important role in supporting the surrounding hillslope seepage wetlands, and the loss of these from the catchment areas of the wetlands will likely significantly reduce flows into the adjacent wetlands.
PES	14.9 ha	14.9 ha of PES category A and B wetlands occur on site.
EIS	Red Data species	The pan immediately adjacent to site B supports large numbers of avifauna, including the Red Data flamingo species, Greater and Lesser, as well as Black-winged Pratincole. Although the ash dam will be outside the pan catchment, the proximity of activities will likely result in disturbances, while dust

		deposition could also affected water quality in the pan.
Proximity to Wilge River	> 3 km	The ash dam site is located more than 3 km from the Wilge River. However, the conveyor will need to cross the Wilge River.
Affected / Unimpacted catchment	Unaffected catchments	Located within in unimpacted catchments. The site falls along the watershed of two quaternary catchments and affects 4 sub-catchments, 2 draining to the Wilge River and 2 to the Bronkhorstspruit.
Service corridor	Wilge River crossing and 4 wetland systems	A significant conveyor crossing will be required over the Wilge River to access the site, as well as four further wetland systems will require crossings. The conveyor will be over 12km in length, the longest for all the alternatives.

Solution B presents a number of concerns from a wetland perspective:

- Its location along a watershed implies that 4 sub-catchments currently unaffected by mining or Kusile Power Station activities will be impacted. This will significantly increase the impacted area and zone of influence.
- Water drains from the site in four different directions, complicating water management and increasing the risk of failure of mitigation measures.
- The four impacted sub-catchments, as well as the long conveyor route result in pollution control dams being required in at least 7 localities.
- The conveyor will be required to cross the Wilge River, the highest priority water resource of the area, exposing it to risk of contamination. The required crossing will likely be more than 50m wide given the need for 2 conveyors, access roads, powerlines etc.

Based on the above concerns, as well as concerns raised through other specialist studies, Solution B was found to be not suitable.

7.3 Solution C

SOLUTION C		
Wetland extent directly impacted	125.34 ha	Low wetland coverage compared to some of the other sites, ranking as third lowest of the six.
Wetland extent indirectly impacted	321.46 ha	Highest extent of wetlands in close proximity to the proposed ash dam footprint, partly as a result of the required borrow pit which significantly increases the footprint and zone of influence of this option.
PES	22.7 ha	Highest extent of PES category A and B wetlands within the footprint.
EIS	Red Data species & breeding site	A number of Red Data bird species confirmed on site, including a Blue Crane breeding site immediately adjacent to the site. Also numerous Mpumalanga

		Protected plant species.
Proximity to Wilge River	< 200m	Western edge of site less than 200m from the edge of the Wilge River floodplain, but only short frontage to the Wilge.
Affected / Unimpacted catchment	Both	Southern half of the site falls within a sub-catchment affected by the Kusile Power Station. Northern half of site is currently unaffected by Kusile or mining activities, but is crossed by N4 highway.
Service corridor	2 crossings	Short conveyor route required with two hillslope seepage crossings.

From a wetland perspective, solution C presents 2 significant negatives:

- A wetland earmarked for rehabilitation as a commitment emanating from the WUL for other Kusile activities, as well as from a commitment to a relocated community, falls completely within the footprint of solution C.
- The shallow soils that characterize this site have as a consequence that insufficient clay material for the liner system can be sourced on site and a borrow pit will be required. The borrow pit will be located within site A, and though no wetland falls directly within the borrow pit footprint, a number of wetlands are immediately adjacent to the site and will likely be significantly impacted through changes to the hydrology driving these wetlands.

In addition to the above concerns, concerns raised through the specialist social study have resulted in this site being considered not suitable.

7.4 Solution FA

In an attempt to reduce the impact of solution A on wetlands, the footprint of solution A was withdrawn from the valley bottom wetland associated with the Klipfonteinspruit (the northern valley bottom wetland). As a consequence the footprint of the smaller site A is no longer sufficient to accommodate 60 years of ash. A second site thus had to be found. This has led to the combination of sites “small A” and F in solution FA.

SOLUTION FA		
Wetland extent directly impacted	210.93 ha	The second highest wetland extent of the 6 alternatives, and only marginally (16ha) less than solution A with the highest coverage.
Wetland extent indirectly impacted	284.74 ha	Extensive wetlands in close proximity to the site. Considering the footprint plus a 500m buffer, this solution has the highest wetland coverage of all the alternatives investigated.
PES	18.5 ha	18.5 ha of PES category A and B wetlands occur on site.
EIS		A seasonal pan is located on site. This pan is considered to be of High importance, and supports

		both Red Data flamingo species.
Proximity to Wilge River	< 350m	Site F is located in close proximity to the Wilge (350m at its nearest point), with the full 4.8 km long western edge of the site located within approximately 1.5km of the Wilge.
Affected / Unimpacted catchment	Both	"small A" is located within the sub-catchment affected by Kusile and will also be affected by New Largo mining. The western portion of site F is located within an unaffected catchment.
Service corridor	4 crossings	4 wetland crossings will be required, including 3 crossings over the Klipfonteinspruit wetland system.

- Solution FA consists of 2 sites, increasing the disturbance footprint and extending the zone of impact.
- Site FA is considered to pose a significant risk to the Wilge River in terms of potential water quality deterioration:
    - Close proximity to the Wilge River
    - Extensive river frontage to the Wilge River (4.8km) as the longitudinal axis of the site is located parallel to the Wilge
    - Pollution Control Dams will be required in at least 5 locations
- The presence of the seasonal pan within the proposed ash dam footprint is a concern from a biodiversity perspective.

It is also clear from the above that the attempt to reduce the extent of wetland habitat directly impacted by using two sites rather than one has not been very successful in this situation.

7.5 Solution GA

Same as with solution FA, in an attempt to reduce the impact of solution A on wetlands, the footprint of solution A was withdrawn from the valley bottom wetland associated with the Klipfonteinspruit (the northern valley bottom wetland). As a consequence the footprint of the smaller site A is no longer sufficient to accommodate 60 years of ash. A second site thus had to be found. This has led to the combination of sites "small A" and G in solution GA.

SOLUTION GA		
Wetland extent directly impacted	197.56 ha	High wetland coverage. Third highest amongst the alternatives and only 30 ha less than solution A.
Wetland extent indirectly impacted	218.20 ha	Extensive wetlands in close proximity.
PES	18.5 ha	18.5 ha of PES category A and B wetlands occur on site.
EIS		No Red Data species were confirmed on site, though species such as the African Grass Owl are expected to occur within all of the sites.
Proximity to Wilge River	+- 600m	At its closest approximately 600m. Less river frontage than site F.

Affected / Unimpacted catchment	Both	"small A" falls within the sub-catchment affected by Kusile and which will be affected by New Largo. Site G, the western portion, is within 2 unimpacted catchments.
Service corridor	3 crossings	3 crossings of the Klipfonteinspruit wetland system will be required.

- Solution GA consists of 2 sites, increasing the disturbance footprint and extending the zone of impact.
- A number of sub-catchments will be affected by site G that are currently unaffected by Kusile activities. In total, 4 sub-catchments will be affected, complicating water management.
- Pollution control dams will be required in 6 locations across the 4 sub-catchments.

7.6 Solution FG

SOLUTION FG		
Wetland extent directly impacted	104.86 ha	Second lowest wetland coverage within direct footprint.
Wetland extent indirectly impacted	246.23 ha	Extensive wetlands in close proximity.
PES	11.45 ha	Lowest coverage of PES category A and B wetlands within footprint
EIS		A seasonal pan is located on site. This pan is considered to be of High importance, and supports both Red Data flamingo species.
Proximity to Wilge River	< 350m	Located in close proximity to the Wilge, with extensive frontage onto the Wilge. The full length of this solution will run parallel to the Wilge for a stretch of approximately 10km, with the entire western edge within 1.5km of the river channel
Affected / Unimpacted catchment	Both	The eastern half of site F falls within the sub-catchment affected by Kusile. The remainder of this solution falls within unimpacted catchments.
Service corridor	2 crossings	2 wetland crossings will be required, including a crossing of the Klipfonteinspruit wetland system

- The greatest concern regarding solution FG is its proximity to the Wilge River and its extended frontage onto the Wilge River. Contamination of the Wilge River could occur via seepage, but also via dust fallout.
- Pollution control dams will be required in 7 localities.

Figure 28. Map showing the proximity of the various alternatives to the Wilge River.

8. PREFERRED ALTERNATIVE

Solution A is considered the preferred alternative from a wetland perspective for the following reasons:

- Highest extent of wetlands within footprint, BUT low extent of wetlands immediately adjacent to the ash dam footprint
- Located furthest from the Wilge River, with 7 km of wetland system to act as buffer to the Wilge River
- Located within the same sub-catchment as Kusile Power Station and the 10-year Ash Dam
- Located within a sub-catchment that will be substantially impacted by mining (18 % of catchment)

In selecting alternative A as the preferred alternative the following assumptions have been made and will require commitments from the development proponent:

- Management and mitigation measures will be put in place along the Klipfonteinspruit to address impacts associated with all the proposed activities within the sub-catchment, i.e. the proposed 60-year ash dam, the 10-year ash dam and the Kusile Power Station. Stormwater runoff from Kusile enters the Klipfonteinspruit and has had a significant impact on the hydrology and water quality (specifically turbidity and suspended solid loads) of the stream. The channel incision within the wetland, already evident prior to the construction of Kusile but exacerbated by the higher volumes and velocities of flows within the system following the onset of construction activities, is limiting the ability of this wetland system to play a role in buffering the Wilge River from impacts associated with the power station activities. A detailed management plan will thus need to be developed and implemented for the Klipfonteinspruit.
- The design of the ash dam within site A will be optimized to minimise the loss of wetland habitat, however recognizing that a certain footprint size and design will be required to accommodate the ash generated and the ashing methods utilised.
- That wetland offsets and rehabilitation of offsite wetlands be investigated to compensate for the loss of wetland habitat within the site A footprint. In this regard the development and implementation of a management plan for the Klipfonteinspruit could be considered, while it is known that wetlands within site C have already been identified as potential rehabilitation targets.

It is important to point out that any activity which is contemplated and which will impact on the wetlands within the study area and falls within 500m of any wetland is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998).

9. IMPACT ASSESSMENT

A detailed impact assessment is undertaken for the preferred alternative, site A, identified as part of the EIA process being undertaken by Zitholele. In addition, on request of the DWA, a detailed impact assessment was also undertaken for site B, the option with the least wetland habitat within the direct footprint of the proposed ash dam, but with the longest conveyor route and including a crossing over the Wilge River.

9.1 Project Description

A detailed project description is provided in the full EIA documentation compiled by Zitholele. Only a brief summary is provided here.

The construction of the proposed ash dam will take place in phases, with only the required footprint for 5 years ash deposition being cleared and prepared at any one time. An engineered barrier system/liner will be placed as per the requirements of the Draft Waste Act Classification Methodology, which requires a Class C liner system (refer to Figure 28 below). The clay material required for the liner will be sourced from within the footprint of the ADF footprint. No additional borrow pit area has been included in this impact assessment.

Ash will be deposited onto the lined footprint using two stackers, a front and back stacker, linked to conveyor systems (refer to Figure 27).

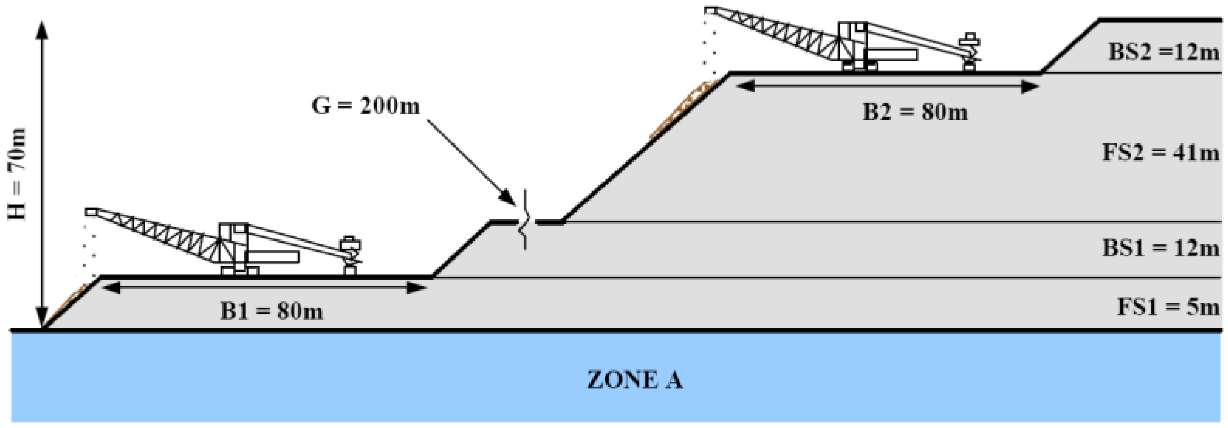


Figure 29. Diagram illustrating the proposed process of ash deposition on the ash dam.

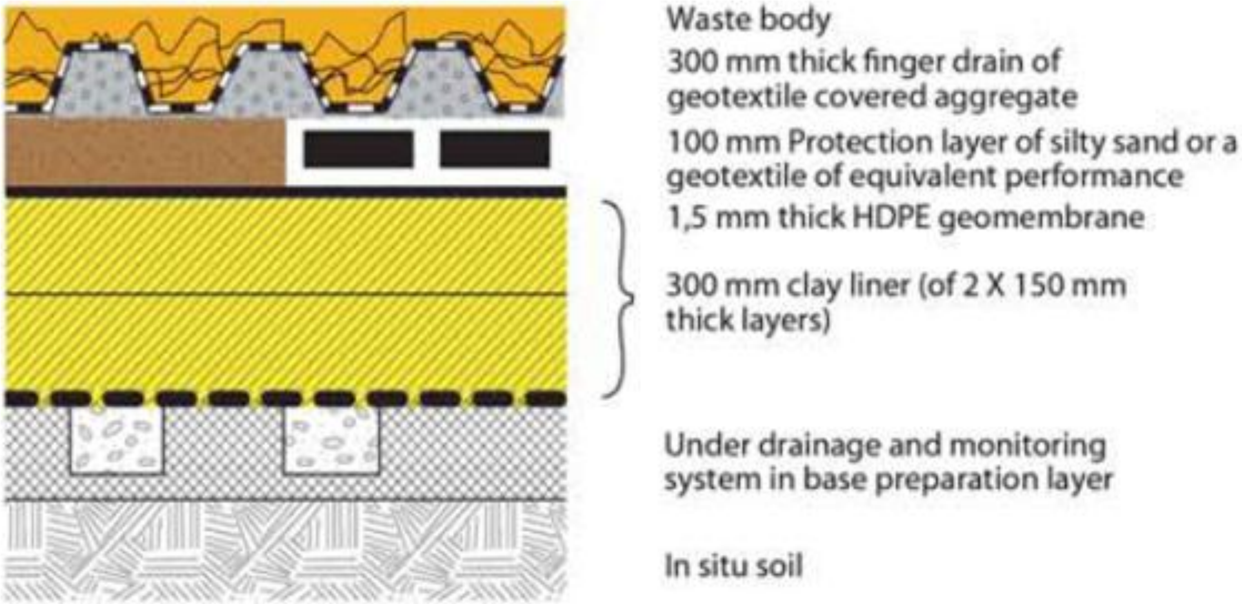


Figure 30. Diagram detailing the proposed liner system.

A process of concurrent rehabilitation will be followed whereby the dump will be capped with topsoil and re-vegetated in phases, as soon as deposition within the first 5 year footprint is complete and deposition has progressed to the new 5 year footprint. An example of a rehabilitated ash dam with associated water management infrastructure is provided in Figure 29.

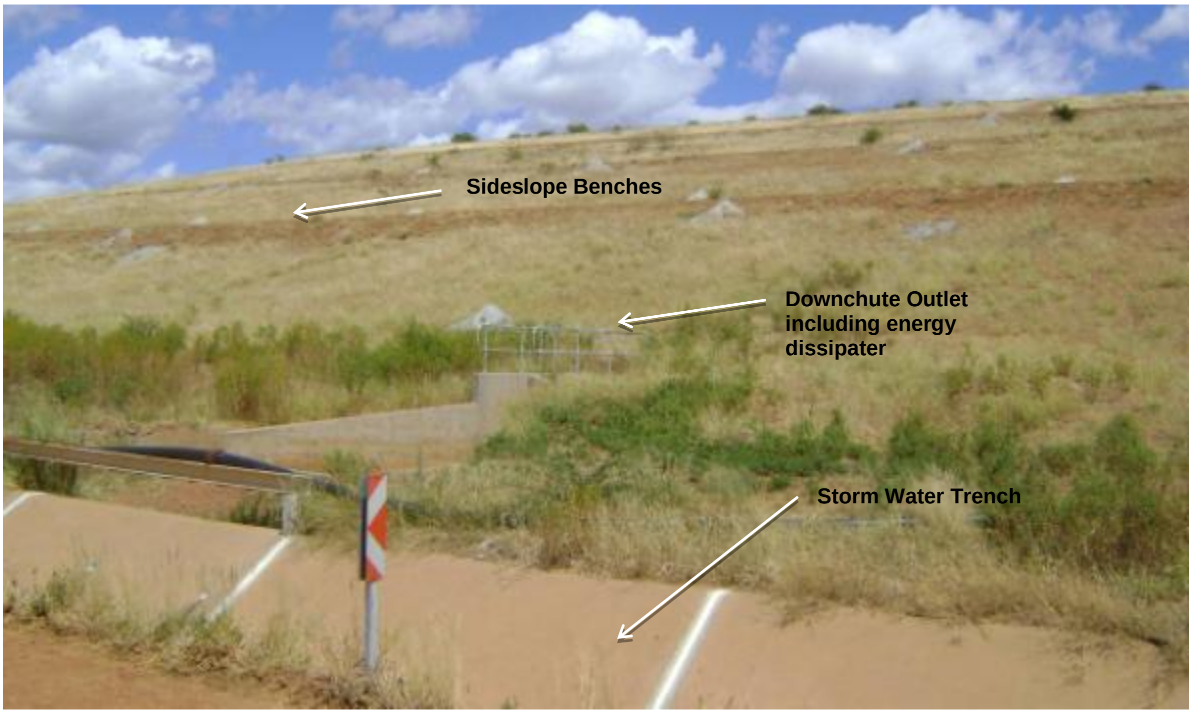


Figure 31. Example of a rehabilitated ash dam surface with water management infrastructure.

Detailed design of the required conveyor system, specifically design of the wetland crossings, was not yet available at the time of compiling this report. It is however understood that the conveyor servitude will be around 100-130 m wide and will include two conveyor systems, a service road, power and pipeline infrastructure, a dirty water canal on either side, as well as a clean water cut-off canal on the upslope side.

The conveyors and service road will be constructed on an infilled platform (refer to Figure 30 below). It was not indicated where the material required for the platform construction will be sourced from, but no borrow pit area for this material has been included in this assessment.

It is assumed that the infilled conveyor platform will extend into wetland areas, with a bridge or culvert structure, depending on the nature of the system crossed, being utilised to cross the active channel of the wetlands and Wilge River. It is further assumed that only the conveyors, pipeline and powerline infrastructure will cross the Wilge River, and that the service road and dirty water canals will not cross the Wilge River. However there will be a single land vehicular access to the bridge and a dirty stormwater collection structure will underlie the steel truss structure supporting the conveyors.

A number of Pollution Control Dams will be constructed along the conveyor route at the various low points to store runoff from the dirty water canals associated with the conveyor servitude.

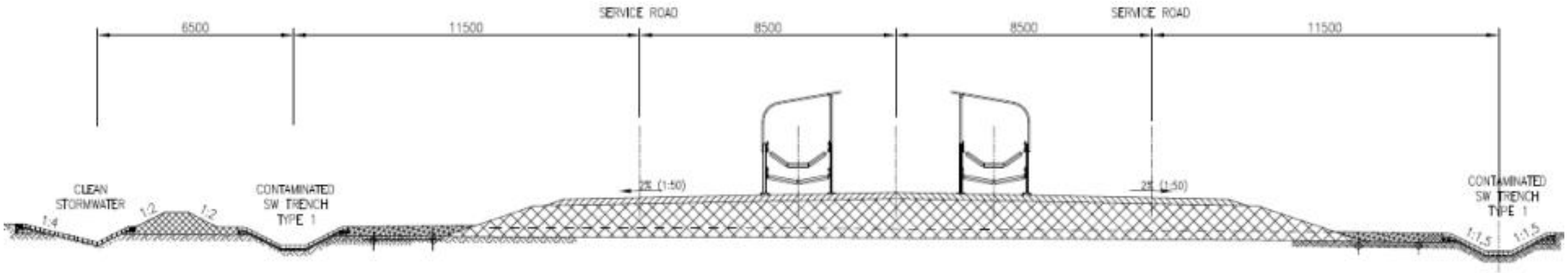


Figure 32. Diagram illustrating the proposed conveyor platform and infrastructure.

9.2 Impact Assessment Methodology

Approach to Assessing Impacts:

Impacts are assessed separately for the **construction**, **operational**, **closure**, and **post-closure** phases of the project;

Impacts are described according to the ***Status Quo, Project Impact, Cumulative Impact, Mitigation Measures*** and ***Residual Impact*** as follows:

- The Status Quo assesses the existing impact on the receiving environment. The existing impact may be from a similar activity, e.g. an existing ash dump, or other activities e.g. mining or agriculture.
- The project impact assesses the potential impact of the proposed development on an environmental element;
- The cumulative impact on an environmental element is the description of the project impact combined with the initial status quo impacts that occur;
- Mitigation measures that could reduce the impact risk are then prescribed; and
- The residual impact describes the cumulative impact after the implementation of mitigation measures.

- Impacts are rated against a predetermined set of criteria including (magnitude, duration, spatial scale, probability, and direction of impact);
- A rating matrix is provided for each environmental element per project phase summarising all the aforementioned in a single table.

More detailed description of each of the assessment criteria and any abbreviations used in the rating matrix is given in the following sections.

Magnitude / 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 (1000 km^2) 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 25 below.

Table 25. Description of the significance rating scale.

Rating			Description
Score	**Code**	**Category**	
7	SEV	SEVERE	Impact most substantive, no mitigation possible
6	VHIGH	VERY HIGH	Impact substantive, mitigation difficult/expensive
5	HIGH	HIGH	Impact substantive, mitigation possible and easier to implement
4	MODH	MODERATE-HIGH	Impact real, mitigation difficult/expensive
3	MODL	MODERATE-LOW	Impact real, mitigation easy, cost-effective and/or quick to implement
2	LOW	LOW	Impact negligible, with mitigation
1	VLOW	VERY LOW	Impact negligible, no mitigation required
0	NO	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

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 26.

Table 26. Description of the spatial rating scale.

Rating			Description
Score	**Code**	**Category**	
7	NAT	*National*	The maximum extent of any impact.
6	PRO	*Provincial*	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a provincial scale
5	DIS	*District*	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a district scale
4	LOC	*Local*	The impact will affect an area up to 5 km from the proposed route corridor.
3	ADJ	*Adjacent*	The impact will affect the development footprint and 500 m buffer around development footprint
2	DEV	*Development footprint*	Impact occurring within the development footprint
1	ISO	*Isolated Sites*	The impact will affect an area no bigger than the servitude.

Duration / Temporal 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 27.

Table 27. Description of the temporal rating scale.

Rating			Description
Score	Code	Category	
5	PERM	Permanent	The environmental impact will be permanent.
4	LONG	Long term	The environmental impact identified will operate beyond the life of operation.
3	MED	Medium term	The environmental impact identified will operate for the duration of life of the line.
2	SHORT	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.
1	INCID	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.

Degree of Probability

The probability or likelihood of an impact occurring will be described as shown in Table 28 below.

Table 28. Description of the degree of probability of an impact accruing.

Score	Code	Category
5	OCCUR	*It's going to happen / has occurred*
4	VLIKE	*Very Likely*
3	LIKE	*Could happen*
2	UNLIKE	*Unlikely*
1	IMPOS	*Practically impossible*

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 29 below. 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 29. 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.

Impact Risk Calculation

To allow for impacts to be described in a quantitative manner in addition to the qualitative description, 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:

$$Impact\ Risk = \frac{Significance + Spatial + Temporal}{2.714} \times \frac{Probability}{5}$$

An example of how this rating scale is applied is shown below in Table 30:

Table 30. Example of rating scale.

Impact	Magnitude	Spatial scale	Temporal scale	Probability	Rating
Greenhouse gas emissions	2	*3*	<u>3</u>	3	1.8
	LOW	*Local*	<u>Medium Term</u>	<u>*Could Happen*</u>	**LOW**

Note*: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 2.714 to give a criteria rating of 2,95. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,95 is then multiplied by the probability rating (0,6) to give the final rating of 1,8, which is rounded to the first decimal.*

The impact risk is classified according to 5 classes as described in Table 31 below.

Table 31. Impact Risk Classes.

Rating	Impact class	Description
6.1 - 7.0	**7**	**SEVERE**
5.1 - 6.0	**6**	**VERY HIGH**
4.1 - 5.0	**5**	**HIGH**
3.1 - 4.0	**4**	**MODERATE-HIGH**
2.1 - 3.0	**3**	**MODERATE-LOW**
1.1 - 2.0	**2**	**LOW**
0.1 - 1.0	**1**	**VERY LOW**

Therefore with reference to the example used for greenhouse gas emissions above, an impact rating of 1.8 will fall in the Impact Class 2, which will be considered to be a Low impact.

<u>Notation of Impacts</u>

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

Spatial Scale – *in italics*

Duration – <u>in underline</u>

Probability – <u>*in italics and underlined.*</u>

Degree of certainty - **in bold**

9.3 Impact Assessment – Solution A

9.3.1 Construction Phase

Status Quo

The footprint of the proposed 60 year ash dam is currently utilised extensively for agriculture, mostly cultivation, though some livestock grazing is also known to occur. These activities have impacted on the wetlands, specifically where cultivation extends into the temporary zones of the wetlands and has resulted in the completed transformation of vegetation. Considerable areas of wetland habitat that are not currently cultivated have also been cultivated at some stage in the past and are characterised by secondary vegetation. Only small areas of natural vegetation remain within the hillslope seepage wetlands.

The impact on the hydrological functioning of the wetlands has not been as severe, though a large farm dam has been constructed on site and is used to supply a centre pivot irrigation system. A number of farm road crossings have also lead to flow concentration within the wetland systems, resulting in erosion. All of the valley bottom wetlands display incised channels.

Impacts to water quality are likely to have materialised from agricultural runoff, while some limited mining activity is also already taking place within the upper catchment of the Klipfonteinspruit.

Based on the PES assessment roughly 77 % of wetlands within the proposed ash dam footprint are already moderately modified (PES category C), with a further 15 % classed as largely modified.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as consequence of the construction activities required for the establishment of the 60 year ash dam and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.):

1. Loss of wetland habitat
2. Disturbance to wetland habitat
3. Increased sediment transport into wetlands
4. Increased erosion within adjacent wetlands
5. Water quality deterioration in adjacent wetlands and water resources
6. Loss of Red Data and protected species
7. Increase in alien vegetation
8. Altered flows within wetlands crossed by the conveyor

Wetland habitat falling within the footprint of the ADF, conveyor and Pollution Control Dams will be lost. Earth works relating to the construction of these facilities will permanently destroy the wetland habitats within the construction footprint. In total, the extent of wetland habitat directly affected exceeds 225 hectares. However, not all wetlands will be lost during the construction phase. For the ash dam, only the footprint required for the first 5 years of ash deposition will be cleared and prepared during the construction phase. The most extensive wetland loss will thus take place during the operational phase.

Table 32. Extent of wetland habitat falling within the direct footprint of the proposed developments. All wetlands falling within the development footprints will be destroyed.

Wetland Type	Ash Dam Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	35.49	1.12	--	36.61
Hillslope seepage	179.48	4.21	4.24	187.94
Dam	3.11	--	--	3.11
TOTAL	**214.98**	**5.33**	**4.24**	**227.67**

The loss of wetland habitat will also result in the loss of functions supported by the wetlands affected, which in the case of site A, are thought to relate mostly to:

- Biodiversity support
- Flow regulation
- Maintenance of water quality
- Erosion control

Species associated with the wetland habitat will be lost or displaced. No Red Data species were observed within the wetlands on site during the wetland study field work. However, species such as the African Grass Owl are expected to occur, while plant species protected within the Mpumalanga Province, e.g. *Gladiolus* sp., are also expected to occur.

Construction activities are also likely to increase the disturbance footprint beyond the boundaries of the actual development footprint through temporary stockpiles, laydown areas, construction camps, uncontrolled driving of machinery etc. Such activities will result in the loss of vegetation cover within the affected areas and increase the risk of erosion. Ruts and vehicle tracks could result in the formation of preferential flow paths that concentrate flow and exacerbate the erosion risk. Eroded sediments will be transported down the systems and deposited further along the wetlands and potentially the Wilge River. Erosion within the wetlands could lead to channel incision and the partial drying out of areas adjacent to the channel and erosion gullies, leading to changes in vegetation.

Discharge of stormwater and diverted clean water will increase flow velocities off the site, increasing the risk of erosion within the receiving wetlands. Stripping of vegetation will increase volumes and velocities of surface runoff generated from the affected area. Soil compaction due to movement of machinery during construction will further increase runoff volumes and velocities, while vehicle ruts and tracks resulting from construction activity could provide preferential flow paths that lead to flow concentration, again increasing erosion risk.

A diversion of the Klipfonteinspruit wetland will be required around the ash dam footprint. The stream diversion could result in discharge of concentrated flow into the downstream wetlands thus increasing the erosion risk in this wetland, and could in itself be at risk of erosion, especially in the period immediately following the completion of construction along the diversion and prior to the full establishment of vegetation. The ***design of the river diversion however allows for a broad system with gentle side slopes that will be earthen and vegetated, i.e. allowing for the establishment of wetland habitat within the diversion***. The river diversion will be terraced to allow for low flows to be conveyed within the so-called ‘concentrated flow’ area, with flood flows overtopping this ‘concentrated flow’ area and spilling onto the ‘floodplain’ either side of the ‘concentrated flow’ area. Currently the Klipfonteinspruit is severely incised and flows are concentrated within the incised channel. The proposed diversion structure will aim to alleviate this somewhat and increase the residence time within the wetland. Erosion protection measures in the form of gabions along the inside and outside bends of the ‘concentrated flow’ area, as well as rock packed mattresses and rip-rap steps in steeper areas have been allowed for.

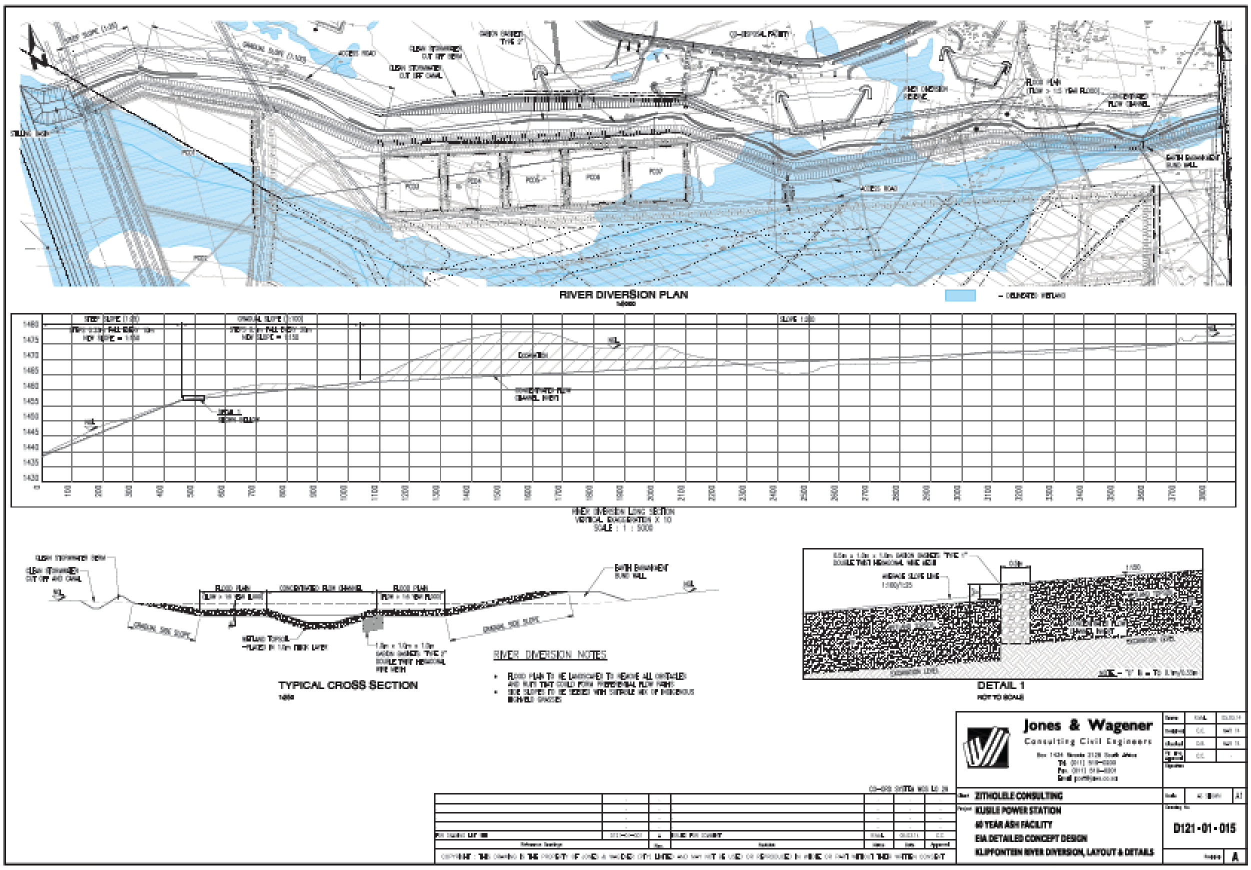


Figure 33. Conceptual design of a diversion structure for the Klipfonteinspruit. Refer to engineering report for full details.

Vegetation clearing and site preparation activities will expose large areas of disturbed soils to erosion by wind and water. Eroded sediments will be transported into downslope wetlands and lead to changes in habitat, specifically vegetation composition and structure.

In addition to increased sediment transport and turbidity, spills and leaks of hazardous substances used during the construction process could enter adjacent wetlands via surface run-off, leading to water quality deterioration. Potentially polluting substances like cement, oil and diesel are likely to be regularly used and temporarily stored on the construction site. Spills of these substances or the incorrect disposal of material contaminated with these substances are likely to result in water quality deterioration in adjacent wetlands, resulting in a loss of sensitive species. Incorrect handling and disposal of waste, including sewage from portable, temporary ablutions could also result in water quality deterioration.

Areas disturbed as a result of the construction activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands (SANBI, http://www.sanbi.org/information/infobases/invasive-alien-plant-alert/campuloclinium-macrocephalum-pom-pom-weed).

As part of the proposed ash dam development a conveyor from the power station to the ash dam will be required. This conveyor will cross a number of wetlands. Conveyor crossings have the potential to impact on flow characteristics of the affected wetlands through the concentration of flows and the impoundment of flows upstream of the crossing.

The combined weighted project impact to wetlands (prior to mitigation) will **definitely** be of a VERY HIGH negative significance, affecting the *local area*. The impact will act in the long term and *will occur*. The impact risk class is thus **Very High.**

Cumulative Impact

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support.

Other activities within the direct area that have resulted in wetland loss include the Kusile Power Station and the 60 year co-disposal facility (also referred to as the “10 year ADF”), while future proposed activities such as the New Largo Mine are likely to result in further wetland loss within the affected sub-catchments.

Changes in water quality and flow characteristics as a consequence of the ADF development will place further pressures and stress on the Klipfonteinspruit wetland system which already is under strain from the existing Kusile developments.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *district area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Very High**.

Mitigation Measures

1. Loss of wetland habitat
   - Optimise design of ash dam to minimise size of footprint, e.g. increase the height of the ash dam, to minimise loss of wetland habitat.
   - Ensure that the selected site has sufficient material in situ as required for rehabilitation and for the proposed liner, to prevent additional disturbed areas.
   - Avoid additional wetland loss by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ash dam.
   - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
   - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
   - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the construction site.
   - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
   - No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
   - Regular cleaning up of the wetland areas should be undertaken to remove litter.
   - Undertake a wetland offset study to investigate the possibility of mitigating the loss of wetland habitat on site A through the rehabilitation and protection of wetlands elsewhere.
     - Such an offset should ideally be located within the same catchment
     - A potential target wetland for rehabilitation is the Klipfonteinspruit system downstream of the proposed ash dam site. This system already receives most of the stormwater discharges from Kusile Power Station and will require management interventions as it is already on a negative trajectory of change.

2. Disturbance to wetland habitat
   - Avoid additional wetland disturbances by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ADF.
   - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
   - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
   - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the construction site.
   - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.

- No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
- Regular cleaning up of the wetland areas should be undertaken to remove litter.

3. Increased sediment transport into wetlands
    - Minimise area of vegetation clearing.
    - Phase vegetation clearing activities as far as possible to limit the area exposed at any one time.
    - Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
    - Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.
    - Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
    - Install the construction stormwater management system prior to the onset of vegetation clearing activities on the ash dam footprint.
    - Install sediment traps as part of the stormwater management plan where necessary upstream of discharge points.
    - Divert clean water around the cleared area and install erosion protection measures and energy dissipaters at points of discharge.
    - Cleared areas outside direct development footprint should be re-vegetated via hydro-seeding as soon as possible.
    - A vegetation and erosion monitoring plan should be established for all rehabilitated sites with clearly defined measures to respond to erosion damage or unsuccessful revegetation.

4. Increased erosion within adjacent wetlands
    - Implement a construction stormwater management plan prior to the onset of vegetation clearing activities on site.
    - Stormwater and clean water discharge points should be protected against erosion.
    - Discharge points should incorporate energy dissipaters and erosion protection.
    - Concentrated, high velocity flows should be avoided.
    - During the construction phase, all discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
    - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.
    - The gradient of the stream diversions should be kept as low as possible. The diversion itself should be broad with gently sloping sideslopes, and should incorporate rip rap steps (rock-packed steps) at regular intervals to protect against erosion and to allow for the required fall in the stream diversions.

- A stilling basin should be incorporated at the end of the diversion to act as attenuation structure.
- Following construction activities the entire diversion floor should be landscaped to remove all obstacles and ruts that could lead to the formation of preferential flow paths.
- Re-vegetation of the stream diversion floor should proceed naturally and establish rapidly (based on experience from the Goedgevonden main river diversion) if sufficient flow through the wetland is available. Should exceptionally low flows be encountered due to drought conditions, seeding of the diversion might be required to ensure rapid vegetation establishment. Regular, monthly monitoring of the stream diversion will thus be required until vegetation cover has been established across the full stream diversion.
- More terrestrial areas such as the sideslopes of the stream diversions will not re-vegetate naturally and should be seeded with a suitable mix of indigenous highveld grasses.

5. Water quality deterioration in adjacent wetlands and water resources
    - Store and handle potentially polluting substances and waste in designated, bunded facilities.
    - Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
    - Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
    - Keep sufficient quantities of spill clean-up materials on site.
    - Clearly define roles and responsibilities of all personnel during spillage events.
    - Keep a detailed log on site of all spills.
    - Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
    - No washing of machinery or equipment within wetlands areas adjacent to the development sites should be allowed.

6. Loss of Red Data and protected species
    - Appoint suitably qualified professionals to undertake search and rescue operations for Red Data plant species prior to vegetation clearing activities.
    - Include Red Data species and suitable habitat in offset considerations

7. Increase in alien vegetation
    - 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. Altered flows within wetlands crossed by the conveyor

- Crossing infrastructure should aim to minimise concentration of flows, as well as impoundment of flows upslope of crossings.
- The active channel of all wetlands should be crossed by a clear span bridge, with no pedestals located within the active channels.
- Where culverts are utilised to cross seepage wetlands or weakly channelled systems, sufficient culverts should be utilised to ensure wetting of the full wetland front downslope of the crossing.
- Gantries should be installed at all wetland crossings.

Residual Impact

The residual impact of the construction of the ash dam will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE LOW negative significance, affecting the *adjacent area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Rated By:				Site A				
	IMPACT DESCRIPTION	Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative		3	2	4	5	**-3.3**
				MODL	DEV	LONG	OCCUR	**MODH**
Project Impact 1	Loss of wetland habitat	Negative	**Definite**	6	3	5	5	**-5.2**
				VHIGH	ADJ	PERM	OCCUR	**VHIGH**
Project Impact 2	Disturbance to wetland habitat	Negative	**Probable**	3	2	2	4	**-2.1**
				MODL	DEV	SHORT	VLIKE	**MODL**
Project Impact 3	Increased sediment transport into wetlands	Negative	**Definite**	4	3	2	5	**-3.3**
				MODH	ADJ	SHORT	OCCUR	**MODH**
Project Impact 4	Increased erosion within adjacent wetlands	Negative	**Probable**	4	3	4	4	**-3.2**
				MODH	ADJ	LONG	VLIKE	**MODH**
Project Impact 5	Water quality deterioration within adjacent wetlands & water resources	Negative	**Possible**	4	4	2	3	**-2.2**
				MODH	LOC	SHORT	LIKE	**MODL**
Project Impact 6	Loss of Red Data species and protected species	Negative	**Probable**	4	2	5	5	**-4.1**
				MODH	DEV	PERM	OCCUR	**HIGH**
Project Impact 7	Increase in alien vegetation	Negative	**Probable**	4	2	4	4	**-2.9**
				MODH	DEV	LONG	VLIKE	**MODL**
Project Impact 8	Alterred flows within wetlands crossed by the conveyor	Negative	**Probable**	3	3	5	5	**-4.1**
				MODL	ADJ	PERM	OCCUR	**HIGH**
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6	5	5	5	**-5.9**
				VHIGH	DIS	PERM	OCCUR	**VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3	3	5	5	**-4.1**
				MODL	ADJ	PERM	OCCUR	**HIGH**

<table>
<tr><td colspan="1"><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td>Wetlands – loss of wetland habitat</td><td colspan="3"></td></tr>
<tr><td colspan="4"><u>Primary Objective:</u></td></tr>
<tr><td colspan="4">Limit the extent of wetland habitat directly impacted.</td></tr>
<tr><td colspan="4">Mitigate the residual impact of wetland loss through implementation of an offset strategy.</td></tr>
<tr><td><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Optimise the design and layout of the 60-year ash dam to minimise the footprint size of the facility and the extent of wetlands directly impacted.</td><td>Developer</td><td></td><td></td></tr>
<tr><td>2) Confirm availability of sufficient clay material for the required liner system and sufficient topsoil for rehabilitation already at the planning stage.</td><td>Developer</td><td></td><td></td></tr>
<tr><td>3) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat. Clearly mark wetland areas.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>4) Commission and implement a wetland offset strategy in line with best practice guidelines.</td><td>Developer, Environmental Manager</td><td></td><td></td></tr>
<tr><td>5) Include environmental awareness aspects into the site induction for all staff to ensure all staff are aware of the importance and location of wetlands on site.</td><td>Contractor, Environmental Manager</td><td></td><td></td></tr>
<tr><td>6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.</td><td>Developer, ECO</td><td></td><td></td></tr>
<tr><td colspan="4"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="4">A detailed site selection process was undertaken to select the preferred site. This site selection was also informed by wetland considerations.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
</table>

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Disturbance to wetland habitat			
Primary Objective:			
Avoid disturbance to wetland habitat outside the required construction servitude.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat.	Contractor, Environmental Manager, ECO		Monthly
2) Include environmental awareness aspects into the site induction program to ensure all staff is aware of the location and importance of wetland habitats in the vicinity of the construction site.	Contractor, Environmental Manager		
3) Implement a construction stormwater management plan.	Contractor, Environmental Manager, ECO		Weekly
4) Rehabilitate all disturbed wetland areas outside the direct development footprints as per the guidelines contained in the wetland report.	Contractor, Environmental Manager, ECO		Weekly (for the first three months following rehabilitation), then quarterly
6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		Weekly
7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.	Developer, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increased sediment transport into wetlands			
Primary Objective:			
Limit the transport of sediments off the construction site			
Limit the deposition of sediments within wetland habitat			
Limit erosion within receiving wetland habitats			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Install and regularly maintain and repair sediment barriers along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Monthly (and after every large storm event)
3) No vegetation clearing should take place in any wetland outside the direct development footprint.	Contractor, Environmental Manager, ECO		Weekly
4) Phase vegetation clearing to limit exposed area at any one time. As far as possible, limit the major clearing activities and earthworks to the dry season.	Contractor, Environmental Manager, ECO		
5) Install sediment barriers and/or low level berms along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Weekly during the rainy season
6) Rehabilitate all cleared areas outside the direct development footprint as soon as possible following the disturbance.	Contractor, Environmental Manager, ECO		Weekly
3) Water quality monitoring and biomonitoring to be undertaken as per the recommended monitoring plan in the aquatic ecology report.	Specialist		As per aquatic ecology report
4) Inspect and maintain all stormwater discharge points.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Erosion in adjacent wetlands			
Primary Objective:			
Limit erosion within receiving wetland habitats			
Limit the deposition of sediments within wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Stormwater discharge point should be protected against erosion and incorporate energy dissipaters.	Contractor, Environmental Manager, ECO		Monthly
3) Install sediment traps or sediment barriers at all discharge points. Sediment traps/barriers should be designed to cope with flow velocities at point of discharge.	Contractor, Environmental Manager, ECO		Monthly
4) Undertake regular inspections and maintenance of all discharge points.	Contractor, Environmental Manager, ECO		Monthly
5) Separate clean and dirty water. All clean water to be discharged to the environment. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
6) Environmental considerations should help inform the stream diversion design. A wetland specialist should be appointed to assist the engineers in this regard.	Developer		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – water quality deterioration			
Primary Objective:			
Prevent water quality deterioration due to spills and leaks			
Prevent water quality deterioration due to incorrect waste disposal			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure separation of clean and dirty water. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.	Contractor, Environmental Manager, ECO		
3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.	Contractor, Environmental Manager, ECO		
4) Regularly remove waste from the construction site and dispose of on an approved facility.	Contractor, Environmental Manager, ECO		
5) No washing of machinery or equipment within the adjacent wetland areas.	Contractor, Environmental Manager, ECO		
6) Compile an emergency response plan to deal with spills.	Contractor, Environmental Manager, ECO		
7) Compile and implement a monitoring plan.	Environmental Manager		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Loss of Red Data and protected species			
Primary Objective:			
Minimise the loss of Red Data and protected species			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Appoint professionals to undertake a search and rescue operation for Red Data and protected species prior to the commencement of any construction activities.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile and implement an alien vegetation management plan for the entire affected area.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Conveyor crossings			
Primary Objective:			
Minimise changes to hydrology of the wetlands to be crossed			
Minimise disturbance to the wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile construction method statements for all conveyor crossings. A wetland specialist should review these method statements.	Developer		
2) The active channel of all wetlands should be crossed by a clear span bridge. No pedestals to be located within the active channel of wetlands.	Developer		
3) Gantries must be installed along all wetland crossings.	Developer		
4) Dirty water generated along the conveyor route must be managed and contained in lined facilities.	Contractor, Environmental Manager, ECO		
5) Clearly demarcate the required construction servitude and limit all activities to the servitude.	Contractor, Environmental Manager, ECO		
6) Rehabilitate the disturbed area as soon as possible following completion of construction.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.3.2 Operational Phase

Status Quo

This is detailed under Section 9.3.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as consequence of the operational of the 60 year ash dam and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.). Most of these impacts are a continuation of impacts expected during the construction phase, as construction activities will persist for most of the operational phase as well as the ADF footprint will be constantly expanded and constructed in "5 year" sections.

1. Loss of wetland habitat
2. Water quality deterioration due to seepage out of the ADF
3. Increased sediment transport into wetlands
4. Increased erosion within adjacent wetlands
5. Water quality deterioration in adjacent wetlands and water resources
6. Decreased flow within adjacent wetlands
7. Loss of Red Data and protected species
8. Increase in alien vegetation
9. Water quality deterioration due to ash dust from the ADF
10. Water quality deterioration due to ash dust from the conveyor

Most of the above impacts have been discussed in detail under the construction phase impact assessment and will be a continuation of the same impacts. Additional impacts expected during the operational phase have been highlighted in red above.

The ash disposed of on the ADF will contain a number of pollutants. Contaminated surface water runoff from the ash dam 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. The Klipfonteinspruit drains into the Wilge River and any water quality impacts to the Klipfonteinspruit are likely to also affect the Wilge River.

Water quality could also be affected through dust deposition in wetlands. 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 ash dam. Direct deposition of this dust into wetlands could result in contamination of surface waters with a resultant loss in sensitive species.

The ADF will be lined and treated as a dirty water area. No surface runoff from the ADF or seepage should thus enter adjacent wetlands. This will reduce the water inputs to adjacent wetlands and could lead to partial desiccation and terrestrialisation of the wetlands, specifically hillslope seepage wetlands, immediately adjacent to the ADF.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will act in the long term and *will occur*. The impact risk class is thus **Very High.**

Cumulative Impact

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support.

Other activities within the direct area that have resulted in wetland loss include the Kusile Power Station and the 60 year co-disposal facility (also referred to as the "10 year ADF"), while future proposed activities such as the New Largo Mine are likely to result in further wetland loss within the affected sub-catchments.

Changes in water quality and flow characteristics as a consequence of the ash dam development will place further pressures and stress on the Klipfonteinspruit wetland system which already is under strain from the existing Kusile developments.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Very High**.

Mitigation Measures

1. Loss of wetland habitat
    - Optimise design of ash dam to minimise size of footprint, e.g. increase the height of the ash dam, to minimise loss of wetland habitat.
    - Ensure that the selected site has sufficient material in situ as required for rehabilitation and for the proposed liner, to prevent additional disturbed areas.
    - Avoid additional wetland loss by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ash dam.
    - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
    - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
    - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the construction site.
    - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.

- No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
- Regular cleaning up of the wetland areas should be undertaken to remove litter.
- Undertake a wetland offset study to investigate the possibility of mitigating the loss of wetland habitat on site A through the rehabilitation and protection of wetlands elsewhere.
    - Such an offset should ideally be located within the same catchment
    - A potential target wetland for rehabilitation is the Klipfonteinspruit system downstream of the proposed ash dam site. This system already receives most of the stormwater discharges from Kusile Power Station and will require management interventions as it is already on a negative trajectory of change.

2. Water quality deterioration due to seepage out of the ash dam
    - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
    - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.
    - Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
    - 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.

3. Increased sediment transport into wetlands
    - Minimise area of vegetation clearing.
    - Phase vegetation clearing activities as far as possible to limit the area exposed at any one time.
    - Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
    - Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.
    - Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
    - Install the construction stormwater management system prior to the onset of vegetation clearing activities on the ash dam footprint.
    - Install sediment traps as part of the stormwater management plan where necessary upstream of discharge points.
    - Divert clean water around the cleared area and install erosion protection measures and energy dissipaters at points of discharge.

- Cleared areas outside direct development footprint should be re-vegetated via hydro-seeding as soon as possible.
- A vegetation and erosion monitoring plan should be established for all rehabilitated sites with clearly defined measures to respond to erosion damage or unsuccessful revegetation.

4. Increased erosion within adjacent wetlands
   - Implement a construction stormwater management plan prior to the onset of vegetation clearing activities on site.
   - Stormwater and clean water discharge points should be protected against erosion.
   - Discharge points should incorporate energy dissipaters and erosion protection.
   - Concentrated, high velocity flows should be avoided.
   - During the construction phase, all discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
   - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.
   - The gradient of the stream diversions should be kept as low as possible. The diversion itself should be broad with gently sloping sideslopes, and should incorporate rip rap steps (rock-packed steps) at regular intervals to protect against erosion and to allow for the required fall in the stream diversions.
   - Following construction activities the entire diversion floor should be landscaped to remove all obstacles and ruts that could lead to the formation of preferential flow paths.
   - Re-vegetation of the stream diversion floor should proceed naturally and establish rapidly (based on experience from the Goedgevonden main river diversion) if sufficient flow through the wetland is available. Should exceptionally low flows be encountered due to drought conditions, seeding of the diversion might be required to ensure rapid vegetation establishment. Regular, monthly monitoring of the stream diversion will thus be required until vegetation cover has been established across the full stream diversion.
   - More terrestrial areas such as the sideslopes of the stream diversions will not re-vegetate naturally and should be seeded with a suitable mix of indigenous highveld grasses.

5. Water quality deterioration in adjacent wetlands and water resources
   - Store and handle potentially polluting substances and waste in designated, bunded facilities.
   - Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
   - Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
   - Keep sufficient quantities of spill clean-up materials on site.
   - Clearly define roles and responsibilities of all personnel during spillage events.
   - Keep a detailed log on site of all spills.

- Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
- No washing of machinery or equipment within wetlands areas adjacent to the development sites should be allowed.

6. Decrease flows within adjacent wetlands
    - Minimise size of ADF footprint and the area contained within the dirty water area.
    - Ensure all clean water and water derived from the upstream catchment are diverted around the ADF and discharged back into downstream water resources.
    - All discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
    - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.

7. Loss of Red Data and protected species
    - Appoint suitably qualified professionals to undertake search and rescue operations for Red Data plant species prior to vegetation clearing activities.
    - Include Red Data species and suitable habitat in offset considerations

8. Increase in alien vegetation
    - 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.

9. Water quality deterioration due to ash from the ADF
    - Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
    - Implement a water quality monitoring plan to monitor potential impacts to water quality.
    - Implement corrective measures to address any water quality impairment that may be observed

10. Water quality deterioration due to ash from the conveyor
    - Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
    - Gantries should be installed along the conveyor for the full extent of all wetland crossings to limit ash and dust fallout into the wetland.
    - Ash transported on the conveyor should contain sufficient moisture to minimise dust generation. Refer to air quality report for guidelines.
    - All transfer stations along the conveyor should be considered dirty water areas and isolated from surrounding runoff and water resources.

- Implement a water quality monitoring plan to monitor potential impacts to water quality.
- Implement corrective measures to address any water quality impairment that may be observed.

Residual Impact

The residual impact of the operation of the ash dam will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE HIGH negative significance, affecting the *adjacent area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Rated By:				Site A				
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	OPERATION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Loss of wetland habitat	Negative	**Definite**	6 VHIGH	3 ADJ	5 PERM	5 OCCUR	**-5.2** **VHIGH**
Project Impact 2	Water quality deterioration due to seepage out of the ADF	Negative	**Definite**	6 VHIGH	5 DIS	4 LONG	5 OCCUR	**-5.5** **VHIGH**
Project Impact 3	Increased sediment transport into wetlands	Negative	**Definite**	4 MODH	3 ADJ	2 SHORT	5 OCCUR	**-3.3** **MODH**
Project Impact 4	Increased erosion within adjacent wetlands	Negative	**Probable**	4 MODH	3 ADJ	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 5	Water quality deterioration in adjacent wetlands & water resources	Negative	**Probable**	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**
Project Impact 6	Decreased flows within adjacent wetlands	Negative	**Probable**	4 MODH	3 ADJ	4 LONG	5 OCCUR	**-4.1** **HIGH**
Project Impact 7	Loss of Red Data species and protected species	Negative	**Probable**	4 MODH	2 DEV	5 PERM	5 OCCUR	**-4.1** **HIGH**
Project Impact 8	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 9	Water quality deterioration due to ash dust from the ADF	Negative	**Possible**	5 HIGH	6 PRO	4 LONG	5 OCCUR	**-5.5** **VHIGH**
Project Impact 10	Water quality deterioration due to ash dust from the conveyor	Negative	**Possible**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	5 HIGH	6 PRO	5 PERM	5 OCCUR	**-5.9** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	3 ADJ	5 PERM	5 OCCUR	**-4.4** **HIGH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – loss of wetland habitat			
Primary Objective:			
Limit the extent of wetland habitat directly impacted.			
Mitigate the residual impact of wetland loss through implementation of an offset strategy.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Optimise the design and layout of the 60-year ADF to minimise the footprint size of the facility and the extent of wetlands directly impacted.	Developer		
2) Confirm availability of sufficient clay material for the required liner system and sufficient topsoil for rehabilitation already at the planning stage.	Developer		
3) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat. Clearly mark wetland areas.	Contractor, Environmental Manager, ECO		
4) Commission and implement a wetland offset strategy in line with best practice guidelines.	Developer, Environmental Manager		
5) Include environmental awareness aspects into the site induction for all staff to ensure all staff are aware of the importance and location of wetlands on site.	Contractor, Environmental Manager		
6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		
7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.	Developer, ECO		
Existing management plans / procedures:			
A detailed site selection process was undertaken to select the preferred site. This site selection was also informed by wetland considerations.			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ash dam from the surrounding catchment through installation of a suitable liner system as per the Waste Classification Guidelines.	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ash dam.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increased sediment transport into wetlands			
Primary Objective:			
Limit the transport of sediments off the construction site			
Limit the deposition of sediments within wetland habitat			
Limit erosion within receiving wetland habitats			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Install and regularly maintain and repair sediment barriers along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Monthly (and after every large storm event)
3) No vegetation clearing should take place in any wetland outside the direct development footprint.	Contractor, Environmental Manager, ECO		Weekly
4) Phase vegetation clearing to limit exposed area at any one time. As far as possible, limit the major clearing activities and earthworks to the dry season.	Contractor, Environmental Manager, ECO		
5) Install sediment barriers and/or low level berms along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Weekly during the rainy season
6) Rehabilitate all cleared areas outside the direct development footprint as soon as possible following the disturbance.	Contractor, Environmental Manager, ECO		Weekly
3) Water quality monitoring and biomonitoring to be undertaken as per the recommended monitoring plan in the aquatic ecology report.	Specialist		As per aquatic ecology report
4) Inspect and maintain all stormwater discharge points.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Erosion in adjacent wetlands			
Primary Objective:			
Limit erosion within receiving wetland habitats			
Limit the deposition of sediments within wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Stormwater discharge point should be protected against erosion and incorporate energy dissipaters.	Contractor, Environmental Manager, ECO		Monthly
3) Install sediment traps or sediment barriers at all discharge points. Sediment traps/barriers should be designed to cope with flow velocities at point of discharge.	Contractor, Environmental Manager, ECO		Monthly
4) Undertake regular inspections and maintenance of all discharge points.	Contractor, Environmental Manager, ECO		Monthly
5) Separate clean and dirty water. All clean water to be discharged to the environment. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
6) Environmental considerations should help inform the stream diversion design. A wetland specialist should be appointed to assist the engineers in this regard.	Developer		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – water quality deterioration			
Primary Objective:			
Prevent water quality deterioration due to spills and leaks			
Prevent water quality deterioration due to incorrect waste disposal			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure separation of clean and dirty water. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.	Contractor, Environmental Manager, ECO		
3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.	Contractor, Environmental Manager, ECO		
4) Regularly remove waste from the construction site and dispose of on an approved facility.	Contractor, Environmental Manager, ECO		
5) No washing of machinery or equipment within the adjacent wetland areas.	Contractor, Environmental Manager, ECO		
6) Compile an emergency response plan to deal with spills.	Contractor, Environmental Manager, ECO		
7) Compile and implement a monitoring plan.	Environmental Manager		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands - decrease flows in adjacent wetlands			
Primary Objective:			
Minimise reduction in flows to adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Divert all clean water from upslope of the ADF around the ADF and into downstream wetlands.	Contractor, Environmental Manager, ECO		
2) Separate clean and dirty water. All clean water to be discharge into the environment.	Contractor, Environmental Manager, ECO		
3) All discharge points to incorporate energy dissipaters and erosion protection measures.	Contractor, Environmental Manager, ECO		
4) Regularly inspect and maintain all diversions and discharge points.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Loss of Red Data and protected species			
Primary Objective:			
Minimise the loss of Red Data and protected species			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Appoint professionals to undertake a search and rescue operation for Red Data and protected species prior to the commencement of any construction activities.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile and implement an alien vegetation management plan for the entire affected area.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from ash dam			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from conveyor			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) Implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
4) install gantries along all wetland crossings.			
5) All transfer stations along the conveyor route should be considered dirty water areas and isolated from the surrounding catchment.			
Existing management plans / procedures:			

9.3.3 Closure Phase

Status Quo

This is detailed under Section 9.3.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as a consequence of the closure phase of the 60 year ADF and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.). Impacts relating to the rehabilitation of the ADF are also applicable to the operational phase of the project, as concurrent rehabilitation will take place.

1. Water quality deterioration due to seepage out of the ADF
2. Water quality deterioration due to ash dust from the ADF
3. Increased sediment transport into wetlands due to erosion of sideslopes
4. Disturbance of wetland habitat
5. Water quality deterioration due to spills and leaks during ongoing construction activities
6. Increased risk of erosion in wetlands
7. Loss of Red Data and protected species
8. Increase in alien vegetation

The ash disposed of on the ash dam will contain a number of pollutants. Contaminated surface water runoff from the ash dam 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. The Klipfonteinspruit drains into the Wilge River and any water quality impacts to the Klipfonteinspruit are likely to also affect the Wilge River.

Water quality could also be affected through dust deposition in wetlands. Ash dust is likely to be blown from the ash dam. Direct deposition of this dust into wetlands could result in contamination of surface waters with a resultant loss in sensitive species.

Rehabilitation of the ash dam will include the placement of topsoil on the sideslopes and crest of the ADF and the establishment of vegetation on the ADF. Surface runoff on the steep sidelsopes of the ADF is likely to erode the placed topsoil, especially in the initial stages prior to the establishment of sufficient vegetation cover.

Decommissioning activities along the conveyor route could result in disturbance to the wetlands that increase the risk of erosion within the affected wetland reaches.

The decommissioning and removal of infrastructure during the closure phase is also likely to result in a number of impacts similar to the construction phase impacts, including:

- Decommissioning activities are likely to increase the disturbance footprint beyond the boundaries of the actual development footprint through temporary stockpiles, laydown areas, contractors camps, uncontrolled driving of machinery etc. Such activities will result in the loss of vegetation cover within the affected areas and increase the risk of erosion. Ruts and vehicle tracks could result in the formation of preferential flow paths that concentrate flow and exacerbate the erosion risk. Eroded sediments will be transported down the systems and deposited further along the wetlands and potentially the Wilge River. Erosion within the wetlands could lead to channel incision and the partial drying out of areas adjacent to the channel and erosion gullies, leading to changes in vegetation.
- In addition to increased sediment transport and turbidity, spills and leaks of hazardous substances used during the decommissioning process could enter adjacent wetlands via surface run-off, leading to water quality deterioration. Potentially polluting substances like cement, oil and diesel are likely to be regularly used and temporarily stored on the site. Spills of these substances or the incorrect disposal of material contaminated with these substances are likely to result in water quality deterioration in adjacent wetlands, resulting in a loss of sensitive species. Incorrect handling and disposal of waste, including sewage from portable, temporary ablutions could also result in water quality deterioration.
- Areas disturbed as a result of the decommissioning activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will be <u>permanent</u> and <u>*will occur*</u>. The impact risk class is thus **Very High.**

Cumulative Impact

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support.

Other activities within the direct area that have resulted in wetland loss include the Kusile Power Station and the 60 year co-disposal facility (also referred to as the “10 year ADF”), while future proposed activities such as the New Largo Mine are likely to result in further wetland loss within the affected sub-catchments.

Changes in water quality and flow characteristics as a consequence of the ADFdevelopment will place further pressures and stress on the Klipfonteinspruit wetland system which already is under strain from the existing Kusile developments.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Severe**.

Mitigation Measures

1. Water quality deterioration due to seepage out of the ADF
   - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
   - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.
   - Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
   - 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.

2. Water quality deterioration due to ash from the ADF
   - Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
   - Implement a water quality monitoring plan to monitor potential impacts to water quality.
   - Implement corrective measures to address any water quality impairment that may be observed

3. Increased sediment transport into wetlands
   - Re-vegetate the side slopes of the ADF as soon as possible following capping with topsoil.
   - Install sediment barriers along the downslope edge of the rehabilitated area.
   - Monitor vegetation establishment to ensure successful establishment.

4. Disturbance to wetland habitat
   - Avoid additional wetland disturbances by limiting decommissioning activities to as small an area as possible, ideally within the disturbed footprint of the activities and infrastructure.
   - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
   - Clearly demarcate the required decommissioning servitude in the field and limit all decommissioning activities to the demarcated area.
   - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the site.

- Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
- No stockpiling of material may take place within the wetland areas and temporary contractor's camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
- Regular cleaning up of the wetland areas should be undertaken to remove litter.

5. Water quality deterioration due to spills and leaks
   - Store and handle potentially polluting substances and waste in designated, bunded facilities.
   - Waste should be regularly removed from the site by suitably equipped and qualified operators and disposed of in approved facilities.
   - Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
   - Keep sufficient quantities of spill clean-up materials on site.
   - Clearly define roles and responsibilities of all personnel during spillage events.
   - Keep a detailed log on site of all spills.
   - Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
   - No washing of machinery or equipment within wetlands areas adjacent to the development sites should be allowed.

6. Increased risk of erosion in wetlands
   - Limit decommissioning and closure activities to the footprint of the servitude.
   - Undertake decommissioning activities during the dry season.
   - Complete conveyor decommissioning activities within a single dry season.
   - Do not locate any temporary stockpiles or laydown areas in wetlands.
   - Restrict access to all wetland areas except where unavoidable.
   - Rehabilitate disturbed areas as soon as possible.

7. Increase in alien vegetation
   - 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.

Residual Impact

The residual impact of the operation of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE LOW negative significance, affecting the *adjacent area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Rated By:		Site A						
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	Closure							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3 MODH**
Project Impact 1	Water quality deterioration due to seepage out of the ADF	Negative	**Definite**	6 VHIGH	5 DIS	4 LONG	5 OCCUR	**-5.5 VHIGH**
Project Impact 2	Water quality deterioration due to ash dust	Negative	**Possible**	5 HIGH	6 PRO	4 LONG	5 OCCUR	**-5.5 VHIGH**
Project Impact 3	Increased sediment transport into wetlands	Negative	**Probable**	4 MODH	3 ADJ	3 MED	5 OCCUR	**-3.7 MODH**
Project Impact 4	Disturbance of wetland habitat	Negative	**Probable**	3 MODL	2 DEV	2 SHORT	4 VLIKE	**-2.1 MODL**
Project Impact 5	Water quality deterioration due to spills and leaks	Negative	**Possible**	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2 LOW**
Project Impact 6	Increased risk of erosion at conveyor crossings	Negative	**Possible**	3 MODL	3 ADJ	4 LONG	4 VLIKE	**-2.9 MODL**
Project Impact 7	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9 MODL**
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	6 PRO	5 PERM	5 OCCUR	**-6.3 SEV**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3 MODL	3 ADJ	5 PERM	5 OCCUR	**-4.1 HIGH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ADF from the surrounding catchment through installation of a suitable liner systems as per the Waste Classification Guidelines	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ADF.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from ADF			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – increased sediment transport into wetlands			
Primary Objective:			
Limit increased sediment transport into wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Revegetate the side slopes and crest of the ADF as soon as possible after placement of topsoil.	Contractor, Environmental Manager, ECO		
2) Monitor successful establishment of vegetation.	Contractor, Environmental Manager, ECO		Weekly for the first 3 months, then monthly
3) install sediment barriers along lower edge of ADF	Contractor, Environmental Manager, ECO		
4) Install water management infrastructure on the slopes and along the base of the ADF to manage stormwater.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Disturbance to wetland habitat			
Primary Objective:			
Avoid disturbance to wetland habitat outside the required construction servitude.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain fence around all wetland areas until the end of the closure phase.	Contractor, Environmental Manager, ECO		Monthly
2) Include environmental awareness aspects into the site induction program to ensure all staff is aware of the location and importance of wetland habitats in the vicinity of the construction site.	Contractor, Environmental Manager		
3) Rehabilitate all disturbed wetland areas as per the guidelines contained in the wetland report.	Contractor, Environmental Manager, ECO		Weekly (for the first three months following rehabilitation), then quarterly
4) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		Weekly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – water quality deterioration			
Primary Objective:			
Prevent water quality deterioration due to spills and leaks			
Prevent water quality deterioration due to incorrect waste disposal			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure separation of clean and dirty water. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.	Contractor, Environmental Manager, ECO		
3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.	Contractor, Environmental Manager, ECO		
4) Regularly remove waste from the construction site and dispose of on an approved facility.	Contractor, Environmental Manager, ECO		
5) No washing of machinery or equipment within the adjacent wetland areas.	Contractor, Environmental Manager, ECO		
6) Compile an emergency response plan to deal with spills.	Contractor, Environmental Manager, ECO		
7) Compile and implement a monitoring plan.	Environmental Manager		
Existing management plans / procedures:			

Management / Environmental Component:	EMPr Reference Code:		
Wetlands – increased risk of erosion			
Primary Objective:			
Limit erosion within remaining wetlands			
Implementation:	Responsibility:	Resources:	Monitoring/Reporting:
1) Decommissioning activities to be undertaken in the dry season.	Contractor, Environmental Manager, ECO		
2) Limit activities to the disturbed footprint.	Contractor, Environmental Manager, ECO		
3) Locate all temporary stockpiles and laydown areas outside delineated wetlands and at least 100m from the wetlands.	Contractor, Environmental Manager, ECO		
4) Rehabilitate disturbed areas as soon as possible following disturbance.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain the alien vegetation management plan for the entire affected area for at least 5 years post closure.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.3.4 Post-closure Phase

Status Quo

This is detailed under Section 9.3.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise post-closure of the ADF.

1. Water quality deterioration due to seepage out of the ADF
2. Water quality deterioration due to ash dust from the ADF
3. Increased sediment transport into wetlands due to erosion of sideslopes
4. Increase in alien vegetation

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 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. The Klipfonteinspruit drains into the Wilge River and any water quality impacts to the Klipfonteinspruit are likely to also affect the Wilge River.

Water quality could also be affected through ash deposition in wetlands. Erosion of the topsoil capping could expose the ash to erosion by wind and water, with eroded ash depositing in adjacent wetlands. Deposition of ash into wetlands could result in contamination of surface waters with a resultant loss in sensitive species.

Rehabilitation of the ADF will include the placement of topsoil on the sideslopes and crest of the ADF and the establishment of vegetation on the ADF. Surface runoff on the steep sidelsopes of the ADF is likely to erode the placed topsoil, especially in the initial stages prior to the establishment of sufficient vegetation cover.

Areas disturbed as a result of the decommissioning activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will be <u>permanent</u> and <u>*will occur*</u>. The impact risk class is thus **Very High.**

Cumulative Impact

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support.

Other activities within the direct area that have resulted in wetland loss include the Kusile Power Station and the 60 year co-disposal facility (also referred to as the "10 year ADF"), while future proposed activities such as the New Largo Mine are likely to result in further wetland loss within the affected sub-catchments

Changes in water quality and flow characteristics as a consequence of the ADF development will place further pressures and stress on the Klipfonteinspruit wetland system which already is under strain from the existing Kusile developments.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Severe**.

Mitigation Measures

1. Water quality deterioration due to seepage out of the ADF
   - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
   - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.
   - Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
   - 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.

2. Water quality deterioration due to ash from the ADF
   - Ensure a stable topsoil cover remains on the ADF post-closure.
   - Ensure successful vegetation cover is established and maintained on the ADF.
   - Implement a management plan to maintain and manage the vegetation cover on the ADF.
   - Implement an erosion monitoring plan on the ADF with clearly defined corrective responses to any observed erosion damage.
   - Implement a water quality monitoring plan as per the recommendations in the aquatic ecology report.

3. Increased sediment transport into wetlands
   - Re-vegetate the side slopes of the ADF as soon as possible following capping with topsoil.
   - Install sediment barriers along the downslope edge of the rehabilitated area.
   - Monitor vegetation establishment to ensure successful establishment.

4. Increase in alien vegetation
    - 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.

Residual Impact

The residual impact of the operation of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE LOW negative significance, affecting the *local area* in extent. The impact *very likely to happen* and will be long term. The impact risk class is thus **Moderate High**.

Rated By:				Site A				
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	Post-closure							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Water quality deterioration due to seepage	Negative	**Probable**	5 HIGH	6 PRO	4 LONG	4 VLIKE	**-4.4** **HIGH**
Project Impact 2	Water quality deterioration due to ash deposition in wetlands	Negative	**Unsure**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 3	Increased sedimentation in wetlands	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 4	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 5								
Project Impact 6								
Project Impact 7								
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	5 DIS	5 PERM	5 OCCUR	**-5.9** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ADF from the surrounding catchment through installation of a suitable liner systems as per the Waste Classification Guidelines.	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ADF.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from ADF			
Primary Objective:			
Limit ash deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure a stable top soil cover is maintained on the ADF slopes and crest.	Contractor, Environmental Manager, ECO		
2) Ensure sufficient vegetation cover is maintained on the dump to limit erosion.	Contractor, Environmental Manager, ECO		
3) Implement a vegetation management plan for the ash dump.	Contractor, Environmental Manager, ECO		
4) Implement an erosion monitoring plan with clearly defined responses to any erosion damage observed.	Contractor, Environmental Manager, ECO		
5) Implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

<table>
<tr><td colspan="2"><u>Management / Environmental Component:</u></td><td colspan="2"><u>EMPr Reference Code:</u></td></tr>
<tr><td colspan="2">Wetlands – increased sediment transport into wetlands</td><td colspan="2"></td></tr>
<tr><td colspan="4"><u>Primary Objective:</u></td></tr>
<tr><td colspan="4">Limit increased sediment transport into wetlands</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Ensure a stable top soil cover is maintained on the ADF slopes and crest.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
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<tr><td colspan="4"><u>Existing management plans / procedures:</u></td></tr>
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</table>

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain the alien vegetation management plan for the entire affected area for at least 5 years post closure.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.4 Impact Assessment – Solution B

9.4.1 Construction Phase

Status Quo

The footprint of solution B is currently dominated by extensive agricultural activities, mostly cultivation, and includes 6 centre-pivot irrigation systems. Within the immediate vicinity of the study area a number of high intensity agricultural activities such as chicken farming and the Bioselect berry farm also occur. The western side of the solution B footprint is characterised by agricultural smallholdings, while the central and eastern regions consist of larger farms.

The agricultural activities on site have impacted on the wetlands of the area in a number of ways:

Hydrology – The change in landuse from natural grassland to cultivated lands is expected to have had an impact on the run-off characteristics of the landscape, increasing surface runoff volumes and velocities somewhat. A more considerable impact to the hillslope seepage wetlands has been the extensive irrigation on site which has increased soil water and thus increases the water supply to the wetlands. This is especially apparent in the hillslope seepage wetlands draining away from the site in a southerly direction. Numerous dams have also been built within the wetlands that impound flows and from which water is abstracted for irrigation (especially the dams in the southern valley bottom wetland).

Geomorphology – Cultivation of most of the wetland catchment's and the increase in surface runoff from these areas has also increased the transport of sediment into the wetlands. The altered hydrology is in turn also reflected in increased erosion within the wetlands and the formation of a number of erosion gullies/incised channels within the hillslope seepage wetlands.

Vegetation – In addition to changes in vegetation due to the changes in hydrology and sediment inputs, which is generally reflected in the increase in pioneer species such as *Typha capensis*, the wetland vegetation has been impacted by transformation associated with cultivation within the hillslope seepage wetlands. Some alien vegetation also occurs.

Water quality – Impacts to water quality are likely to have materialised from agricultural runoff and the transport of fertiliser and agricultural chemicals into wetland areas.

Based on the PES assessment roughly 28 % of wetlands within the proposed ADF footprint are moderately modified (PES category C), with a further 29 % classed as largely modified. 29 % of the wetland extent within the direct solution B footprint is still considered to be in a largely natural condition, with this being a seepage wetland that has not been previously cultivated and which is surrounded by mostly natural grassland.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as a consequence of the construction activities required for the establishment of the 60 year ADF and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.) on site B:

1. Loss of wetland habitat
2. Disturbance to wetland habitat
3. Decreased flow within downstream wetlands
4. Increased sediment transport into wetlands
5. Increased erosion within adjacent wetlands
6. Water quality deterioration in adjacent wetlands and water resources
7. Loss of Red Data and protected species
8. Increase in alien vegetation
9. Altered flows within wetlands crossed by the conveyor

Wetland habitat falling within the footprint of the ADF, conveyor and Pollution Control Dams will be lost. Earth works relating to the construction of these facilities will permanently destroy the wetland habitats within the construction footprint. In total, the extent of wetland habitat directly affected exceeds 50 hectares. However, not all wetlands will be lost during the construction phase. For the ADF, only the footprint required for the first 5 years of ash deposition will be cleared and prepared during the construction phase. The most extensive wetland loss will thus take place during the operational phase.

Table 33. Extent of wetland habitat falling within the direct footprint of the proposed developments. All wetlands falling within the development footprints will be destroyed.

Solution B

Wetland Type	ADF Footprint	Conveyor Route	Pollution Control Dams	TOTAL
Channelled valley bottom	--	2.36	--	2.36
Floodplain	--	3.80	--	3.80
Hillslope seepage	32.34	12.91	0.29	45.55
Dam	0.44	0.60	--	1.04
TOTAL	**32.34**	**19.07**	**0.29**	**52.74**

The loss of wetland habitat will also result in the loss of functions supported by the wetlands affected, which in the case of site B, are thought to relate mostly to:

- Flow regulation
- Maintenance of water quality
- Biodiversity support
- Direct human use – water supply

The exclusion of the ADF footprint from the catchments feeding the wetland areas surrounding the site will result in decreased flow within these wetlands. This will be significantly exacerbated by the interception of rainfall and the prevention of infiltration into the soil and thus the decreased recharge of the perched aquifer feeding these wetlands. Not only will this result in desiccation of the wetland areas downslope of the ADF footprint, but it will also alter the seasonality of flows within the wetlands as the wetlands become more dependent on surface flows and receive less delayed interflow. Springs feeding the wetland systems could potential dry up, impacting on water supply to downslope water users dependent on water from the seepage wetlands. Decreased flow within the wetlands is likely to lead to terrestrialisation of the wetland vegetation and decreased functionality of the systems. Approximately 190 ha of wetland occur within 500m of the proposed ADF footprint, with most of these wetlands, with the probable exception of the large pan, being fed, at least in part, by flows from the proposed site B footprint.

A number of Red Data bird species were observed at the large pan immediately adjacent to site B, including Greater Flamingo and Black-winged Pratincole. Although this pan will not be directly impacted by construction activities, the Black-winged Pratincoles do utilise the agricultural fields as foraging areas. The hillslope seepage wetland draining in an easterly direction away from the site is also associated with primary grassland and is considered to be of High ecological importance and sensitivity.

Construction activities are also likely to increase the disturbance footprint beyond the boundaries of the actual development footprint through temporary stockpiles, laydown areas, construction camps, uncontrolled driving of machinery etc. Such activities will result in the loss of vegetation cover within the affected areas and increase the risk of erosion. Ruts and vehicle tracks could result in the formation of preferential flow paths that concentrate flow and exacerbate the erosion risk. Eroded sediments will be transported down the systems and deposited further along the wetlands and potentially the Wilge River and Bronkhorstspruit. Erosion within the wetlands could lead to channel incision and the partial drying out of areas adjacent to the channel and erosion gullies, leading to changes in vegetation.

Discharge of stormwater will increase flow velocities and erosion risk within receiving wetlands. Stripping of vegetation will increase volumes and velocities of surface runoff generated from the affected area. Soil compaction due to movement of machinery during construction will further increase runoff volumes and velocities, while vehicle ruts and tracks resulting from construction activity could provide preferential flow paths that lead to flow concentration, again increasing erosion risk.

Vegetation clearing and site preparation activities will expose large areas of disturbed soils to erosion by wind and water. Eroded sediments will be transported into downslope wetlands and lead to changes in habitat, specifically vegetation composition and structure.

In addition to increased sediment transport and turbidity, spills and leaks of hazardous substances used during the construction process could enter adjacent wetlands via surface run-off, leading to water quality deterioration. Potentially polluting substances like cement, oil and diesel are likely to be regularly used and temporarily stored on the construction site. Spills of these substances or the incorrect disposal of material contaminated with these substances are likely to result in water quality deterioration in adjacent wetlands, resulting in a loss of sensitive species. Incorrect handling and disposal of waste, including sewage from portable, temporary ablutions could also result in water quality deterioration.

Areas disturbed as a result of the construction activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands (SANBI, http://www.sanbi.org/information/infobases/invasive-alien-plant-alert/campuloclinium-macrocephalum-pom-pom-weed), as well as the black wattle, *Acacia mearnsii.*

As part of the proposed ADF development a conveyor from the power station to the ADF will be required. In the case of site B, this conveyor will be approximately 11 km in length and will require crossing the Wilge River, the Klipfonteinspruit as well as a further 3 wetland systems. The conveyor will be constructed on a filled platform approximately 30 m wide and, together with the dirty water canals on either side of the platform will occupy and area approximately 50m wide. All wetland habitat falling within the footprint of the 50m wide direct disturbance footprint will be lost, while the construction of a filled platform across wetland systems is also likely to impact on flows within the wetlands, especially during bank overtopping events. The construction process is also likely to increase sediment transport into wetlands and increase the risk of erosion at crossing points.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will be permanent and *will occur*. The impact risk class is thus **Very High.**

Cumulative Impact

Construction of the ADF on site B, together with the associated conveyor, will result in the overall zone of influence of Kusile being significantly increased, given the location more than 11km from the Kusile Power Station and the fact that is situated along a watershed between 2 quarternary catchments (and 4 sub-catchments). Specifically, the zone of influence will be extended into sub-catchments that are as yet not impacted by mining or industrial activities

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support. Although impacted by agriculture, the affected wetland systems are largely still unimpacted by mining or industrial activities, as well as urbanisation.

The proposed development will also contribute to the following cumulative impacts:

- The loss of wetland habitat within the site B footprint will contribute to the loss of wetland habitat within the region

- Decreased flows within a number of the hillslope seepage wetlands and the potential drying up of springs could make a number of farming operations in the area untenable
- Water quality is likely to deteriorate in a number of wetlands draining away from the site.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *district area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Very High**.

Mitigation Measures

1. Loss of wetland habitat
   - Optimise design of ADF to minimise size of footprint, e.g. increase the height of the ADF, to minimise loss of wetland habitat.
   - Ensure that the selected site has sufficient material in situ as required for rehabilitation and for the proposed liner, to prevent additional disturbed areas.
   - Avoid additional wetland loss by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ADF.
   - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
   - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
   - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the construction site.
   - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
   - No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
   - Regular cleaning up of the wetland areas should be undertaken to remove litter.
   - Undertake a wetland offset study to investigate the possibility of mitigating the loss of wetland habitat on site B through the rehabilitation and protection of wetlands elsewhere.
     - Such an offset should ideally be located within the same catchment
     - An opportunity for wetland offsets might exist within the wetlands of site C and adjacent areas. Such an offset could act as an extension of the offset and wetland rehabilitation already planned within this area. Any offset project should be undertaken according to the offset guidelines which are currently being updated by SANBI.
     - A potential target wetland for rehabilitation is the Klipfonteinspruit system downstream of the proposed ADF site. This system already receives most

of the stormwater discharges from Kusile Power Station and will require management interventions as it is already on a negative trajectory of change.

2. Disturbance to wetland habitat
    - Avoid additional wetland disturbances by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ADF.
    - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
    - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
    - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the construction site.
    - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
    - No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
    - Regular cleaning up of the wetland areas should be undertaken to remove litter.

3. Decreased flow within downstream wetlands

From a water quality perspective it is important that the ash dump be isolated from the surrounding environment through clean and dirty water separation and the installation of a liner. This allows for limited possibilities to mitigate against a reduction in flow within adjacent wetlands. The following recommendations are however made:

- All clean water should be diverted around dirty water areas and discharged into adjacent wetlands.
- The ADF design should be optimised so as to minimise the ADF footprint.
- The source of water to the springs feeding the hillslope seepage wetlands should be determined and the reduction in flows quantified. An alternative source of water might need to be found/supplied for farmers dependant on the springs.

4. Increased sediment transport into wetlands
    - Minimise area of vegetation clearing.
    - Phase vegetation clearing activities as far as possible to limit the area exposed at any one time.
    - Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
    - Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.

- Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
- Install the construction stormwater management system prior to the onset of vegetation clearing activities on the ADF footprint.
- Install sediment traps as part of the stormwater management plan where necessary upstream of discharge points.
- Divert clean water around the cleared area and install erosion protection measures and energy dissipaters at points of discharge.
- Cleared areas outside direct development footprint should be re-vegetated via hydro-seeding as soon as possible.
- A vegetation and erosion monitoring plan should be established for all rehabilitated sites with clearly defined measures to respond to erosion damage or unsuccessful revegetation.

5. Increased erosion within adjacent wetlands
    - Implement a construction stormwater management plan prior to the onset of vegetation clearing activities on site.
    - Stormwater and clean water discharge points should be protected against erosion.
    - Discharge points should incorporate energy dissipaters and erosion protection.
    - Concentrated, high velocity flows should be avoided.
    - During the construction phase, all discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
    - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.
    - The gradient of the stream diversions should be kept as low as possible. The diversion itself should be broad with gently sloping sideslopes, and should incorporate rip rap steps (rock-packed steps) at regular intervals to protect against erosion and to allow for the required fall in the stream diversions.
    - Following construction activities the entire diversion floor should be landscaped to remove all obstacles and ruts that could lead to the formation of preferential flow paths.
    - Re-vegetation of the stream diversion floor should proceed naturally and establish rapidly (based on experience from the Goedgevonden main river diversion) if sufficient flow through the wetland is available. Should exceptionally low flows be encountered due to drought conditions, seeding of the diversion might be required to ensure rapid vegetation establishment. Regular, monthly monitoring of the stream diversion will thus be required until vegetation cover has been established across the full stream diversion.
    - More terrestrial areas such as the sideslopes of the stream diversions will not re-vegetate naturally and should be seeded with a suitable mix of indigenous highveld grasses.

6. Water quality deterioration in adjacent wetlands and water resources

- Store and handle potentially polluting substances and waste in designated, bunded facilities.
- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
- Keep sufficient quantities of spill clean-up materials on site.
- Clearly define roles and responsibilities of all personnel during spillage events.
- Keep a detailed log on site of all spills.
- Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
- No washing of machinery or equipment within wetlands areas adjacent to the development sites should be allowed.

7. Loss of Red Data and protected species
   - Appoint suitably qualified professionals to undertake search and rescue operations for Red Data plant species prior to vegetation clearing activities.
   - Include Red Data species and suitable habitat in offset considerations.

8. Increase in alien vegetation
   - 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.

9. Altered flows within wetlands crossed by the conveyor
   - Crossing infrastructure should aim to minimise concentration of flows, as well as impoundment of flows upslope of crossings.
   - The active channel of all wetlands should be crossed by a clear span bridge, with no pedestals located within the active channels.
   - Where culverts are utilised to cross seepage wetlands or weakly channelled systems, sufficient culverts should be utilised to ensure wetting of the full wetland front downslope of the crossing.
   - Gantries should be installed at all wetland crossings.

Residual Impact

The residual impact of the construction of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within two quarternary catchments and 4 sub-catchments, including the Wilge River and the Bronkhorstspruit, will increase the extent of the impacts significantly.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE HIGH negative significance, affecting the *local area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Rated By:		Site B						
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Loss of wetland habitat	Negative	**Definite**	5 HIGH	3 ADJ	5 PERM	5 OCCUR	**-4.8** **HIGH**
Project Impact 2	Disturbance to wetland habitat	Negative	**Probable**	3 MODL	2 DEV	2 SHORT	4 VLIKE	**-2.1** **MODL**
Project Impact 3	Decreased flow within downstream wetlands	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 4	Increased sediment transport into wetlands	Negative	**Definite**	4 MODH	3 ADJ	2 SHORT	5 OCCUR	**-3.3** **MODH**
Project Impact 5	Increased erosion within adjaent wetlands	Negative	**Probable**	4 MODH	3 ADJ	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 6	Water quality deterioration within adjacent wetlands & water resources	Negative	**Probable**	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**
Project Impact 7	Loss of Red Data species and protected species	Negative	**Possible**	3 MODL	3 ADJ	5 PERM	3 LIKE	**-2.4** **MODL**
Project Impact 8	Increase in alien vegetation	Negative	**Possible**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 9	Alterred flows within wetlands crossed by the conveyor	Negative	**Definite**	5 HIGH	3 ADJ	5 PERM	5 OCCUR	**-4.8** **HIGH**
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	5 DIS	5 PERM	5 OCCUR	**-5.9** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	5 PERM	5 OCCUR	**-4.8** **HIGH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – loss of wetland habitat			
Primary Objective:			
Limit the extent of wetland habitat directly impacted.			
Mitigate the residual impact of wetland loss through implementation of an offset strategy.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Optimise the design and layout of the 60-year ADF to minimise the footprint size of the facility and the extent of wetlands directly impacted.	Developer		
2) Confirm availability of sufficient clay material for the required liner system and sufficient topsoil for rehabilitation already at the planning stage.	Developer		
3) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat. Clearly mark wetland areas.	Contractor, Environmental Manager, ECO		
4) Commission and implement a wetland offset strategy in line with best practice guidelines.	Developer, Environmental Manager		
5) Include environmental awareness aspects into the site induction for all staff to ensure all staff is aware of the importance and location of wetlands on site.	Contractor, Environmental Manager		
6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		
7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.	Developer, ECO		
Existing management plans / procedures:			
A detailed site selection process was undertaken to select the preferred site. This site selection was also informed by wetland considerations.			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Disturbance to wetland habitat			
Primary Objective:			
Avoid disturbance to wetland habitat outside the required construction servitude.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat.	Contractor, Environmental Manager, ECO		Monthly
2) Include environmental awareness aspects into the site induction program to ensure all staff is aware of the location and importance of wetland habitats in the vicinity of the construction site.	Contractor, Environmental Manager		
3) Implement a construction stormwater management plan.	Contractor, Environmental Manager, ECO		Weekly
4) Rehabilitate all disturbed wetland areas outside the direct development footprints as per the guidelines contained in the wetland report.	Contractor, Environmental Manager, ECO		Weekly (for the first three months following rehabilitation), then quarterly
6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		Weekly
7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.	Developer, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Decreased flow in downslope wetlands			
Primary Objective:			
Quantify reduction in flow to downstream wetlands.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Commission studies to quantify the possible reduction in flows to downslope hillslope seepage wetlands and associated springs.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increased sediment transport into wetlands			
Primary Objective:			
Limit the transport of sediments off the construction site			
Limit the deposition of sediments within wetland habitat			
Limit erosion within receiving wetland habitats			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Install and regularly maintain and repair sediment barriers along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Monthly (and after every large storm event)
3) No vegetation clearing should take place in any wetland outside the direct development footprint.	Contractor, Environmental Manager, ECO		Weekly
4) Phase vegetation clearing to limit exposed area at any one time. As far as possible, limit the major clearing activities and earthworks to the dry season.	Contractor, Environmental Manager, ECO		
5) Install sediment barriers and/or low level berms along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Weekly during the rainy season
6) Rehabilitate all cleared areas outside the direct development footprint as soon as possible following the disturbance.	Contractor, Environmental Manager, ECO		Weekly
3) Water quality monitoring and biomonitoring to be undertaken as per the recommended monitoring plan in the aquatic ecology report.	Specialist		As per aquatic ecology report
4) Inspect and maintain all stormwater discharge points.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Erosion in adjacent wetlands			
Primary Objective:			
Limit erosion within receiving wetland habitats			
Limit the deposition of sediments within wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Stormwater discharge point should be protected against erosion and incorporate energy dissipaters.	Contractor, Environmental Manager, ECO		Monthly
3) Install sediment traps or sediment barriers at all discharge points. Sediment traps/barriers should be designed to cope with flow velocities at point of discharge.	Contractor, Environmental Manager, ECO		Monthly
4) Undertake regular inspections and maintenance of all discharge points.	Contractor, Environmental Manager, ECO		Monthly
5) Separate clean and dirty water. All clean water to be discharged to the environment. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
6) Environmental considerations should help inform the stream diversion design. A wetland specialist should be appointed to assist the engineers in this regard.	Developer		
Existing management plans / procedures:			

<table>
<tr><td><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td>Wetlands – water quality deterioration</td><td colspan="3"></td></tr>
<tr><td colspan="4"><u>Primary Objective:</u></td></tr>
<tr><td colspan="4">Prevent water quality deterioration due to spills and leaks</td></tr>
<tr><td colspan="4">Prevent water quality deterioration due to incorrect waste disposal</td></tr>
<tr><td><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Ensure separation of clean and dirty water. No dirty water to be discharged.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>4) Regularly remove waste from the construction site and dispose of on an approved facility.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>5) No washing of machinery or equipment within the adjacent wetland areas.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>6) Compile an emergency response plan to deal with spills.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>7) Compile and implement a monitoring plan.</td><td>Environmental Manager</td><td></td><td></td></tr>
<tr><td colspan="4"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="4"></td></tr>
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<table>
<tr><td><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td>Wetlands – Loss of Red Data and protected species</td><td colspan="3"></td></tr>
<tr><td colspan="4"><u>Primary Objective:</u></td></tr>
<tr><td colspan="4">Minimise the loss of Red Data and protected species</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Appoint professionals to undertake a search and rescue operation for Red Data and protected species prior to the commencement of any construction activities.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="4"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="4"></td></tr>
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</table>

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile and implement an alien vegetation management plan for the entire affected area.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Conveyor crossings			
Primary Objective:			
Minimise changes to hydrology of the wetlands to be crossed			
Minimise disturbance to the wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile construction method statements for all conveyor crossings. A wetland specialist should review these method statements.	Developer		
2) The active channel of all wetlands should be crossed by a clear span bridge. No pedestals to be located within the active channel of wetlands.	Developer		
3) Gantries must be installed along all wetland crossings.	Developer		
4) Dirty water generated along the conveyor route must be managed and contained in lined facilities.	Contractor, Environmental Manager, ECO		
5) Clearly demarcate the required construction servitude and limit all activities to the servitude.	Contractor, Environmental Manager, ECO		
6) Commence rehabilitation activities as soon as construction activities within a disturbed area are completed.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.4.2 Operational Phase

Status Quo

This is detailed under Section 9.4.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as consequence of the operation of the 60 year ADF and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.). Most of these impacts are a continuation of impacts expected during the construction phase, as construction activities will persist for most of the operational phase as well, as the ADF footprint will be constantly expanded and constructed in "5 year" sections.

1. Loss of wetland habitat
2. Water quality deterioration due to seepage out of the ADF
3. Increased sediment transport into wetlands
4. Increased erosion within adjacent wetlands
5. Water quality deterioration in adjacent wetlands and water resources due to ADF construction activities
6. Decreased flow within adjacent wetlands
7. Loss of Red Data and protected species
8. Increase in alien vegetation
9. Water quality deterioration due to ash dust from the ADF
10. Water quality deterioration due to ash dust from the conveyor

Most of the above impacts have been discussed in detail under the construction phase impact assessment and will be a continuation of the same impacts. Additional impacts expected during the operational phase have been highlighted in red above.

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. The location of the ADF on a watershed between 4 sub-catchments as well as the long conveyor route with associated dirty water canals and pollution control dams significantly increases the zone of influence and provides a challenge to effective mitigation and prevention of spills. Wetlands draining away from site B drain into the Wilge River and the Bronkhorstspruit, while all wetlands crossed by the conveyor drain into the Wilge River, which itself will also be crossed.

Water quality could also be affected through dust deposition in wetlands. 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. Of special concern is the large pan, considered to be of Very High ecological importance and sensitivity, located immediately to the west of the ADF. Pans, being inwardly draining systems, cannot be readily flushed of pollutants once they enter the pan, and tend to accumulate. Even very low contaminant inputs can, over time, become significant problems within pan systems whereas they can be more easily flushed from stream systems.

The ADF will be lined and treated as a dirty water area. No surface runoff from the ADF or seepage should thus enter adjacent wetlands. This will reduce the water inputs to adjacent wetlands and could lead to partial desiccation and terrestrialisation of the wetlands, specifically hillslope seepage wetlands, immediately adjacent to the ADF. It is considered likely that a number of the springs feeding the hillslope seepage wetlands will dry up (modelling should be done to confirm this if site B is selected as the preferred alternative). Loss of flow from these springs will likely have far reaching consequences to farming operations of the area relying on water from these springs, e.g. the Bioselect berry farm.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *provincial area*. The impact will act in the permanent and *will occur*. The impact risk class is thus **Severe.**

Cumulative Impact

Construction of the ADF on site B, together with the associated conveyor, will result in the overall zone of influence of Kusile being significantly increased, given the location more than 11km from the Kusile Power Station and the fact that is situated along a watershed between 2 quarternary catchments (and 4 sub-catchments). Specifically, the zone of influence will be extended into sub-catchments that are as yet not impacted by mining or industrial activities.

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support. Although impacted by agriculture, the affected wetland systems are largely still unimpacted by mining or industrial activities, as well as urbanisation.

The proposed development will also contribute to the following cumulative impacts:

- The loss of wetland habitat within the site B footprint will contribute to the loss of wetland habitat within the region.
- Decreased flows within a number of the hillslope seepage wetlands and the potential drying up of springs could make a number of farming operations in the area untenable.
- Water quality is likely to deteriorate in a number of wetlands draining away from the site.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact is going to happen and will be permanent. The impact risk class is thus **Severe**.

Mitigation Measures

1. Loss of wetland habitat
    - Optimise design of ADF to minimise size of footprint, e.g. increase the height of the ADF, to minimise loss of wetland habitat.
    - Ensure that the selected site has sufficient material in situ as required for rehabilitation and for the proposed liner, to prevent additional disturbed areas.
    - Avoid additional wetland loss by limiting construction activities to as small an area as possible, ideally within the footprint of the proposed ADF.
    - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
    - Clearly demarcate the required construction servitude in the field and limit all construction activities to the demarcated area.
    - Include environmental awareness aspects into the site induction program to ensure all staff is aware of the location and importance of wetland habitats in the vicinity of the construction site.
    - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
    - No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
    - Regular cleaning up of the wetland areas should be undertaken to remove litter.
    - Undertake a wetland offset study to investigate the possibility of mitigating the loss of wetland habitat on site B through the rehabilitation and protection of wetlands elsewhere.
        - Such an offset should ideally be located within the same catchment
        - Any proposed offset strategy should link into the existing offset commitments to ensure a consolidated overall strategy rather than adopting a piecemeal approach.
        - A potential target wetland for rehabilitation is the Klipfonteinspruit system downstream of the proposed ADF site. This system already receives most of the stormwater discharges from Kusile Power Station and will require management interventions as it is already on a negative trajectory of change.

2. Water quality deterioration due to seepage out of the ADF
    - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
    - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.

- Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
- 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.

3. Increased sediment transport into wetlands
   - Minimise area of vegetation clearing.
   - Phase vegetation clearing activities as far as possible to limit the area exposed at any one time.
   - Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
   - Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.
   - Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
   - Install the construction stormwater management system prior to the onset of vegetation clearing activities on the ADF footprint.
   - Install sediment traps as part of the stormwater management plan where necessary upstream of discharge points.
   - Divert clean water around the cleared area and install erosion protection measures and energy dissipaters at points of discharge.
   - Cleared areas outside direct development footprint should be re-vegetated via hydro-seeding as soon as possible.
   - A vegetation and erosion monitoring plan should be established for all rehabilitated sites with clearly defined measures to respond to erosion damage or unsuccessful revegetation.

4. Increased erosion within adjacent wetlands
   - Implement a construction stormwater management plan prior to the onset of vegetation clearing activities on site.
   - Stormwater and clean water discharge points should be protected against erosion.
   - Discharge points should incorporate energy dissipaters and erosion protection.
   - Concentrated, high velocity flows should be avoided.
   - During the construction phase, all discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
   - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.

5. Water quality deterioration in adjacent wetlands and water resources

- Store and handle potentially polluting substances and waste in designated, bunded facilities.
- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
- Keep sufficient quantities of spill clean-up materials on site.
- Clearly define roles and responsibilities of all personnel during spillage events.
- Keep a detailed log on site of all spills.
- Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
- No washing of machinery or equipment within wetlands areas and/or dams adjacent to the development sites should be allowed.

6. Decrease flows within adjacent wetlands
    - Minimise size of ADF footprint and the area contained within the dirty water area.
    - Ensure all clean water and water derived from the upstream catchment are diverted around the ADF and discharged back into downstream water resources.
    - All discharge points should incorporate sediment barriers or sediment traps designed to cope with the flow velocities and volumes at the point of discharge.
    - All discharge points should be regularly inspected for signs of erosion, sediment deposition or obstructions.

7. Loss of Red Data and protected species
    - Appoint suitably qualified professionals to undertake search and rescue operations for Red Data plant species prior to vegetation clearing activities.
    - Include Red Data species and suitable habitat in offset considerations.

8. Increase in alien vegetation
    - 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.

9. Water quality deterioration due to ash from the ADF
    - Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
    - Implement a water quality monitoring plan to monitor potential impacts to water quality, specifically the pan to the south west of the site footprint, but including all water courses draining away from the site.
    - Implement corrective measures to address any water quality impairment that may be observed.

10. Water quality deterioration due to ash from the conveyor
- Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
- Gantries should be installed along the conveyor for the full extent of all wetland crossings to limit ash and dust fallout into the wetland.
- Ash transported on the conveyor should contain sufficient moisture to minimise dust generation. Refer to air quality report for guidelines.
- All transfer stations along the conveyor should be considered dirty water areas and isolated from surrounding runoff and water resources.
- Implement a water quality monitoring plan to monitor potential impacts to water quality.
- Implement corrective measures to address any water quality impairment that may be observed.

Residual Impact

The residual impact of the operation of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a HIGH negative significance, affecting the *local area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Very High**.

Rated By:		Site B						
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	OPERATION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Loss of wetland habitat	Negative	**Definite**	5 HIGH	3 ADJ	5 PERM	5 OCCUR	**-4.8** **HIGH**
Project Impact 2	Water quality deterioration due to seepage out of the ADF	Negative	**Definite**	6 VHIGH	6 PRO	4 LONG	5 OCCUR	**-5.9** **VHIGH**
Project Impact 3	Increased sediment transport into wetlands	Negative	**Definite**	4 MODH	3 ADJ	2 SHORT	5 OCCUR	**-3.3** **MODH**
Project Impact 4	Increased erosion within adjacent wetlands	Negative	**Probable**	4 MODH	3 ADJ	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 5	Water quality deterioration in adjacent wetlands & water resources	Negative	**Probable**	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**
Project Impact 6	Decreased flows within adjacent wetlands	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	5 OCCUR	**-4.8** **HIGH**
Project Impact 7	Loss of Red Data species and protected species	Negative	**Probable**	4 MODH	2 DEV	5 PERM	3 LIKE	**-2.4** **MODL**
Project Impact 8	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 9	Water quality deterioration due to ash dust from the ADF	Negative	**Possible**	5 HIGH	6 PRO	4 LONG	5 OCCUR	**-5.5** **VHIGH**
Project Impact 10	Water quality deterioration due to ash dust from the conveyor	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	4 VLIKE	**-3.8** **MODH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	6 PRO	5 PERM	5 OCCUR	**-6.3** **SEV**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – loss of wetland habitat			
Primary Objective:			
Limit the extent of wetland habitat directly impacted.			
Mitigate the residual impact of wetland loss through implementation of an offset strategy.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Optimise the design and layout of the 60-year ADF to minimise the footprint size of the facility and the extent of wetlands directly impacted.	Developer		
2) Confirm availability of sufficient clay material for the required liner system and sufficient topsoil for rehabilitation already at the planning stage.	Developer		
3) Fence off all wetland areas adjacent to the construction footprint to prevent access and limit disturbance to wetland habitat. Clearly mark wetland areas.	Contractor, Environmental Manager, ECO		
4) Commission and implement a wetland offset strategy in line with best practice guidelines.	Developer, Environmental Manager		
5) Include environmental awareness aspects into the site induction for all staff to ensure all staff is aware of the importance and location of wetlands on site.	Contractor, Environmental Manager		
6) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		
7) All activities taking place within or within 500m of the wetlands will require a Water Use License Application.	Developer, ECO		
Existing management plans / procedures:			
A detailed site selection process was undertaken to select the preferred site. This site selection was also informed by wetland considerations.			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ADF from the surrounding catchment through installation of a suitable liner system as per the Waste Classification Guidelines.	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ADF.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increased sediment transport into wetlands			
Primary Objective:			
Limit the transport of sediments off the construction site			
Limit the deposition of sediments within wetland habitat			
Limit erosion within receiving wetland habitats			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a construction stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Install and regularly maintain and repair sediment barriers along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Monthly (and after every large storm event)
3) No vegetation clearing should take place in any wetland outside the direct development footprint.	Contractor, Environmental Manager, ECO		Weekly
4) Phase vegetation clearing to limit exposed area at any one time. As far as possible, limit the major clearing activities and earthworks to the dry season.	Contractor, Environmental Manager, ECO		
5) Install sediment barriers and/or low level berms along the downslope edge of cleared areas.	Contractor, Environmental Manager, ECO		Weekly during the rainy season
6) Rehabilitate all cleared areas outside the direct development footprint as soon as possible following the disturbance.	Contractor, Environmental Manager, ECO		Weekly
3) Water quality monitoring and biomonitoring to be undertaken as per the recommended monitoring plan in the aquatic ecology report.	Specialist		As per aquatic ecology report
4) Inspect and maintain all stormwater discharge points.	Contractor, Environmental Manager, ECO		Monthly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Erosion in adjacent wetlands			
Primary Objective:			
Limit erosion within receiving wetland habitats			
Limit the deposition of sediments within wetland habitat			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Develop and implement a stormwater management plan prior to the start of construction activities. See recommendations in wetland report.	Contractor		Monthly
2) Stormwater discharge point should be protected against erosion and incorporate energy dissipaters.	Contractor, Environmental Manager, ECO		Monthly
3) Install sediment traps or sediment barriers at all discharge points. Sediment traps/barriers should be designed to cope with flow velocities at point of discharge.	Contractor, Environmental Manager, ECO		Monthly
4) Undertake regular inspections and maintenance of all discharge points.	Contractor, Environmental Manager, ECO		Monthly
5) Separate clean and dirty water. All clean water to be discharged to the environment. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
6) Environmental considerations should help inform the stream diversion design. A wetland specialist should be appointed to assist the engineers in this regard.	Developer		
Existing management plans / procedures:			

<table>
<tr><td colspan="2"><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td colspan="2">Wetlands – water quality deterioration</td><td colspan="3"></td></tr>
<tr><td colspan="5"><u>Primary Objective:</u></td></tr>
<tr><td colspan="5">Prevent water quality deterioration due to spills and leaks</td></tr>
<tr><td colspan="5">Prevent water quality deterioration due to incorrect waste disposal</td></tr>
<tr><td colspan="2"><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td colspan="2">1) Ensure separation of clean and dirty water. No dirty water to be discharged.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">4) Regularly remove waste from the construction site and dispose of on an approved facility.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">5) No washing of machinery or equipment within the adjacent wetland areas.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">6) Compile an emergency response plan to deal with spills.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="2">7) Compile and implement a monitoring plan.</td><td>Environmental Manager</td><td></td><td></td></tr>
<tr><td colspan="5"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="5"></td></tr>
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<tr><td><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td>Wetlands - decrease flows in adjacent wetlands</td><td colspan="3"></td></tr>
<tr><td colspan="4"><u>Primary Objective:</u></td></tr>
<tr><td colspan="4">Minimise reduction in flows to adjacent wetlands</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td><u>Implementation:</u></td><td><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Divert all clean water from upslope of the ADF around the ADF and into downstream wetlands.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>2) Separate clean and dirty water. All clean water to be discharge into the environment.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>3) All discharge points to incorporate energy dissipaters and erosion protection measures.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>4) Regularly inspect and maintain all diversions and discharge points.</td><td>Contractor, Environmental Manager, ECO</td><td></td><td>Monthly</td></tr>
<tr><td colspan="4"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="4"></td></tr>
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Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Loss of Red Data and protected species			
Primary Objective:			
Minimise the loss of Red Data and protected species			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Appoint professionals to undertake a search and rescue operation for Red Data and protected species prior to the commencement of any construction activities.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Compile and implement an alien vegetation management plan for the entire affected area.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from ADF			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) Implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from conveyor			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
4) install gantries along all wetland crossings.			
5) All transfer stations along the conveyor route should be considered dirty water areas and isolated from the surrounding catchment.			
Existing management plans / procedures:			

9.4.3 Closure Phase

Status Quo

This is detailed under Section 9.4.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as a consequence of the closure phase of the 60 year ADF and the associated infrastructure (e.g. conveyor, access roads, PCD's etc.). Impacts relating to the rehabilitation of the ADF are also applicable to the operational phase of the project, as concurrent rehabilitation will take place.

1. Water quality deterioration due to seepage out of the ADF
2. Water quality deterioration due to ash dust from the ADF
3. Increased sediment transport into wetlands due to erosion of sideslopes
4. Disturbance of wetland habitat
5. Water quality deterioration due to spills and leaks
6. Increased risk of erosion in wetlands
7. Loss of Red Data and protected species
8. Increase in alien vegetation

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. The location of the ADF on a watershed between 4 sub-catchments as well as the long conveyor route with associated dirty water canals and pollution control dams significantly increases the zone of influence and provides a challenge to effective mitigation and prevention of spills. Wetlands draining away from site B drain into the Wilge River and the Bronkhorstspruit, while all wetlands crossed by the conveyor drain into the Wilge River, which itself will also be crossed.

Water quality could also be affected through dust deposition in wetlands. Ash dust is likely to be blown from the ADF. Direct deposition of this dust into wetlands could result in contamination of surface waters with a resultant loss in sensitive species. Of special concern is the large pan, considered to be of Very High ecological importance and sensitivity, located immediately to the west of the ADF. Pans, being inwardly draining systems, cannot be readily flushed of pollutants once they enter the pan, and tend to accumulate. Even very low contaminant inputs can, over time, become significant problems within pan systems whereas they can be more easily flushed from stream systems.

Rehabilitation of the ADF will include the placement of topsoil on the sideslopes and crest of the ADF and the establishment of vegetation on the ADF. Surface runoff on the steep sidelsopes of the ADF is likely to erode the placed topsoil, especially in the initial stages prior to the establishment of sufficient vegetation cover.

Decommissioning activities along the conveyor route could result in disturbance to the wetlands that increase the risk of erosion within the affected wetland reaches.

The decommissioning and removal of infrastructure during the closure phase is also likely to result in a number of impacts similar to the construction phase impacts, including:

- Decommissioning activities are likely to increase the disturbance footprint beyond the boundaries of the actual development footprint through temporary stockpiles, laydown areas, contractors camps, uncontrolled driving of machinery etc. Such activities will result in the loss of vegetation cover within the affected areas and increase the risk of erosion. Ruts and vehicle tracks could result in the formation of preferential flow paths that concentrate flow and exacerbate the erosion risk. Eroded sediments will be transported down the systems and deposited further along the wetlands and potentially the Wilge River. Erosion within the wetlands could lead to channel incision and the partial drying out of areas adjacent to the channel and erosion gullies, leading to changes in vegetation.
- In addition to increased sediment transport and turbidity, spills and leaks of hazardous substances used during the decommissioning process could enter adjacent wetlands via surface run-off, leading to water quality deterioration. Potentially polluting substances like cement, oil and diesel are likely to be regularly used and temporarily stored on the site. Spills of these substances or the incorrect disposal of material contaminated with these substances are likely to result in water quality deterioration in adjacent wetlands, resulting in a loss of sensitive species. Incorrect handling and disposal of waste, including sewage from portable, temporary ablutions could also result in water quality deterioration.
- Areas disturbed as a result of the decommissioning activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands, as well as the black wattle, *Acacia mearnsii*.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will be <u>permanent</u> and *<u>will occur</u>*. The impact risk class is thus **Very High.**

Cumulative Impact

Construction of the ADF on site B, together with the associated conveyor, will result in the overall zone of influence of Kusile being significantly increased, given the location more than 11km from the Kusile Power Station and the fact that is situated along a watershed between 2 quarternary catchments (and 4 sub-catchments). Specifically, the zone of influence will be extended into sub-catchments that are as yet not impacted by mining or industrial activities.

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support. Although impacted by agriculture, the affected wetland systems are largely still unimpacted by mining or industrial activities, as well as urbanisation.

The proposed development will also contribute to the following cumulative impacts:

- The loss of wetland habitat within the site B footprint will contribute to the loss of wetland habitat within the region.
- Decreased flows within a number of the hillslope seepage wetlands and the potential drying up of springs could make a number of farming operations in the area untenable.
- Water quality is likely to deteriorate in a number of wetlands draining away from the site.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Severe**.

Mitigation Measures

1. Water quality deterioration due to seepage out of the ADF
    - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
    - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.
    - Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
    - 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.

2. Water quality deterioration due to ash from the ADF
    - Implement all dust suppression mitigation measures as detailed in the air quality specialist assessment.
    - Implement a water quality monitoring plan to monitor potential impacts to water quality.
    - Implement corrective measures to address any water quality impairment that may be observed

3. Increased sediment transport into wetlands
    - Re-vegetate the side slopes of the ADF as soon as possible following capping with topsoil.

- Install sediment barriers along the downslope edge of the rehabilitated area.
- Monitor vegetation establishment to ensure successful establishment.

4. Disturbance to wetland habitat
    - Avoid additional wetland disturbances by limiting decommissioning activities to as small an area as possible, ideally within the disturbed footprint of the activities and infrastructure.
    - Fence off all wetland areas falling outside the direct footprint of activities to limit impacts to these wetlands.
    - Clearly demarcate the required decommissioning servitude in the field and limit all decommissioning activities to the demarcated area.
    - Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats in the vicinity of the site.
    - Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
    - No stockpiling of material may take place within the wetland areas and temporary contractor's camps and infrastructure should also be located at least 100m away from wetland areas falling outside the development footprint.
    - Regular cleaning up of the wetland areas should be undertaken to remove litter.

5. Water quality deterioration due to spills and leaks
    - Store and handle potentially polluting substances and waste in designated, bunded facilities.
    - Waste should be regularly removed from the site by suitably equipped and qualified operators and disposed of in approved facilities.
    - Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
    - Keep sufficient quantities of spill clean-up materials on site.
    - Clearly define roles and responsibilities of all personnel during spillage events.
    - Keep a detailed log on site of all spills.
    - Locate ablution facilities at least 100m from the edge of wetland areas outside the direct development footprint.
    - No washing of machinery or equipment within wetlands areas adjacent to the development sites should be allowed.

6. Increased risk of erosion in wetlands
    - Limit decommissioning and closure activities to the footprint of the servitude.
    - Undertake decommissioning activities during the dry season.
    - Complete conveyor decommissioning activities within a single dry season.
    - Do not locate any temporary stockpiles or laydown areas in wetlands.
    - Restrict access to all wetland areas except where unavoidable.
    - Rehabilitate disturbed areas as soon as possible.

7. Increase in alien vegetation

- 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.

Residual Impact

The residual impact of the operation of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE HIGH negative significance, affecting the *district area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Rated By:				Site B				
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Water quality deterioration due to seepage out of the ADF	Negative	**Definite**	6 VHIGH	6 PRO	4 LONG	4 VLIKE	**-4.7** **HIGH**
Project Impact 2	Water quality deterioration due to ash dust	Negative	**Possible**	5 HIGH	4 LOC	4 LONG	3 LIKE	**-2.9** **MODL**
Project Impact 3	Increased sediment transport into wetlands	Negative	**Probable**	4 MODH	3 ADJ	3 MED	5 OCCUR	**-3.7** **MODH**
Project Impact 4	Disturbance of wetland habitat	Negative	**Probable**	3 MODL	2 DEV	2 SHORT	4 VLIKE	**-2.1** **MODL**
Project Impact 5	Water quality deterioration due to spills and leaks	Negative	**Possible**	5 HIGH	4 LOC	2 SHORT	3 LIKE	**-2.4** **MODL**
Project Impact 6	Increased risk of erosion at conveyor crossings	Negative	**Probable**	5 HIGH	3 ADJ	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 7	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	6 PRO	5 PERM	5 OCCUR	**-6.3** **SEV**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	5 DIS	5 PERM	5 OCCUR	**-5.2** **VHIGH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ADF from the surrounding catchment through installation of a suitable liner systems as per the Waste Classification Guidelines.	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ADF.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash dust from ADF			
Primary Objective:			
Limit ash dust deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Implement all dust suppression mitigation measures as per the air quality specialist report.	Contractor, Environmental Manager, ECO		
2) implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
3) Implement corrective measures to deal with any water quality impairment that may occur.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – increased sediment transport into wetlands			
Primary Objective:			
Limit increased sediment transport into wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Revegetate the side slopes and crest of the ADF as soon as possible after placement of topsoil.	Contractor, Environmental Manager, ECO		
2) Monitor successful establishment of vegetation.	Contractor, Environmental Manager, ECO		Weekly for the first 3 months, then monthly
3) Install sediment barriers along lower edge of ADF.	Contractor, Environmental Manager, ECO		
4) Install water management infrastructure on the slopes and along the base of the ADF to manage stormwater.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Disturbance to wetland habitat			
Primary Objective:			
Avoid disturbance to wetland habitat outside the required construction servitude.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain fence around all wetland areas until the end of the closure phase.	Contractor, Environmental Manager, ECO		Monthly
2) Include environmental awareness aspects into the site induction program to ensure all staff is aware of the location and importance of wetland habitats in the vicinity of the construction site.	Contractor, Environmental Manager		
3) Rehabilitate all disturbed wetland areas as per the guidelines contained in the wetland report.	Contractor, Environmental Manager, ECO		Weekly (for the first three months following rehabilitation), then quarterly
4) No temporary stockpiles or infrastructure should be located within the delineated wetland habitat on site, or within a 100m buffer around the wetlands.	Contractor, Environmental Manager, ECO		Weekly
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – water quality deterioration			
Primary Objective:			
Prevent water quality deterioration due to spills and leaks			
Prevent water quality deterioration due to incorrect waste disposal			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure separation of clean and dirty water. No dirty water to be discharged.	Contractor, Environmental Manager, ECO		
2) All temporary storage areas for potentially hazardous substances or waste should be located at least 100m from the wetlands on bunded/isolated areas.	Contractor, Environmental Manager, ECO		
3) Clean up spills using approved absorbent material such as Drizit or Spillsorb. Such material must be available on site at all times.	Contractor, Environmental Manager, ECO		
4) Regularly remove waste from the construction site and dispose of on an approved facility.	Contractor, Environmental Manager, ECO		
5) No washing of machinery or equipment within the adjacent wetland areas.	Contractor, Environmental Manager, ECO		
6) Compile an emergency response plan to deal with spills.	Contractor, Environmental Manager, ECO		
7) Compile and implement a monitoring plan.	Environmental Manager		
Existing management plans / procedures:			

<table>
<tr><td colspan="2"><u>Management / Environmental Component:</u></td><td colspan="3"><u>EMPr Reference Code:</u></td></tr>
<tr><td colspan="2">Wetlands – increased risk of erosion</td><td colspan="3"></td></tr>
<tr><td colspan="5"><u>Primary Objective:</u></td></tr>
<tr><td colspan="5">Limit erosion within remaining wetlands</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td><u>Implementation:</u></td><td colspan="2"><u>Responsibility:</u></td><td><u>Resources:</u></td><td><u>Monitoring/Reporting:</u></td></tr>
<tr><td>1) Decommissioning activities to be undertaken in the dry season.</td><td colspan="2">Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>2) Limit activities to the disturbed footprint.</td><td colspan="2">Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>3) Locate all temporary stockpiles and laydown areas outside delineated wetlands and at least 100m from the wetlands.</td><td colspan="2">Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td>4) Rehabilitate disturbed areas as soon as possible following disturbance.</td><td colspan="2">Contractor, Environmental Manager, ECO</td><td></td><td></td></tr>
<tr><td colspan="5"><u>Existing management plans / procedures:</u></td></tr>
<tr><td colspan="5"></td></tr>
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Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain the alien vegetation management plan for the entire affected area for at least 5 years post closure.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.4.4 Post-closure Phase

Status Quo

This is detailed under Section 9.4.1 above.

Project Impact (Unmitigated)

A number of impacts are expected to materialise post-closure of the ADF.

1. Water quality deterioration due to seepage out of the ADF
2. Water quality deterioration due to ash sediments from the ADF
3. Increased sediment transport into wetlands due to erosion of sideslopes
4. Increase in alien vegetation

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. The location of the ADF on a watershed between 4 sub-catchments significantly increases the zone of influence and provides a challenge to effective mitigation and prevention of spills. Wetlands draining away from site B drain into the Wilge River and the Bronkhorstspruit, while all wetlands crossed by the conveyor drain into the Wilge River, which itself will also be crossed.

Water quality could also be affected through ash deposition in wetlands. Erosion of the topsoil capping could expose the ash to erosion by wind and water, with eroded ash depositing in adjacent wetlands. Deposition of ash into wetlands could result in contamination of surface waters with a resultant loss in sensitive species. Of special concern is the large pan, considered to be of Very High ecological importance and sensitivity, located immediately to the west of the ADF. Pans, being inwardly draining systems, cannot be readily flushed of pollutants once they enter the pan, and tend to accumulate. Even very low contaminant inputs can, over time, become significant problems within pan systems whereas they can be more easily flushed from stream systems.

.Areas disturbed as a result of the construction and decommissioning activities, be it direct or indirect disturbances, are likely to be susceptible to invasion by alien vegetation. Of particular concern within the wetlands and grasslands of the area is the Pompom weed (*Campuloclinium macrocephalum*) which poses a serious threat to grasslands and wetlands, as well as black wattle, *Acacia mearnsii*.

The combined weighted project impact to wetlands (prior to mitigation) will **probably** be of a VERY HIGH negative significance, affecting the *district area*. The impact will be <u>permanent</u> and <u>*will occur*</u>. The impact risk class is thus **Very High.**

Can we expect that during the post-closurephase, or beyond, that the stream diversions around the ADF in Site A vs Site B would reach some sort of equilibrium or reference condition capable of fulfilling the functions and services that the lost wetlands is currently providing at each site? Therefore is it probably that in the medium to long term artificial stream diversions would be able to re-establish the necessary wetland services at Site A and/or Site B. This is probably more relevant as an indirect/cumulative impact.

Cumulative Impact

The agricultural activities on site have resulted in wetland habitat degradation, though most of the wetlands still exist and are at least partially functional compared to their reference condition and functions they were likely to support.

Other activities within the direct area that have resulted in permanent wetland loss include the Kusile Power Station and the 60 year co-disposal facility (also referred to as the "10 year ADF"), while future proposed activities such as the New Largo Mine are likely to result in further wetland loss within the affected sub-catchments. During the post-closure phase of the ADF, which will take place in effect 60 years after the onset of operation, the Kusile Power Station will however also likely have been decommissioned.

Changes in water quality and flow characteristics as a consequence of the ADF development will place further pressures and stress on the Klipfonteinspruit wetland system which already is under strain from the existing Kusile developments.

The baseline impacts are considered to be substantial, and additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will **probably** be of a VERY HIGH negative significance, affecting the *provincial area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **Severe**.

Mitigation Measures

1. Water quality deterioration due to seepage out of the ADF
   - Isolate the ADF from the surrounding catchment through installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water.
   - Water management infrastructure should be sized as per best practice guidelines and should be able to cope with 1:50 year storm events without overflowing as a minimum.
   - Water management infrastructure should be regularly inspected and maintained fully functional at all times. Implement a water quality monitoring plan.
   - 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.

2. Water quality deterioration due to ash from the ADF
   - Ensure a stable topsoil cover remains on the ADF post-closure.
   - Ensure successful vegetation cover is established and maintained on the ADF.

- Implement a management plan to maintain and manage the vegetation cover on the ADF.
- Implement an erosion monitoring plan on the ADF with clearly defined corrective responses to any observed erosion damage.
- Implement a water quality monitoring plan as per the recommendations in the aquatic ecology report.

3. Increased sediment transport into wetlands
   - Re-vegetate the side slopes of the ADF as soon as possible following capping with topsoil.
   - Install sediment barriers along the downslope edge of the rehabilitated area.
   - Monitor vegetation establishment to ensure successful establishment.

4. Increase in alien vegetation
   - 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.

Residual Impact

The residual impact of the operation of the ADF will include the permanent loss of wetland habitat, as well as declines in water quality and degradation of downstream wetland habitat. Most of these impacts are expected to be mostly restricted to the local scale, though the possible deterioration of water quality within the water courses draining away from the area will increase the extent of the impacts.

The residual impact to wetlands beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to wetlands will **probably** be of a MODERATE LOW negative significance, affecting the *local area* in extent. The impact *is very likely to happen* and will be long term. The impact risk class is thus **Moderate High**.

Rated By:				Site B				
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnatude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**
Project Impact 1	Water quality deterioration due to seepage	Negative	**Probable**	5 HIGH	6 PRO	4 LONG	4 VLIKE	**-4.4** **HIGH**
Project Impact 2	Water quality deterioration due to ash deposition in wetlands	Negative	**Unsure**	4 MODH	5 DIS	4 LONG	4 VLIKE	**-3.8** **MODH**
Project Impact 3	Increased sedimentation in wetlands	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 4	Increase in alien vegetation	Negative	**Probable**	4 MODH	2 DEV	4 LONG	4 VLIKE	**-2.9** **MODL**
Project Impact 5								
Project Impact 6								
Project Impact 7								
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	5 DIS	5 PERM	5 OCCUR	**-5.9** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – seepage out of ADF			
Primary Objective:			
Prevent water quality deterioration in adjacent wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Isolate the ADF from the surrounding catchment through installation of a suitable liner systems as per the Waste Classification Guidelines.	Developer		
2) Install seepage collection infrastructure to collect and contain seepage out of the ADF.	Developer		
3) Install lined Pollution Control Dams and dirty water management infrastructure to cater for the 1:50 year flood as a minimum.	Developer		
4) Compile and emergency response plan to deal with spills or infrastructure failure.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – ash sediments from ADF			
Primary Objective:			
Limit ash deposition in wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure a stable top soil cover is maintained on the ADF slopes and crest.	Contractor, Environmental Manager, ECO		
2) Ensure sufficient vegetation cover is maintained on the dump to limit erosion.	Contractor, Environmental Manager, ECO		
3) Implement a vegetation management plan for the ash dump	Contractor, Environmental Manager, ECO		
4) Implement an erosion monitoring plan with clearly defined responses to any erosion damage observed.	Contractor, Environmental Manager, ECO		
5) Implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – increased sediment transport into wetlands			
Primary Objective:			
Limit increased sediment transport into wetlands			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Ensure a stable top soil cover is maintained on the ADF slopes and crest.	Contractor, Environmental Manager, ECO		
2) Ensure sufficient vegetation cover is maintained on the dump to limit erosion.	Contractor, Environmental Manager, ECO		
3) Implement a vegetation management plan for the ash dump.	Contractor, Environmental Manager, ECO		
4) Implement an erosion monitoring plan with clearly defined responses to any erosion damage observed.	Contractor, Environmental Manager, ECO		
5) Implement a water quality monitoring plan as per the aquatic ecology and surface water specialist reports.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

Management / Environmental Component:	**EMPr Reference Code:**		
Wetlands – Increase in alien vegetation			
Primary Objective:			
Limit establishment of alien vegetation			
Control the spread of alien vegetation			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**
1) Maintain the alien vegetation management plan for the entire affected area for at least 5 years post closure.	Contractor, Environmental Manager, ECO		
2) Conduct regular surveys for alien vegetation and remove populations.	Contractor, Environmental Manager, ECO		
3) All removal of alien vegetation to be undertaken under supervision of a trained professional.	Contractor, Environmental Manager, ECO		
Existing management plans / procedures:			

9.5 Cumulative Impacts

A number of large developments are currently proposed for the general vicinity of the Kusile Power Station. In addition to the Kusile 60-year Ash Disposal Facility, the following projects are known to be in various stages of planning and/or implementation in the area:

- the continuous ashing at Kendal Power Station will result in an increased ash dam footprint;
- the proposed Kendal 30-year Ash Disposal Facility. 4 alternatives are currently being investigated;
- The proposed New Largo opencast coal mine; and
- A number of other small mining operations.

Numerous small mines are also already active in the general area.

Figure 34 shows all of the proposed activities in relation to the Kusile Power Station and the various alternatives investigated for the 60-year ADF. All of these activities fall within the Wilge River sub-catchment of the Olifants River Catchment, with both the Wilge River and the Saalboomspruit being affected.

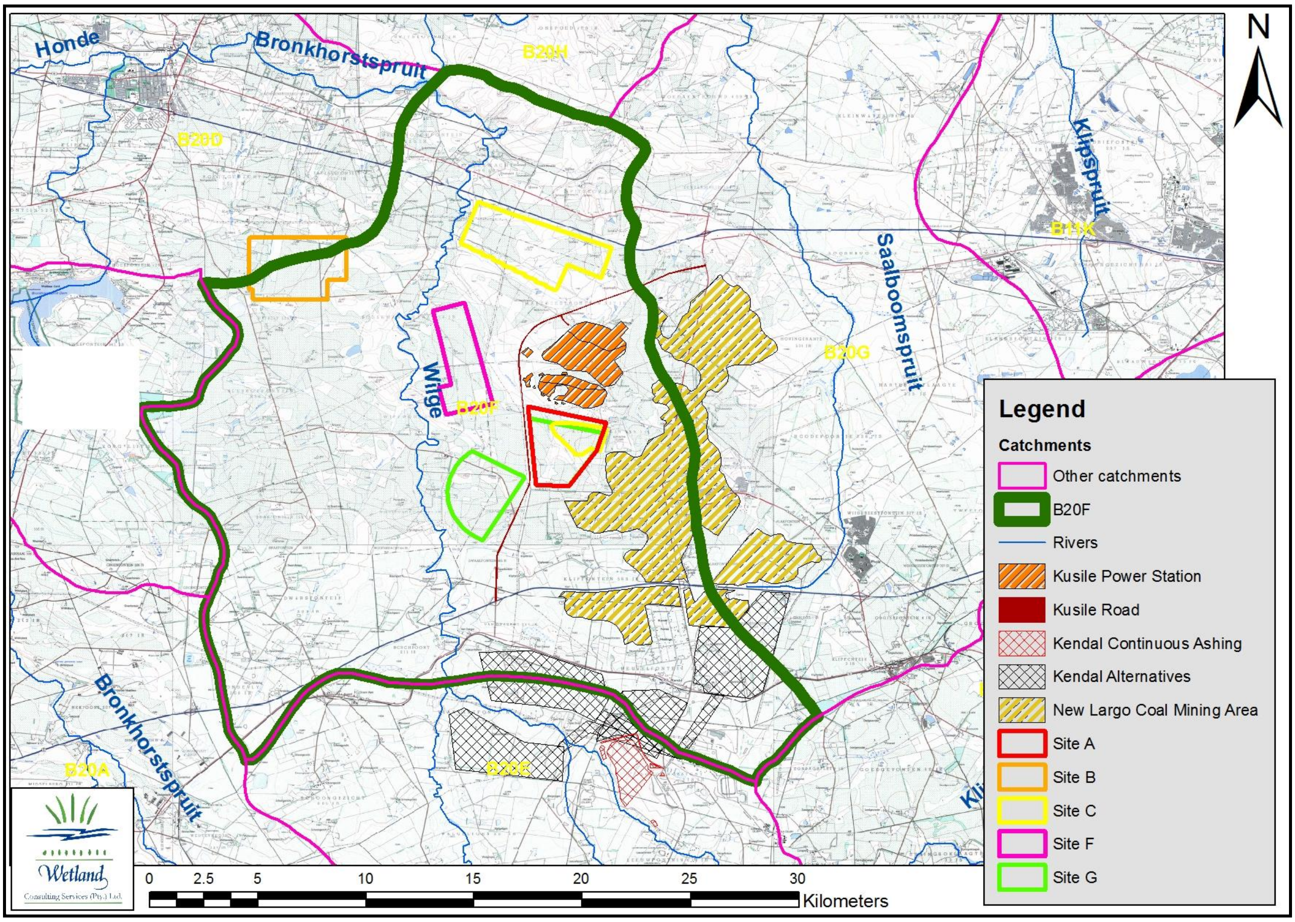

Figure 34. Map of the general area showing the location and extent of other proposed activities in the area.

Considered cumulatively, these activities could potentially place considerable stress on the Wilge River system in terms of water quality and quantity. All of these activities have the potential to lead to water quality deterioration if not carefully managed and mitigated through all phases of the project life cycle, including post-closure, and could also lead to decreased watermake to the river.

Wetland habitats falling within the direct footprints of these developments are furthermore also likely to be permanently lost, with further impacts to adjacent wetland systems. Given the number and extent of activities proposed for the area the potential wetland loss could be very significant, while at the same time also placing constraints on any wetland offsets within the direct vicinity of the activities due to impacts from other proposed activities upstream.

It is however also clear from the map that all of the proposed activities shown in Figure 34 are concentrated within the south east of quaternary catchment B20F. In our opinion it makes sense from an environmental perspective to rather concentrate impacts within a single area, rather than spreading them out over a larger area. This is especially relevant to the management of water resources that can pass impacts downstream along their length. For this reason, amongst others, Site A was selected as the preferred alternative as the entire site is located within a sub-catchment already impacted by Kusile Power Station and the associated co-disposal facility and which will also be significantly impacted by New Largo. The location of these activities within a single sub-catchment implies that all runoff from these areas drains towards a single point, providing one area on which mitigation and management measures can be focussed.

In contrast, Site B would be located along a watershed of 4 different sub-catchments as yet unimpacted by any of the other surrounding mine or power projects, dramatically increasing the impacted footprint and requiring the management of runoff draining away from the impacted areas in a number of different directions.

10. CONCLUSION

A detailed wetland delineation and assessment study was undertaken for 5 sites that had been identified by Zitholele as potentially suitable sites for the proposed 60 year ADF. All sites are located within a 15 km radius of the Kusile Power Station and between the N4 in the north and the N12 in south, for assessment during the site selection process.

From a wetland perspective, Solution A was considered the preferred alternative for the following reasons:

- Highest extent of wetlands within footprint, BUT low extent of wetlands immediately adjacent to the ADF footprint
- Located furthest from the Wilge River, with 7 km of wetland system to act as buffer to the Wilge River, in the unlikely event of a major pollution spill.
- Located within the same sub-catchment as Kusile Power Station and the 10-year co-disposal facility.
- Located within a sub-catchment that will be substantially impacted by mining (18 % of catchment)

A comprehensive assessment process undertaken by Zitholele confirmed Site A as the preferred alternative.

Approximately 227.67 hectares of wetlands occur within the footprint of solution A, making up 27.5 % of the surface area, with a further 126 ha within 500m of the footprint boundary. The wetlands on site make up the headwaters of the Klipfonteinspruit. The 10 year co-disposal facility, currently under construction, is located immediately to the north of site A, while the New Largo mining area is located immediately upstream and to the east of the site.

Based on the impact assessment undertaken for site A, the main concerns are as follows:

- The permanent loss of 227 hectares of wetland
- The potential deterioration in water quality within the Klipfonteinspruit and the Wilge River
- The further degradation of the wetland system associated with the Klipfonteinspruit downstream of the proposed ADF facility

In addition to the mitigation measures recommended to address the expected impacts, the following points are highlighted:

- Management and mitigation measures should be put in place along the Klipfonteinspruit to address impacts associated with all the proposed activities within the sub-catchment, i.e. the proposed 60-year ADF, the 10-year co-disposal facility and the Kusile Power Station (consideration should also be given the proposed mining within the upper catchment). Stormwater runoff from Kusile enters the Klipfonteinspruit and has a significant impact on the hydrology and water quality (specifically turbidity and suspended solid loads) of the stream. The channel incision within the wetland, already evident prior to the construction of Kusile but exacerbated by the higher volumes and velocities of flows within the system following the onset of construction activities, is limiting the ability of this wetland system to play a role in buffering the Wilge River from impacts associated with the power station activities. A detailed management plan will thus need to be developed and implemented for the Klipfonteinspruit.
- That wetland offsets and rehabilitation of offsite wetlands be investigated to compensate for the loss of wetland habitat within the site A footprint. In this regard the development and implementation of a management plan for the Klipfonteinspruit could be considered, while it is known that wetlands within site C have already been identified as potential rehabilitation targets.
- The required stream diversions will be permanent features of the landscape following construction of the ADF. It is therefore important that the design of the stream diversions aims to create a stable wetland habitat that will in the long term be able to perform some of the functions currently supported by the natural wetland systems that the diversion will replace, i.e. biodiversity maintenance, water quality maintenance and erosion control. Ecological considerations to enhance biodiversity support of the diversion should thus be incorporated into the design of the diversions.

Approximately 52 ha of wetland habitat fall within the direct footprint of site B, with a further 190 ha of wetland habitat occurring within 500m of the proposed ADF footprint. The site is located along a watershed between two quarternary catchments drained by the Bronkhorstspruit and Wilge Rivers respectively, and four smaller sub-catchments. The deep terrestrial soils within the footprint of site B are considered to be an important store and source of water to the wetlands draining away from the site, with numerous springs recorded within the hillslope seepage wetlands. Extensive use is made of this spring water within the surrounding agricultural activities.

Based on the impact assessment undertaken for site B, the main concerns are as follows:

- The permanent loss of 52 hectares of wetland
- The loss of the deep terrestrial soils that are thought to provide the storage and source of water maintaining a number of springs and hillslope seepage wetlands draining away from the site
- The location of the site on a watershed, with water draining away from the site in 4 directions. This is likely to pose a challenge to successfully isolating the dump from the surrounding environment
- The location of the site more than 11km away from the power station, considerably increasing the zone of influence, and extending it into sub-catchments not currently impacted by mining or large scale industrial activities
- The longer conveyor route with numerous wetland crossings, including a Wilge River crossing, which again considerably increases the zone of influence of the overall Kusile operations.

In addition to the mitigation measures recommended to address the expected impacts, the following points are highlighted:

- The probable decreased flow within hillslope seepage wetlands draining away from site B due to drying up of the perched aquifer, and the potential drying up of the springs should be investigated in more detail and the changes quantified. Flows from these seepage wetlands and springs are important not only in maintaining downstream wetland habitat and base flow within the upper reaches of these water courses, but are also extensively used by high intensity agricultural activities. Decreased flows within these systems could thus have far reaching consequences, not only from an ecological perspective.
- That wetland offsets and rehabilitation of offsite wetlands be investigated to compensate for the loss of wetland habitat within the site B footprint. In this regard the development and implementation of a management plan for the Klipfonteinspruit could be considered, while it is known that wetlands within site C have already been identified as potential rehabilitation targets, and further wetland habitat within this area should be targeted.
- The longer conveyor route with numerous wetland crossings, as well as the dirty water infrastructure associated with the conveyor route poses a considerable risk in terms of water quality deterioration as well as changes in flow characteristics within the affected wetlands. This activity will need to be carefully managed through all phases of the project to ensure impacts are minimised.

It is also pointed out that any activity which is contemplated and which will impact on the wetlands within the study area and/or falls within 500m of any wetland is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998).

11. REFERENCES

Brinson, M. M. 1993. A hydrogeomorphic classification for wetlands. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Department of Water Affairs and Forestry. 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999b. Resource Directed Measures for Protection of Water Resources. Volume 1. River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Department of Water Affairs and Forestry, 2009. INTEGRATED WATER RESOURCE MANAGEMENT PLAN FOR THE UPPER AND MIDDLE OLIFANTS CATCHMENT: Integrated Water Resource Management Plan. Report Number: P WMA 04/000/00/7007. DWAF, Pretoria

Ferrar, A.A. and Lötter, M.C. 2006. Mpumalanga Biodiversity Conservation Plan Map. Mpumalanga Tourism and Parks Agency, Nelspruit.

Kleynhans, C.J. 1999. A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African Rivers. Institute for Water Quality Studies. Department of Water Affairs and Forestry, Pretoria.

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.S. and Collins, N.B. 2009. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. Water Research Commission. WRC TT 339/09

Kotze, D.C. and Marneweck, G.C. 1999. Guidelines for delineating the boundaries of a wetland and the zones within a wetland in terms of the South African Water Act. Pretoria: Department of Water Affairs.

Macfarlane, D.M., Kotze, D.C., Ellery, W. N., Walters, D., Koopman, V., Goodman, P. and Goge, C. 2009. WET-Health: A technique for rapidly assessing wetland health. Water Research Commsision. Report No. TT340/09

Marneweck, G.C. and Batchelor, A. 2002. Wetland inventory and classification. In: Ecological and economic evaluation of wetlands in the upper Olifants River catchment. (Palmer, R.W., Turpie, J., Marneweck, G.C and Batchelor (eds.). Water Research Commission Report No. 1162/1/02.

Midgley, D.C., Pitman, W.V. and Middelton, B.J. 1994. Surface Water Resources of South Africa 1990 Book of Maps: Volume 1. Water Research Commission. WRC 298/1.2/94

Mucina, L. and Rutherford, M.C. 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. SANBI, Pretoria.

Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H. Swartz, E. and Smith-Adao, L.B. 2011. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission, Gezina. WRC Report No. TT 500/11

SANBI. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

South Africa. 1998. National Water Act 38 of 1998. Pretoria: Government Printer

