Wetland Verification, Delineation & Impact Assessment for Kusile Ash Dump

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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by Tania Oosthuizen from Knight Piésold to establish the extent of the wetlands and assess the potential impacts on these wetlands within the footprint of an ash dump associated with the Kusile Power Station. It is understood that the site selected for the Ash Dump was a conscious decision based on the limited impact that the ash dump would have on the environment. A wetland was identified within the footprint of the proposed ash dump, classified as a depression. It is a widely perceived belief that pans reflect contained systems with little to no drainage from them and thus would be considered as ideal systems to contain wastes.

The purpose of this document is to describe the wetlands found within the study area, to map, classify and assess the impact of the planned ash dump on the wetlands, all as a necessary requirement for inclusion in a Water Use License Application.

2. SCOPE OF WORK

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

- ⇒ Confirmation/rejection of the presence of previously identified wetlands on site;
- ⇒ If present, delineation and mapping of the wetland extent; and
- ⇒ Establish the Present Ecological State and Ecological Importance and Sensitivity of the wetland
- ⇒ Assess the impact of the ash dump on the wetland
- ⇒ Identify and describe mitigation measures associated with the proposed activity.

3. LIMITATIONS

Due to the scale of the remote imagery used (1:10 000 ortho-photographs and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 20m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

4. STUDY AREA

4.1 Location

The study area is located south of the N4, and west of the Balmoral/ Kendall Road, the R545, in Mpumalanga. The location and extent of the property is illustrated in Figure 1. The study area was initially confined to the footprint of the actual ash dump, but after cursorily examining aerial photographs, areas outside of the original study area were included. The additional areas covered extended to the south and west of the footprint of the ash dump to include the areas identified for the dirty water dams and the soil stockpiles.

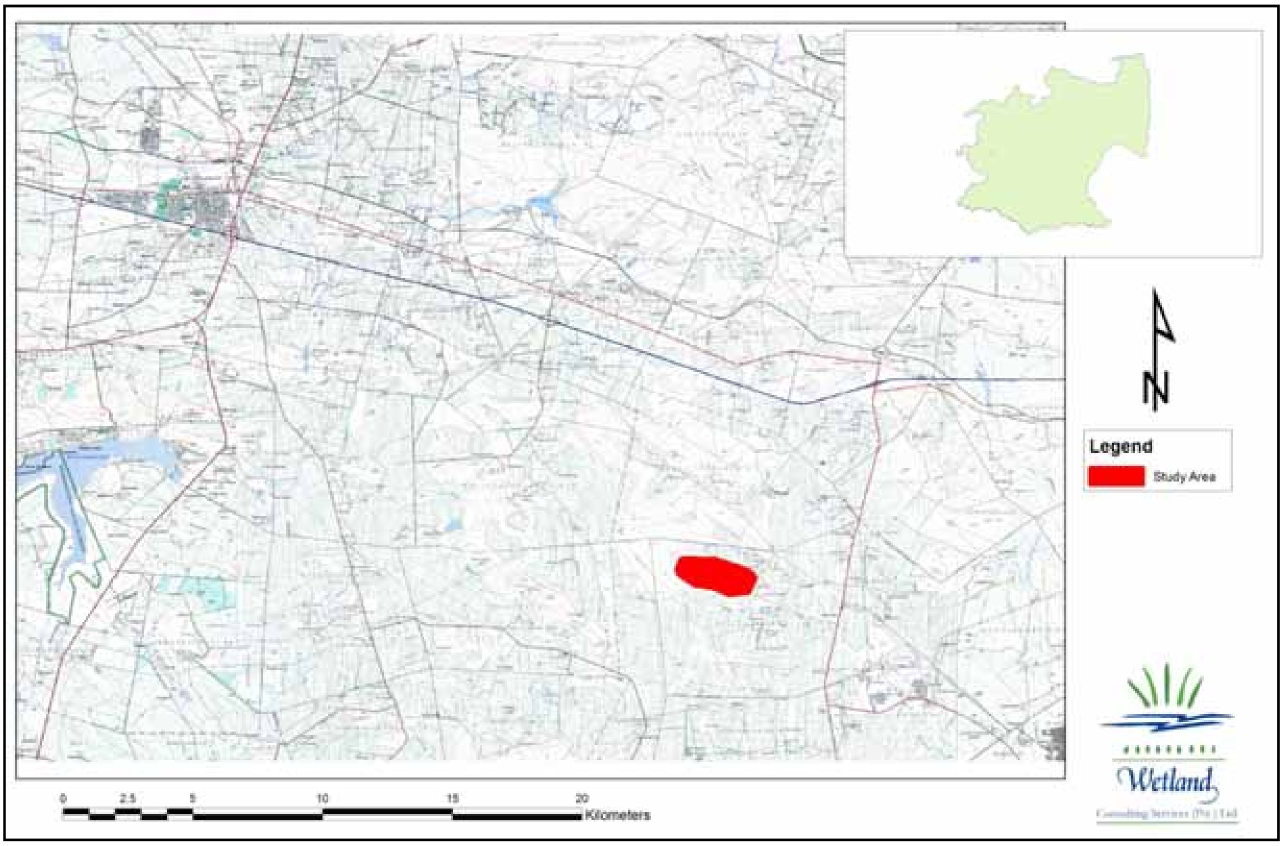

Figure 1. Map showing the location of the original defined study area.

4.2 Catchments

The study area is located within the Oliphant's River Catchment (Primary Catchment B), and more specifically within quaternary catchment B20F. The catchment drains into the Wilge River.

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). Figure 2 indicates the position of the study area in relation to the affected quaternary catchment.

Table 1. 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 km^2	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
B20F	0.045443	666	33	5

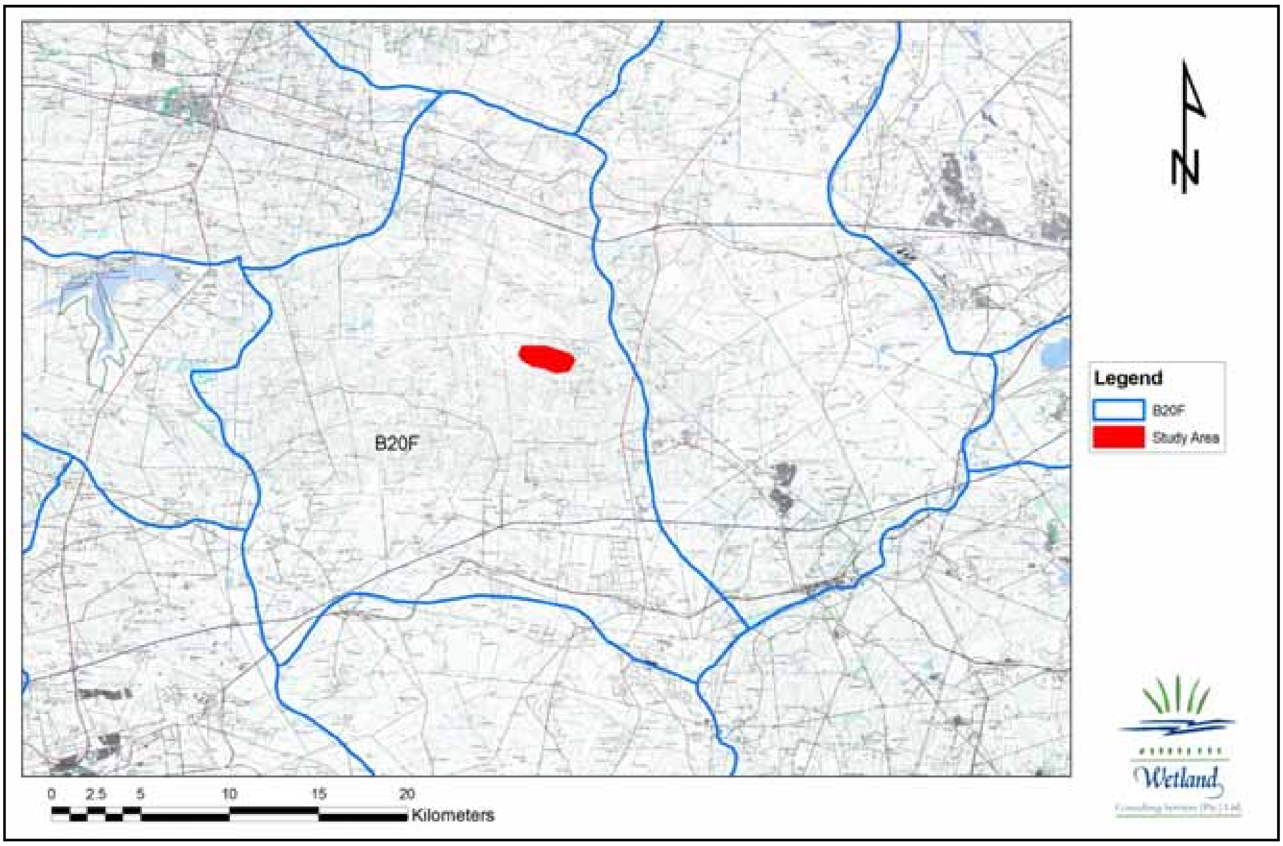

Figure 2. Map showing the study area in relation to the quaternary catchment.

4.3 Geology and Soils

According to the 1:250 000 Geological Map Series of South Africa 2528 East Rand, the study area is underlain by a diabase sill overlain by tillite and shales of the Dwyka formation of the Karoo system. Shales associated with the Strubenskop formation outcrop on the eastern section of the site, Figure 3.

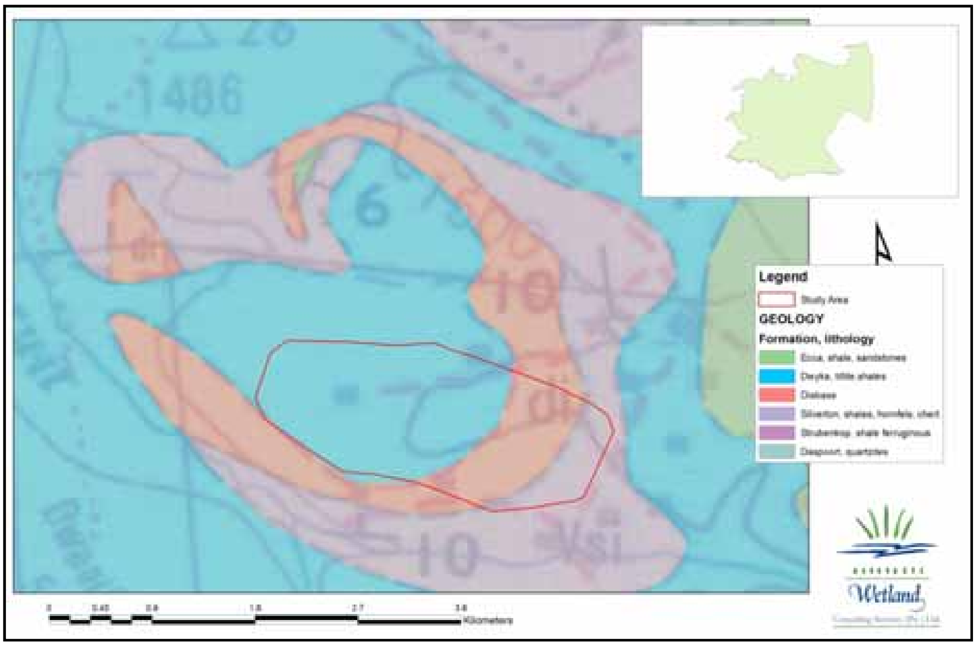

Figure 3. Simplified map indicating the dominant geology of the site. (source 1:250 000 2528 geology map)

The soils associated with this site range from moderately deep sandy soils , cultivated in the past to shallow soils, in some instances underlain by a well-developed ferricrete horizon, to rocky in places.

5. APPROACH

5.1 Wetland Delineation and Classification

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 SANBI (2009).

6. FINDINGS

6.1 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. The wetlands originally identified on the site in 2006, (Ecosun, 2006) comprised only the valley head pan and its associated seeps and a channelled valley bottom wetland.

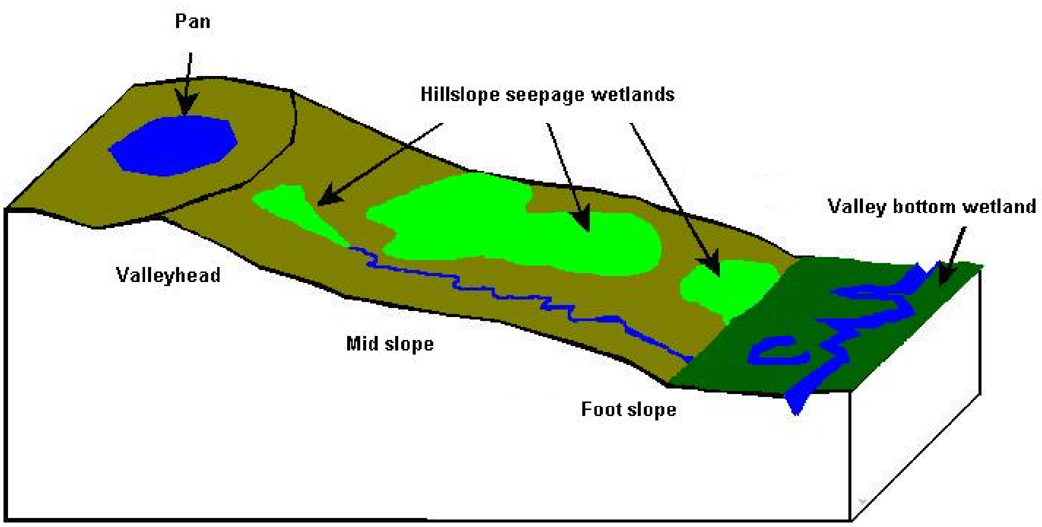

Figure 4. Diagram illustrating the position of the various wetland types within the landscape.

A site visit to the Kusile Ash dump study area was undertaken on 3 March and again on 7 March 2011. Two wetland types were identified on the site itself a depression or pan with associated seepage wetlands and contact seepage wetlands on the and south western slopes of the site. The extent of the identified delineated wetlands together with the valley bottom wetland are illustrated in the figure below, Figure 5, and their respective areas in Table 2. These identified wetlands occupy 8% of the catchment area of 207 ha, of which 98 ha of the catchment falls within the footprint of the proposed ash dump.

Table 2. Summary of the wetland types expressed as a percentage of the area of wetlands.

HGM Unit	HGM Type	Ha	% of wetlands
1	Isolated Hillslope seepage associated with pan	7.9	46
2	Depression (includes Pans)	2.3	13
3	Contact seepage wetlands	7.1	41
Total		**17.3**	**100**

Of these wetlands, the hillslope seepage wetlands associated with the depression and the depression itself were identified in a previous study conducted by ECOSUN in 2006, Report No: E457/06/B. The contact wetlands were not recorded.

The seepage wetlands on site were delineated based on the presence of hydromorphic features in the soil such as mottling and gleying on the deeper soils, while the presence of certain vegetation types was used for delineation in areas where the soil was shallow. These wetlands are generally seasonally to temporarily saturated, and are dependent on water derived from rainfall and its storage and slow release into the wetlands from adjacent upslope areas. Typical wetland indicator species observed in the seepage wetlands include *Aristida junciformis*, *Eragrostis gummiflua*, *Helictotrichon turgidulum*, *Hemarthria altissima*, *Leersia hexandra*, *Setaria* spp., *Cyperaceae* spp., *Fimbrostylis complanata*, *Fuirena pubescens*, *Kyllinga erecta*, *Chironia purpurascens*, *Haplocarpha scaposa*, *Helichrysum aureonitens*, *Pseudognaphalium luteo-album*, and *Wahlenbergia caledonica*.

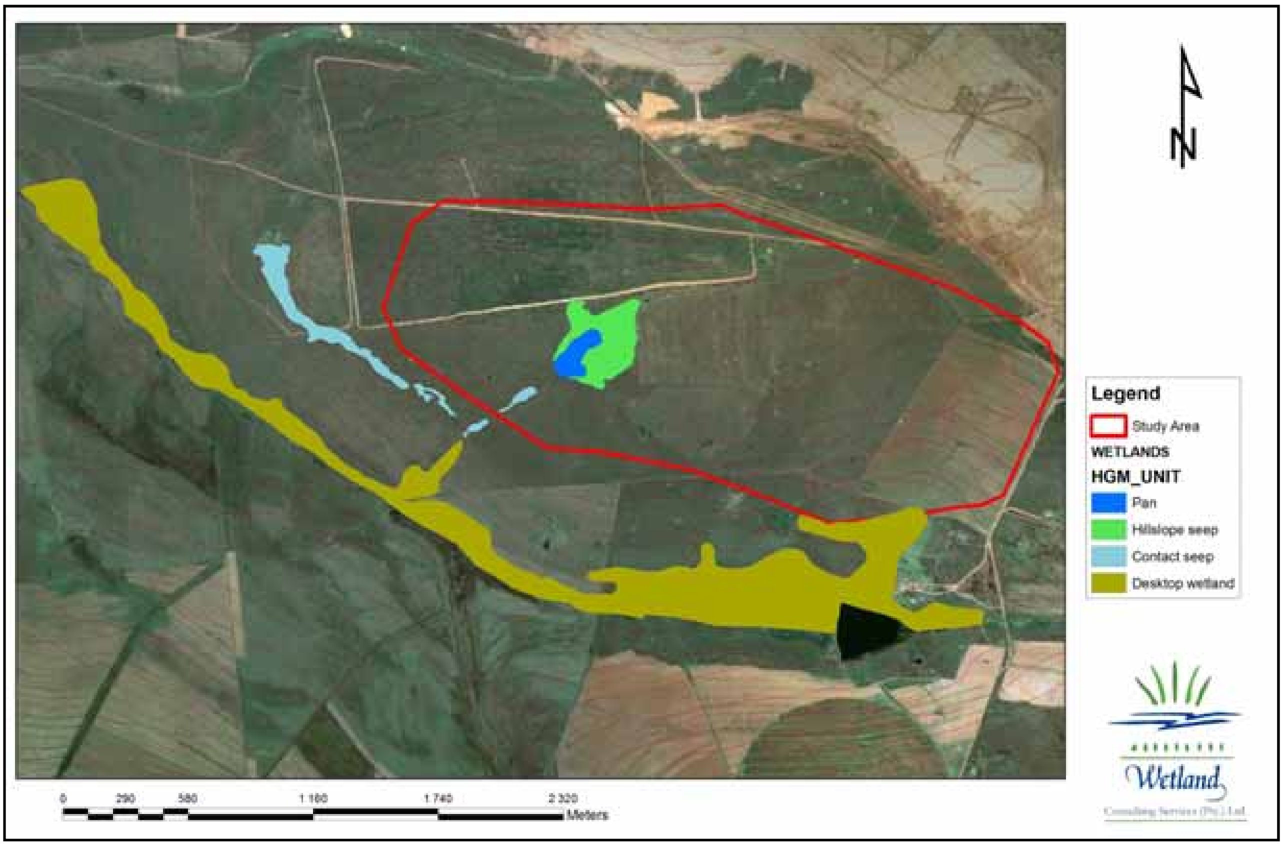

Figure 5. Map of the delineated wetlands on site.

The hillslope seepage wetlands to the east of the pan are on deep to moderately deep sandy soils while those to the north and west are associated with shallow rocky soils, underlain in places by a hard ferricrete horizon. There is a ferricrete sill in the south eastern section of the pan which appears to provide an impediment to flow although the seep immediately downslope of the depression would suggest that a connection exits between the pan the seepage wetland. The presence of a lineament identified by Partridge and Maud would explain this feature.

The sandy soil allows easy infiltration of rainwater into the soil. Infiltrated water thus starts slowly percolating laterally through the soil profile along the aquitard. Most of this water is likely lost to evapotranspiration over time (in the process supporting the vegetation growing on site), while some is discharged into the adjacent stream. The largest contribution of these seepage wetlands to stream flow probably occurs during high rainfall periods when the shallow soils of the seepage wetland become saturated faster than upslope terrestrial areas and encourage surface runoff into the stream (McCarthy, 2000).

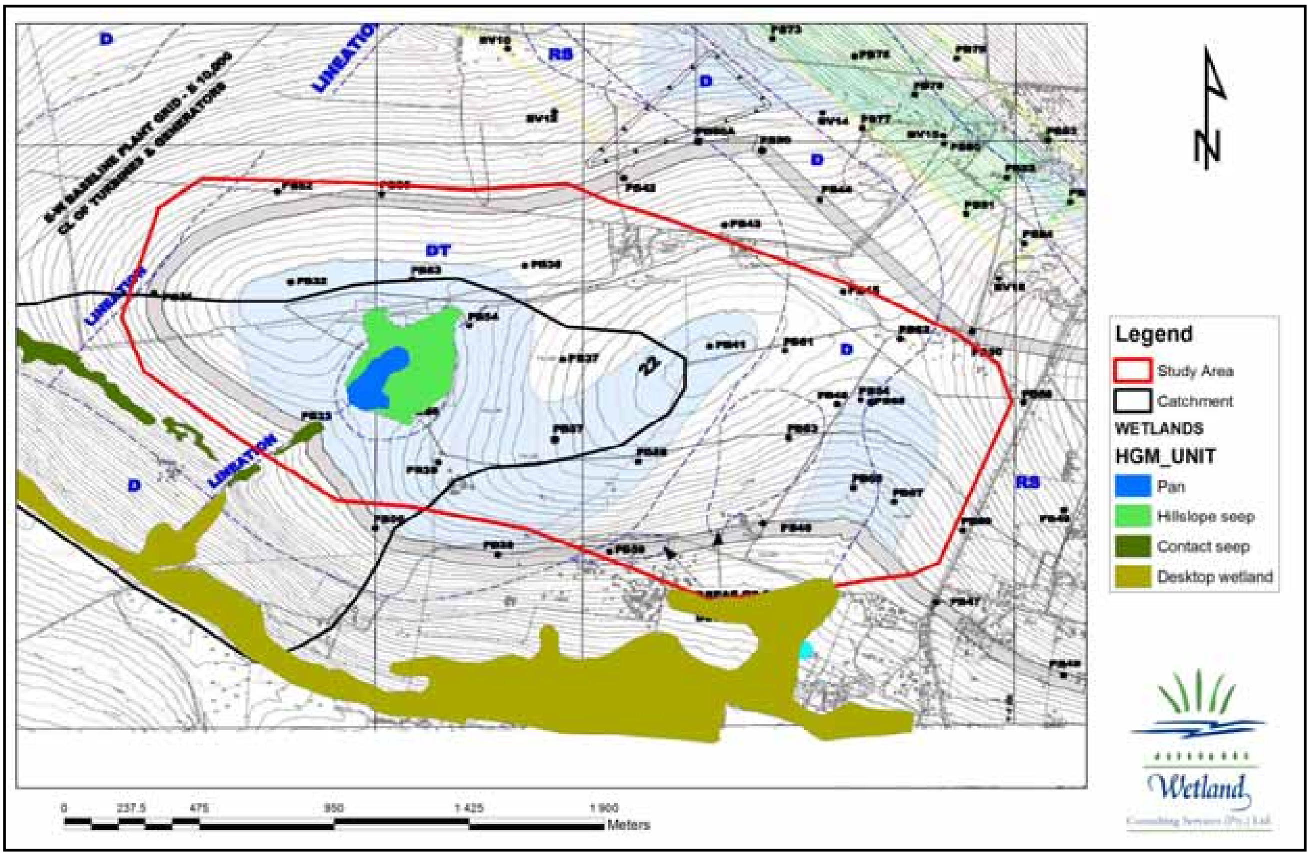

Figure 6. A map showing the relationship between the depression, the contact seep and the position of the lineation detected by Partridge and Maud.

Figure 7. Photographs of the hillslope seepage (left) and the pan, showing the differences in vegetation**.**

The soils within the pan basin have a well developed organic horizon and would likely be classified as a Katspruit soil.

Vegetation in the pan itself is dominated by *Agrostis lacnantha, Paspalum urvillei, Persicaria sp and Leersia hexandra, (Figure 6 left).*

In addition to the wetlands identified within the footprint of the ash dump, wetlands were detected and delineated outside of the footprint of the ash dump. These wetlands are associated with the contact between a diabase sill and the Dwyka formation. These are seasonal wetlands with their extent and expression directly proportional to the amount of antecedent rainfall, Figure 8. It is suspected that the water responsible for the expression of the contact seep is water derived from the catchment as a whole which is prevented from deep infiltration by the diabase sill. They are dominated by sedges, Figure 9.

The water emerging within these wetlands is mostly subsurface, but close enough to the surface to influence the vegetation.

Previous landowners have excavated into the side slope to expose the seepage front to provide access to water by livestock, Figure 9. The depth at which water was emerging from the soil profile is indicated by a white line.

In total, the wetlands occupy approximately 17 hectares of the expanded study area, excluding the valley bottom wetlands, which represents about 8% of the wetlands catchment. 93 ha (45%) of the catchment supporting the identified wetland falls directly within the foot print of the ash dump. The latter occupies an area of 278 Ha

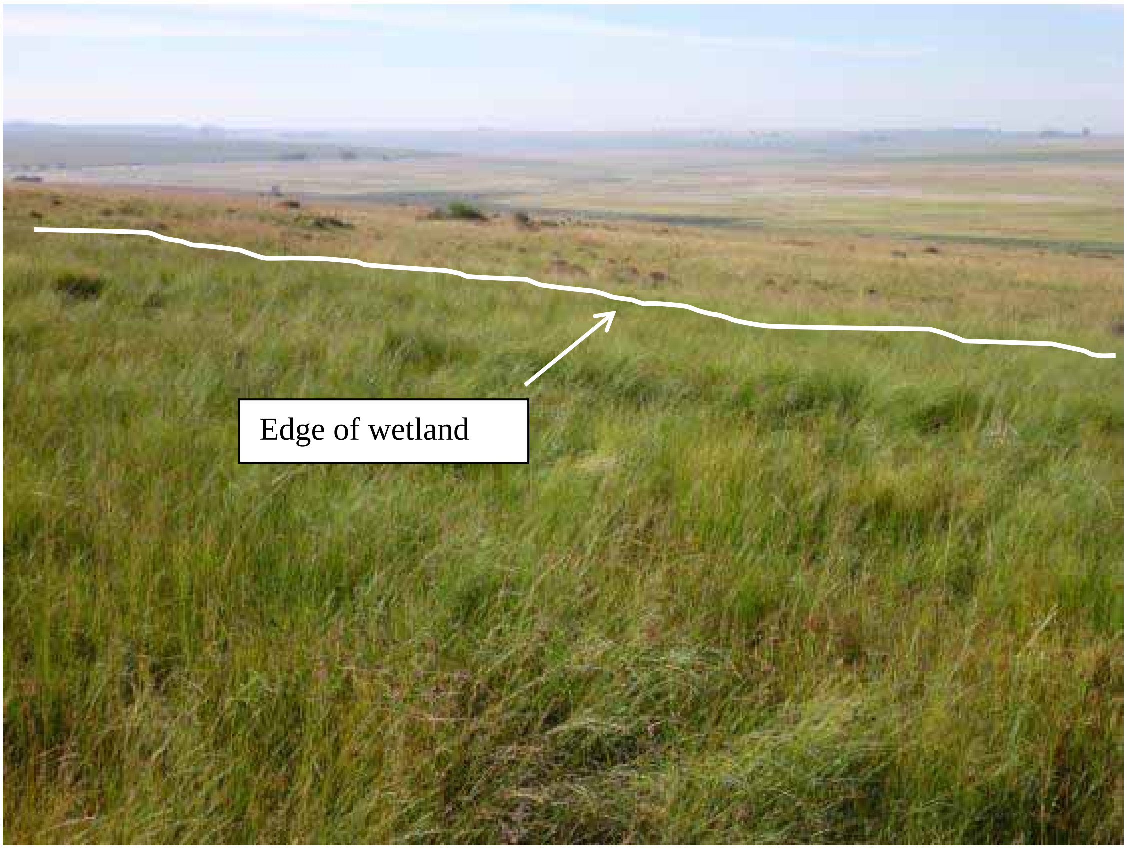

Figure 8. Hillslope seepage wetlands on the contact between the Dwyka and diabase.

Figure 9. Excavation into the seepage wetland to expose water to make it available to livestock.

Figure 10. A photograph of the vegetation associated with the contact seepage wetlands.

6.2 Present Ecological State (Health)

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 and EISC. Two tools have been developed to facilitate the derivation of scores, namely the Index of Habitat Integrity (IHI) (DWAF, 2007), and Wet-Health, developed by Macfarlane et al., 2008. Both these tools have limitations in that they were developed primarily to assess conditions of floodplain and valley bottom wetlands and hillslope seepage wetlands linked to drainage lines. The former tool was developed to provide a rapid assessment of the PES specifically for application in reserve studies, while the latter tool was developed to support the Working for Wetlands program. The objective of the latter tool was to provide a semi quantitative assessment of the state of wetland prior to rehabilitation, and one post rehabilitation to demonstrate "improvement". The intention in defining the health category (PES) of a wetland is to provide an indication of the current "condition" of a wetland in order to inform a management class. The latter provides the guidelines against that inform water quality and quantity required to maintain or improve the quality of the water resource.

An attempt was made to apply the tool Wet-health to provide an indication of the departure of the wetlands from an unimpacted state.

Wet-Health comprises three modules, a hydrological, geomorphological and vegetation module, each one providing indicators that collectively contribute to determining the PES. A water quality component was added using the protocol in the tool, Index of Habitat Integrity for valley bottom and floodplain wetlands in DWAF, 2007.

6.2.1 Hydrology

There are no obvious indications of changes in the hydrology influencing the two wetland types, namely the hillslope seepage and depression or pan. It is possible that the conversion of the original grassland to cultivation within portions of the catchment may have influenced the rate and/or volume of water through and into the systems, as might have the small copse of wattles.
Based on site observations the changes in hydrology to both the systems is considered to be small, with an impact rating of between 0.5 for sections of the hillslope seepage wetlands and 1 for others. This translates to a total impact score 0.5 for the combined system, suggesting a health category of A, Table 3.

Table 3. Assessment of hydrological changes in to the wetlands on the site

HGM Unit	HGM Type	Impact Score	Health Category
1	Isolated Hillslope seepage associated with pan	0.7	A
2	Depression (includes Pans)	0.2	A
3	Contact seepage wetlands	0	A

Table 4. Summary of impact scores and health category associated with changes in hydrology

DESCRIPTION	IMPACT SCORE RANGE	HEALTH CATEGORY
No discernible modifications, or the modifications are of such a nature that they have no impact on the hydrological integrity.	0-0.9	A
Although identifiable, the impact of the modifications on the hydrological integrity are small.	1-1.9	B
The impact of the modifications on the hydrological integrity is clearly identifiable, but limited.	2-3.9	C
The impact of the modifications is clearly detrimental to the hydrological integrity. Approximately 50% of the hydrological integrity has been lost.	4-5.9	D
Modifications clearly have an adverse effect on the hydrological integrity. 51% to 79% of the hydrological integrity has been lost.	6-7.9	E
Modifications are so great that the hydrological functioning has been drastically altered. 80% or more of the hydrological integrity has been lost.	8 - 10	F

6.2.2 Geomorphology

There were no signs of erosion, deposition, head cuts or other signs of geomorphological changes in other than the intentionally excavated section of a contact seepage wetland.. The excavation into the hillslope seepage wetland reduces the "health" of this small section of seepage but this does not significantly influence the overall rating of the combined system. The combined system is thus considered as unimpacted, with an impact rating of 0.5, or in an A state, Table 3.

Table 5. Assessment of the changes in geomorphology associated with the various wetlands on the site

HGM Unit	HGM Type	Impact Score	Health Category
1	Isolated Hillslope seepage associated with pan	0	A
2	Depression (includes Pans)	0	A
3	Contact seepage wetlands	0.7	A

Table 6. Summary of impact scores and health category associated with changes in geomorphology

IMPACT SCORE	DESCRIPTION	PGS CATEGORY
0-0.9	Unmodified, natural.	A
1-1.9	Largely natural. A slight change in geomorphic processes is discernable but the system remains largely intact.	B
2-3.9	Moderately modified. A moderate change in geomorphic processes has taken place but the system remains	C
4-5.9	Largely modified. A large change in geomorphic processes has occurred and the system is appreciably altered.	D
6-7.9	Greatly modified. The change in geomorphic processes is great but some features are still recognizable.	E
8-10	Modifications have reached a critical level as geomorphic processes have been modified completely.	F

6.2.3 Vegetation

An assessment of the vegetation within the catchments and in the wetlands themselves suggest that some disturbance has taken place. Typically some cultivation and cattle grazing and trampling has occurred in some sections of, particularly the hillslope seepage wetlands on the perimeter of the depression. The occurrence of the small copse of wattles is also indicative of disturbance. However the extent of the changes was not assessed as being extensive or intensive resulting in an overall impact score of 1.5, equating to a PES of B, Table 4.

Table 7. Assessment of the changes in vegetation associated with the various wetlands on the site

HGM Unit	HGM Type	Impact Score	Health Category
1	Isolated Hillslope seepage associated with pan	2.1	C
2	Depression (includes Pans)	0	A
3	Contact seepage wetlands	0.1	A

Table 8. Summary of impact scores and health category associated with changes in vegetation.

Description	Overall Impact Score	Present Vegetation State Category
Vegetation composition appears natural.	0-0.9	A
A very minor change to vegetation composition is evident at the site.	1-1.9	B
Vegetation composition has been moderately altered but introduced; alien and/or increased ruderal species are still clearly less abundant than characteristic indigenous wetland species.	2-3.9	C
Vegetation composition has been largely altered and introduced; alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.	4-5.9	D
Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	6-7.9	E
Vegetation composition has been totally or almost totally altered, and if any characteristic species still remain, their extent is very low.	8 - 10	F

6.2.4 *Water Quality*

There is no way of establishing except by inference based on changes in land use, changes that might have occurred to the water quality contributing to the development and support of the wetlands. Given that a portion of the catchment in which the wetlands are located has been used for cultivation it is possible that there has been a change in the quality of water reaching the wetlands. There are however a number of processes that occur within the soil profile that are known to transform and or remove substances such as nitrogen and phosphates, making it difficult to assess whether the quality of water reaching the wetland has in fact changed. Thus the inferred PES of water quality associated with the various HGM units must be regarded as being speculative.

Table 9. Assessment of the changes in water quality associated with the various wetlands on the site

HGM Unit	HGM Type	Impact Score	Health Category
1	Isolated Hillslope seepage associated with pan	1.9	B
2	Depression (includes Pans)	0	A
3	Contact seepage wetlands	0	A

Table 10 Summary of impact scores and health category associated with changes in water quality

DESCRIPTION	IMPACT SCORE RANGE	HEALTH CATEGORY
No discernible changes in landuse, or the changes are of such a nature that they have no impact on the water quality	0-0.9	A
Although identifiable, the impact of the changes in landuse on water quality is small.	1-1.9	B
The impact of the changes in land use on water quality is clearly discernable, but limited.	2-3.9	C
The changes in landuse in the catchment are of such a nature that they clearly have a detrimental affect on water quality. Approximately 50% of the catchment has been modified.	4-5.9	D
The changes in landuse and their impact on water quality is clearly evident in the changes in the vegetation within the wetland.	6-7.9	E
Changes in landuse and the water quality associated with these changes is such that the wetland is dominated by pollution tolerant species or no vegetation at all.	8 - 10	F

6.2.5 Overall PES

The overall PES of the wetlands on the site given the relative contributions give a PES of A for the pan and A/B for the hillslope seepage, summarised in Figure 10, and Table 5., suggesting that most of the functions attributed to these have not been compromised . These are biodiversity and productivity support, flow regulation through the interception and storage and release of water from the catchment as a whole. The nature of the land use within the catchment is such that the quality of water reflected in the wetlands is high.

Table 11. Summarised PES categories of the wetlands on the site

	PES	
Hillslope seepage wetlands around the pan	B	Largely natural. A slight change in processes is discernable but the system are largely intact
Depression	A	Unmodified, natural.
Contact seepage wetlands	A	Unmodified, natural.

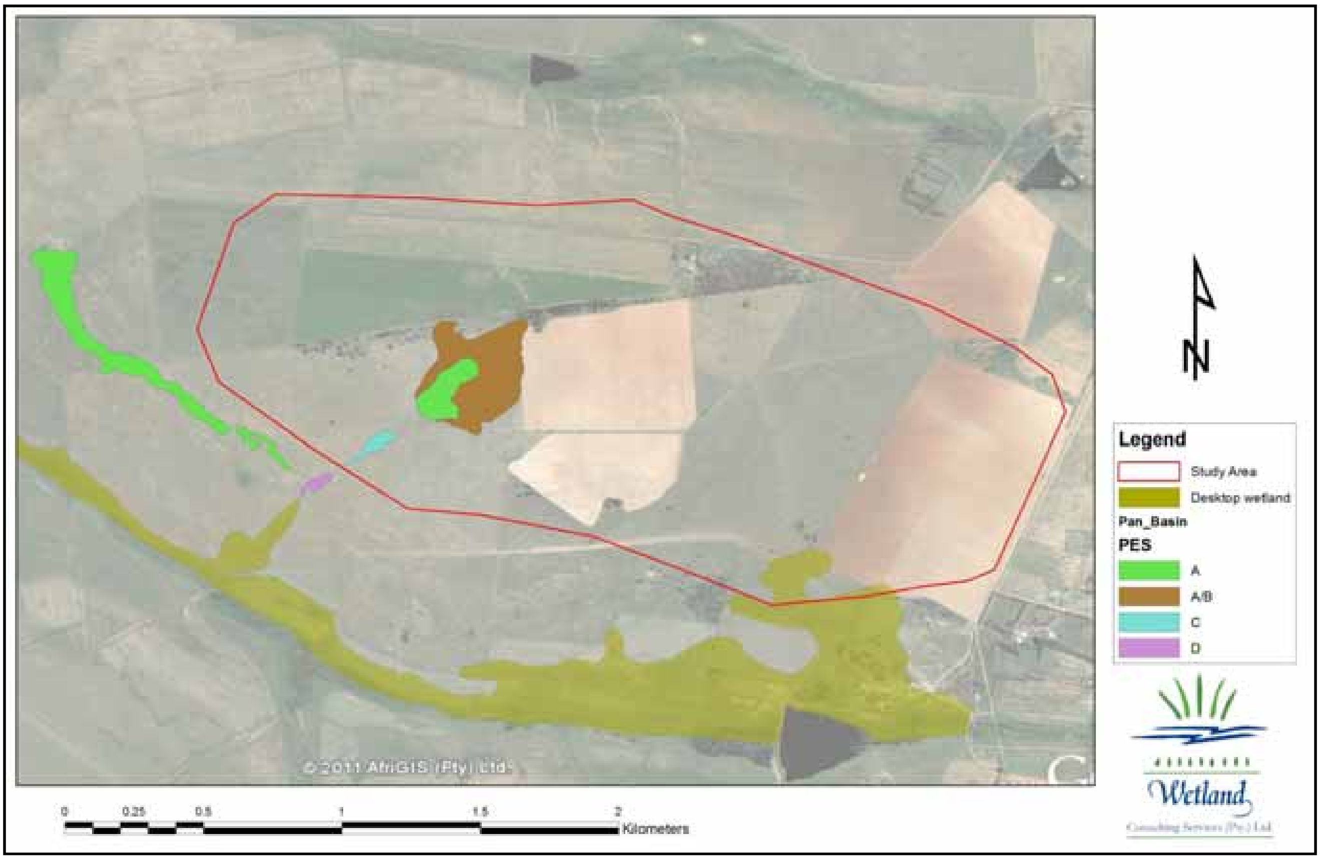

Figure 11. A map showing the wetlands and their associated PES scores

6.3 *Ecological Importance & Sensitivity.*

Wetlands are regarded as important components of the landscape in which they occur as they are associated with a number of functions that are of value to society. Typically these functions include water quality improvement, flood attenuation, biodiversity support as well as products. Critically it is difficult if not impossible at the level that these assessments are undertaken to separate at least the first two functions from the catchments in which the wetlands are located. It is thus difficult to determine their ecological importance and sensitivity without considering the wetlands in the broader catchment context. A summary of the functions expected to be performed by the hillslope seepage wetlands and the depression to which they are summarised in Figure 11.

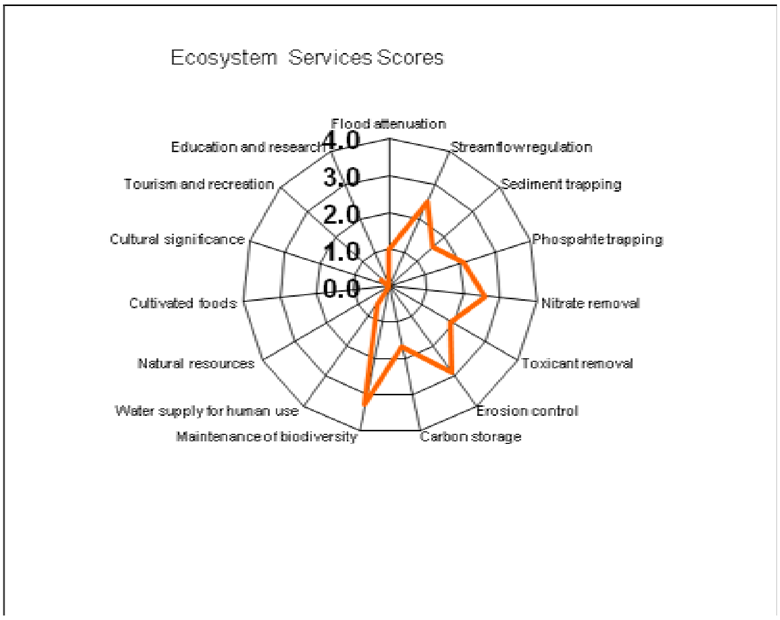

Figure 12. A radial plot indicating some of the functions associated with his wetland complex.

Not unexpectedly those functions associated with water movement, its role in creating a moisture mosaic, which in turn influences biodiversity and inferred nutrient transformation are important.

The water feeding these wetlands contributes to the maintenance of the what have been termed contact seepage wetlands and their associated biodiversity that occur on the western and south western slopes of the ridge on which the ash dump has been positioned.

On the negative side, from a water provisioning perspective, it is probable that much of the water associated with these hillslope seepage wetlands and depression is lost to evapotranspiration (Bullock, 1992).

The water emerging from the seepage wetlands on these slopes provides drinking water for livestock while the vegetation is grazed.

An indication of the ecological importance and sensitivity of the wetlands is portrayed in Figure 11, with an explanation of the categories associated with the derived EIS. The ecological importance and sensitivity was rated as an A based:

- on an assessment of the wetlands taken in isolation from surrounding land uses,
- the lack of biodiversity information which invoked the precautionary principle and
- the rate of transformation of the land use to open cast coal mining in the Upper Olifants and Wilge catchments in relation to their impact on water flow and wetlands.

However this score was down rated to a C for the following reasons:

- Kusile Power station and its supporting infrastructure is a strategically important project and has been approved, and has been granted a Water Use License
- The environmental impact associated with its positioning has been established and accepted by society
- The cost, in terms of time (delays to commissioning the power station), monetary and environmental associated with finding an alternative site.

.**Table 12.** Table explaining the 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 floodplains 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

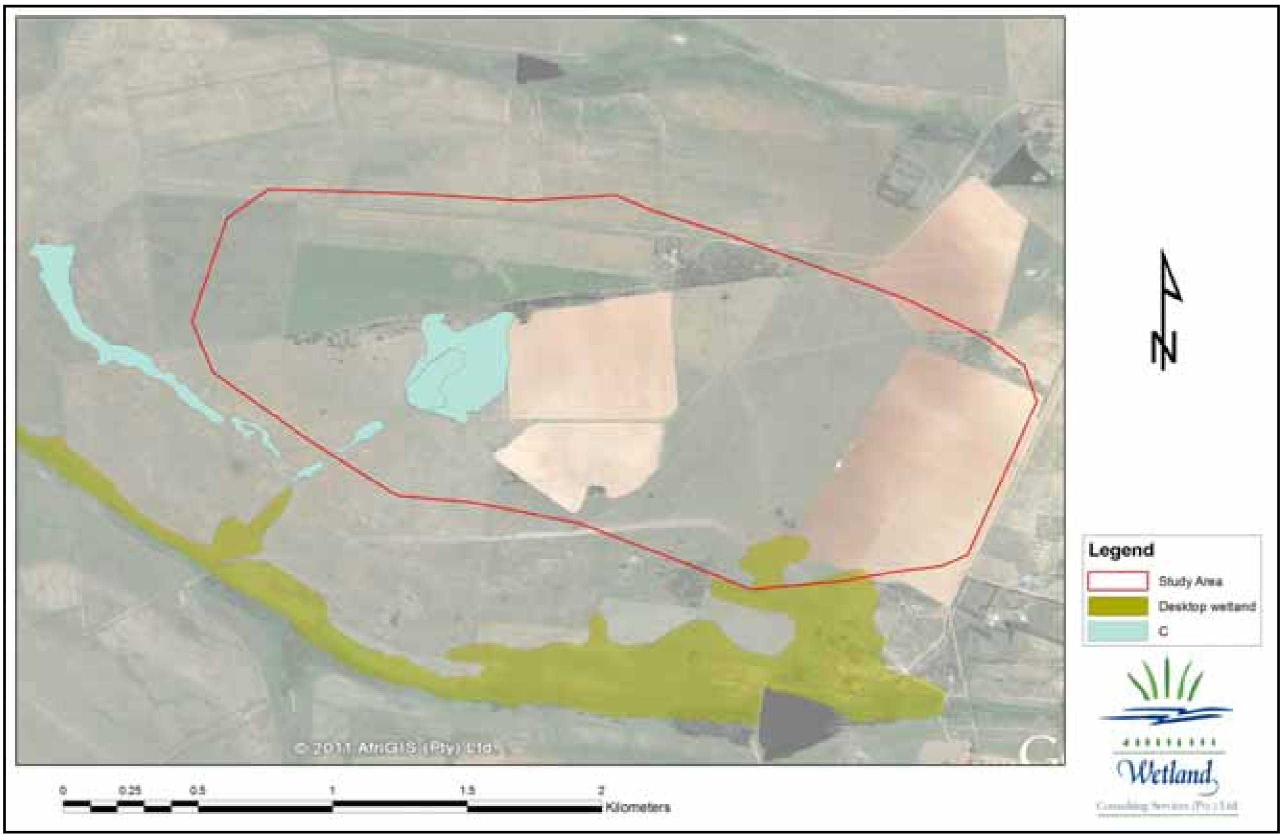

Figure 13. A map showing the wetlands and interpreted ecological importance and sensitivity

7. IMPACT ASSESSMENT

To ensure uniformity, the assessment of potential impacts was addressed in a standard manner to ensure comparable treatment over a wide range of impacts. A clearly defined rating scale was used (Appendix I) to assess the impacts on wetlands associated with the proposed development. Each impact identified was assessed in terms of probability (likelihood of occurring), extent (spatial scale), intensity (severity) and duration (temporal scale). To enable a scientific approach to the determination of the impact significance (importance), a numerical value was linked to each rating scale. The sum of the numerical values defined the significance. Details on the scoring system used in this impact rating procedure are provided in Appendix I.

The assessment of impacts will focus separately on the construction and operational phases of the proposed development, as well as addressing possible cumulative impacts to the wetlands.

7.1 The Project

An ash dump is proposed to be created on the site. The deposition of ash across the site is planned to take place over a period of 60 years. The design and operation of the ash dump is such that the area on which the ash is to be deposited has been designed to limit the amount of rainfall that will be intercepted and diverted off the site into a clean water system, while at the same time limiting the quantity of dirty water that will be collected off the ash itself. The design and operation of the ash dump makes provision for 40% of the footprint of the ash dump to be occupied in the first 5 years, with the remainder being covered slowly by flue gas deposits (gypsum) over the next 55 years. The gypsum is environmental cost associated with desulphurization of emissions.

Provision has also been made in the design to intercept runoff from the dump and to divert this into lined dirty water storage dams for subsequent use in dust suppression and irrigation of the rehabilitated surfaces of the ash dump..

Details of how this is to be achieved is contained in the ash dump design report.

In addition considerable thought has been put into the design and operation of the system with a view to minimising the quantities of both clean and dirty water that need to be managed.

The relationship of the extent of the ash dump and its associated dirty water return dam is depicted in Figure 7.

It can be seen from this figure that the footprint of the ash dump covers the extent of the seepage wetlands and the depression.In addition the dirty water dumps occupy contact seepage wetlands that exist at the contact of the dwyka and the diabase sill as well as topsoil stockpiles.

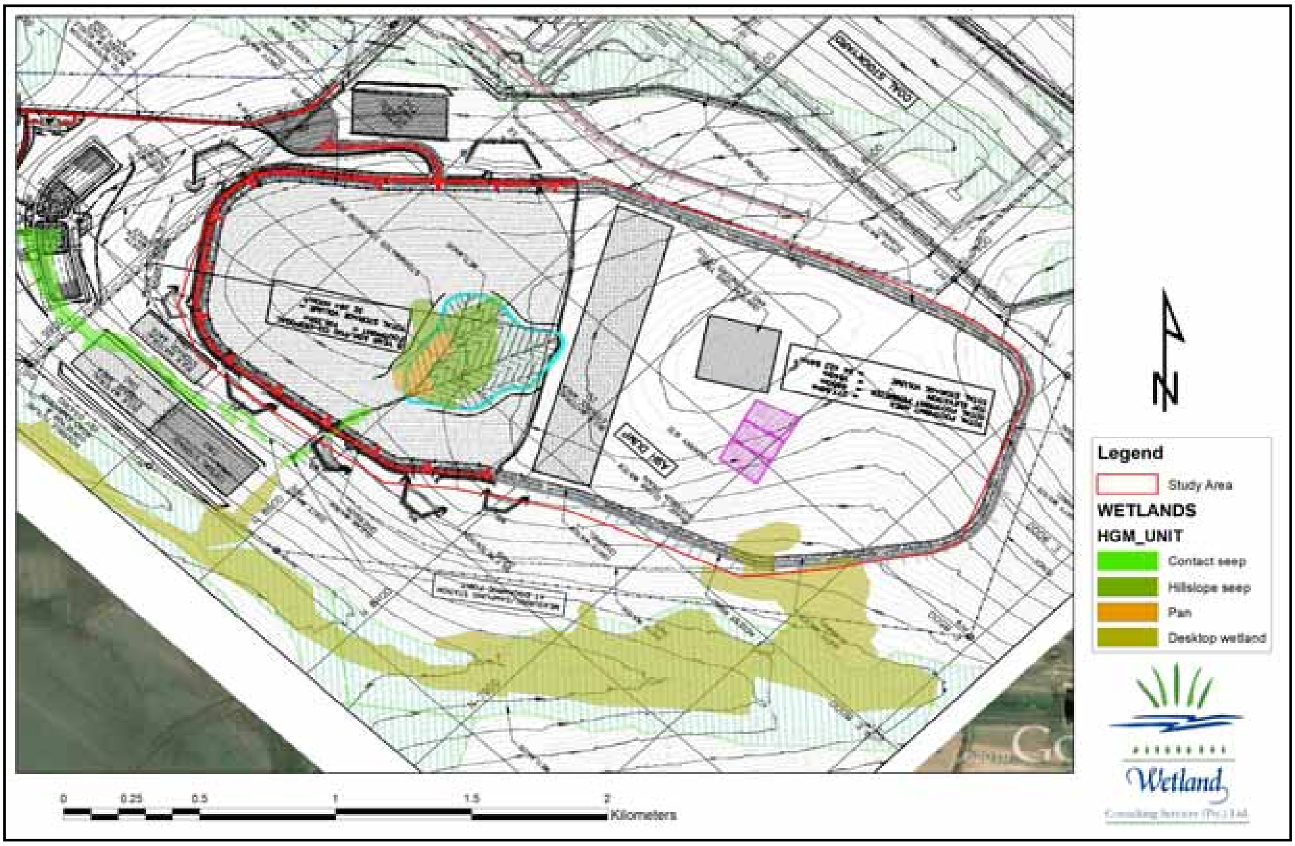

Figure 14. A map showing the position of the planned ash dump and associated support structures in relation to the wetlands on the site.

7.2 *Identification of Potential Impacts*

Construction:

- → Loss of Wetlands
- → *Erosion and Sedimentation*
- → *Surface Water Pollution*
- → *Loss of Biodiversity*

Operation:

- → Surface Water Pollution
- → Erosion and Sedimentation

7.3 *Description of Potential Impacts and Mitigation Recommendations – Construction Phase*

7.3.1 Loss of Wetlands

It is inevitable that the placement of the ash dump on the current site will result in the e loss, of both the hillslope seepage as well as the depression wetlands as these occur within the footprint of the ash dump.

The dirty water dirty water dams will directly impact the contact seepage wetlands as will access roads and general construction related activities associated with the initial preparation of the site.

While the soil stockpiles can be relocated so as to avoid impacting the wetlands, their future is jeopardised by the ash dump itself as this will result in the displacement of water responsible for their existence. Much of the water that makes to this catchment will be intercepted and will either contribute to the dirty or clean water systems that form part of the overall water management strategy for the ash dump. As a consequence they will be deprived of water the flows that support them

This impact is considered to be Negative and of High significance.

Mitigation Measures

Unless the ash dump is relocated the impacts associated with the loss of wetlands and their function is unavoidable. Off-site mitigation could be considered to compensate for the loss of biodiversity. Water falling on the site will from an overall water quantity perspective still be available to support the main streams that drain the site.

In terms of compensating for the loss of biodiversity, a source of water capable of supporting wetlands, as well as a suitable locality, preferably already disturbed so as to avoid altering another ecosystem, would need to be identified. Consideration could be given to using treated domestic effluent for this purpose. This has the potential advantages from an environmental perspective for example:

- Providing the opportunity for further treatment and nutrient removal
- If appropriately designed affords a ranges of habitats that would encourage biodiversity
- Afford a buffer between the treatment works and the receiving environment in the event of operational mishaps.

The feasibility of this recommendation both from a cost and environmental perspective should be investigated as it may not be practical in the overall context of the Kusile Project.

7.3.2 Erosion and sedimentation

Construction activities will require the clearing of large areas of vegetation, thereby leaving the soil exposed to erosion during rainfall events. Eroded sediment will likely make its way into the wetlands and the channel and contribute to sedimentation in the valley bottom wetland down slope of the planned activities. This would not only reduce the geomorphological condition of the wetland, but would also affect the water quality by increasing the load of suspended sediments in the water column. This impact is considered to be Negative and of Low to Moderate significance.

Mitigation Measures

In order to reduce the risks of sediment loss:

- the extent of exposed soils at any one time should be limited
- the construction footprint should be minimised to avoid unnecessarily exposing soils to erosion
- low level berms and the placement of sediment traps in obvious low points will contain the extent of erosion and deposition reducing the scale of the impacts to the site itself.

The design report contains details of the mitigation measures that have been considered and provided for during the design and construction of the ash dump.

7.3.3 Water pollution.

The close proximity of the valley bottom wetlands to the proposed ash dump makes the wetlands and water resource it represents susceptible to pollution during construction. Dust generated by construction activities, eroded sediments, leaked hydrocarbons from construction vehicles, litter, and small amounts of construction materials can all find their way into the valley bottom wetland below the site, potentially negatively affecting water quality.

This impact is considered to be Negative and of Low to Moderate significance.

Mitigation Measures
Mitigation measures suggested to curb erosion and sedimentation will also mitigate against some forms of water pollution. All toxic products or possible pollutants such as hydrocarbons must be stored offsite or in sealed areas on site to prevent surface water pollution. Vehicles should be parked on impermeable surfaces, to prevent the absorption of leaked hydrocarbons in to the soil profile, and stormwater from these areas channelled away from the wetlands. Litter should be disposed of in appropriate waste disposal bins. Spill kits and drip trays will be provided at all times. All contaminated materials will be disposed off at permitted waste disposal facilities.

7.3.4 Loss of biodiversity

Wetlands support a unique biodiversity not usually encountered in adjacent terrestrial habitats and also provide an important resource for both terrestrial and aquatic species. Development of the ash dump will lead to the loss of all the wetlands and any populations or communities of species associated with, or dependant on, them.

This impact is considered to be Negative and of High significance.

Mitigation Measures
If areas of wetland are lost, it is unavoidable that the biodiversity supported within these wetlands will also be lost. However, it is possible to prevent unnecessary disturbance to the remaining wetland fauna and flora by preventing thoroughfare, by people and vehicles, through the wetlands as well as adjacent grasslands. Cognisance should be taken of the fact that wetlands lie downstream of their water supply hence any activities that influence the flow of water are likely to influence wetlands. Travelling through grasslands above wetlands and through wetlands and grasslands outside of immediate construction areas should be avoided.

Off-site mitigation could be considered, see Section 7.3.1 **.**

A summary of the impacts on the wetlands associated with construction related activities is listed in Table 13.

With the exception of the loss of the wetlands themselves, reflected in their structure and biodiversity, some of the functions associated with the wetlands for example regulated release of clean water can be successfully mitigated. A summary of the predicted impacts and their significance before and after implementation of mitigation measures arising during the construction phase are summarised in Table 13.

Table 13. Summary of potential impacts to the wetlands during construction

Expected Impact	Probability	Extent	Duration	Intensity	Significance of Impact pre mitigation	Significance of Impact post mitigation
Loss of Wetlands	Definite	local	Permanent	Very high	***HIGH***	***HIGH***
Erosion and Sedimentation	Probable	Local	Medium	Medium	***MODERATE***	***MODERATE to LOW***
Surface Water Pollution	Probable	Local	medium	Low	***MODERATE***	***LOW***
Loss of Biodiversity	Definite	local	Permanent	Very high	***HIGH***	***HIGH***

7.4 Description of Potential Impacts and Mitigation Recommendations – Operational Phase

The impacts identified as being possible during the construction phase will, because of the design and operation of the ash dump, are likely to continue through the operational phase.

Mitigation Measures

From a water and sediment management perspective, the design of the ash dump makes provision for the separation of dirty and clean water, with clean water being designed to be discharged into the environment. Dirty wall will be recovered and used for dust suppression

7.4.1 Increased volumes of clean water discharged to the environment

An additional impact that is likely to arise is as a consequence of the interception and transfer of rainwater on areas of the rehabilitated portions of the ash dump that will enter the clean water system and be discharged via sedimentation traps equipped with controlled release systems. It is probable that the losses to evaporation and evapotranspiration will be reduced thus increasing the volume making to the local streams. Opportunities to dispose of this excess water to irrigation or for dust suppression are possibly limited as they are likely to coincide with already saturated conditions associated with rainfall events.

These additional flows could cause changes in the receiving streams where from :

- An overall quantity perspective the impact might be perceived as beneficial
- An environmental perspective at the wetland level, possibly negative to neutral.

Mitigation Measures

Whether mitigation is desirable and/or necessary would depend on the differences in volumes and discharge rates and the resource quality and management objectives of the receiving stream and its associated wetland.

7.4.2 Increased velocities of clean water discharged to the environment

It is possible that the velocities associated with the discharges from the individual clean water sediment traps at their point of discharge into the environment will be higher than the pre-developed situation despite the designed mitigation measures. As a consequence there is an increased risk of erosion if the discharges occur on the side slopes.

The impact is expected to be NEGATIVE and of moderate to high significance

Mitigation Measures

Discharge velocities should be reduced by ensuring that the discharge are distributed across a wide footprint and/or alternatively the discharge points should be at the lowest point in the landscape, ie the valley bottom systems where the slopes are shallow rather than on the hillsides themselves or a combination of both. Appropriate energy dissipation structures should be created at the points of discharge to limit the impact of the discharges to the immediate area.

Table 14. Summary of impacts expected during the operational phase of the Ash dump. These are the same as expected during the construction phase due to the progressive nature of ash storage. Pink indicates negative impact, blue indicates ambivalent.

Expected Impact	Probability	Extent	Duration	Intensity	Significance of Impact pre mitigation	Significance of Impact post mitigation
Loss of Wetlands	Definite	local	Permanent	Very high	***HIGH***	***HIGH***
Erosion and Sedimentation	Probable	Local	Medium	Medium	***MODERATE***	***LOW***
Surface Water Pollution	Probable	Local	medium	Low	***MODERATE***	***LOW***
Loss of Biodiversity	Definite	local	Permanent	Very high	***HIGH***	***HIGH***
Increase volumes of discharge	Probable	Local to regional	Long term	Low to medium	**MODERATE**	***LOW***
Increase velocity	Probable	Local	Long term	Medium	**MODERATE to HIGH**	***LOW***

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8. CONCLUSION

The presence of wetlands was verified on site, and two hydrogeomorphic wetland types were identified, namely hillslope seepage wetlands and a depression. Together, these wetlands cover approximately 17 ha of the overall site.

The wetlands on site although showing some signs of disturbance have a PES of either an A or B state.

The nature of the proposed activity is such that the wetlands beneath the footprint of the ash dump and their supporting hydrology will be lost. Associated with the ash dump are dirty water dams and soil stockpiles. The positioning of these conflicts with seepage wetlands that were not identified in the previous survey, Ecosun, 2006. While the soil stockpiles can be relocated so as to avoid impacting the wetlands, the future of these contact wetlands is jeopardised by the ash dump itself. There is strong but circumstantial evidence that the water responsible for their existence is derived from the upstream catchment. In the event that the ash dump is constructed much of the water that makes to this catchment will be intercepted and will either contribute to the dirty or clean water systems that form part of the overall water management strategy for the ash dump.

However the Water Act recognises the right of existence of water resources, including wetlands, and requires that they receive an allocation of water, in terms of both flow and quality to maintain them in a predefined state. ***The quantity and quality of water required to maintain this resource is a legal requirement known as the ecological reserve and needs to be provided irrespective of possible changes in land use. The reserve also includes an allocation of water for direct human use.***

In this particular instance the nature of the proposed changes in land use are such that there is little likelihood of the wetlands existing in the future, given that the current site has been approved from an Environmental perspective. As a consequence of the proposed project the interception and flow of water through the catchment will change, determined by the surface water management plan. It is likely that more water will be available to the downstream users and the water will be clean. Thus from a water management perspective the placement of the ash dump on this particular site will have an impact on the wetlands, directly, and their associated biodiversity, but other functions linked to wetlands will not be affected. Of particular importance from a water management perspective, are:

- The regulated release of water
- The quality of the water that will be discharged.

Finally there is a requirement to provide an ash dump to deal with ash and gypsum associated with the generation of electricity from the Kusile Power Station. In the event that consideration is given to recommending the relocation of the ash dump to a new position in the landscape that doesn't impact wetlands directly, the impacts associated with the ash dump will remain, with instead of wetlands being affected that sensitive and threatened grasslands will be affected. These support a higher biodiversity than wetlands, the principle issue of concern that cannot be effectively mitigated. Thus from an environmental and water management perspective, and given the design considerations that have been incorporated in the overall project that the existing locality, despite the presence of wetlands, is considered suitable for purpose.

It is important to point out that any activity which is contemplated and which will impact on the wetlands within the study area is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998). As such, all activities that impact wetlands will require a Water Use License.

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APPENDIX I: IMPACT RATING SCALE

Table 1. Probability

Category	Rating	Description
Definite	3	More than 90 per cent sure of a particular fact or of the likelihood of that impact occurring
Probable	2	70 to 90 per cent sure of a particular fact or of the likelihood of that impact occurring
Possible	1	40 to 70 per cent sure of a particular fact or of the likelihood of that impact occurring
Improbable	0	Less than 40 per cent sure of a particular fact or of the likelihood of that impact occurring

Table 2. Extent

Category	Rating	Description
Site	1	Immediate project site
Local	2	Up to 5 km from the project site
Regional	3	20 km radius from the project site
Provincial	4	Provincial
National	5	South African
International	6	Neighbouring countries/overseas

Table 3. Duration

Category	Rating	Description
Very short-term	1	Less than 1 year
Short-term	2	1 to 5 years
Medium-term	3	5 to 10 years
Long-term	4	10 to 15 years
Very long-term	5	Greater than 15 years
Permanent	6	Permanent

Table 4. Intensity

Category	Rating	Description
Very low	0	Where the impact affects the environment in such a way that natural, cultural and social functions are not affected

Category	Rating	Description
Low	1	Where the impact affects the environment in such a way that natural, cultural and social functions are only marginally affected
Medium	2	Where the affected environment is altered but natural, cultural and social function and processes continue albeit in a modified way
High	3	Where natural, cultural or social functions or processes are altered to the extent that they will temporarily cease
Very high	4	Where natural, cultural or social functions or processes are altered to the extent that they will permanently cease

Table 5. Significance Rating

Score	Significance Rating
2 – 4	Low
5 – 7	Low to Moderate
8 – 10	Moderate
11 - 13	Moderate to High
14 – 16	High
17 – 19	Very High