July 2013

ZITHOLELE CONSULTING (PTY) LTD

Impact Assessment of Kusile Power Station Ash Dam on surface water resources

Submitted to:
Dr Mathys Vosloo
Zitholele Consulting (Pty) Ltd

REPORT

Report Number: 13615231 - 12222 - 3

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Golder Associates

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1.0 INTRODUCTION

Eskom is constructing the Kusile coal fired power station in the Mpumulanga Province. The power station falls in the Wilge River Catchment in the Olifants Water Management Area (WMA). Associated with the power station will be the ash disposal facility (ADF). Eskom is investigating a number of disposal sites to store ash for 60 years. The locations of the potential ash facility sites identified are shown in Figure 1.

Given the 60 year life, the ADF will cover an extensive area. The contribution of runoff and recharge of the area covered by the facilities to the water resource will be isolated by the stormwater management facilities and the ADF liner system. The water balance for the Olifants WMA is currently in deficit and the ADF will further reduce the volume of water reporting to the river system.

Zitholele Consulting (Pty) Ltd (Zitholele) is undertaking the Environmental Impact Assessment (EIA) for the ADF. Zitholele commissioned Golder Associates Africa (Pty) Ltd (Golder) to undertake an assessment to quantify the potential impact that the ADF options could have on the water resources at the quaternary catchment level. This report presents the approach and results of the assessment.

Six alternative sites have been identified:

- Option A;
- Option B;
- Option C;
- Option F and G;
- Option F and small A; and
- Option G and small A.

2.0 DESCRIPTION OF THE CATCHMENT

2.1 General

The ADF sites are located in the Wilge River Catchment in quaternary catchment B20F. The quaternary catchment B20E is located upstream of B20F. The Wilge River joins the Olifants River from the west upstream of Loskop Dam. The extensively mined Witbank Dam and Middelburg Dam catchments are located upstream of the confluence of the Wilge and Olifants Rivers. The Bronkhorstspruit is the major tributary of the Wilge River. The Bronkhorstspruit Dam is located on the Bronkhorstspruit upstream of the town of Bronkhorstspruit in quaternary catchment B20C. The dam supplies Bronkhorstspruit with water. Water is also transferred from the Bronkhorstspruit Dam into the Western Highveld Region in the upper Elands River Catchment to meet domestic and industrial water requirements. The proposed ADF are located in the adjacent catchment and therefore they do not impact on the water resources of this water supply system. A portion of the ADF Option B falls in B20D. For the purposes of this analysis, the footprint for the ADF Option B is taken as being in B20F.

The Wilge Dam (formerly Premier Mine Dam) is located downstream of the Bronkhorstspruit Dam at the confluence of the Bronkhorstspruit and Wilge Rivers. Water is abstracted from this dam to supply the town of Cullinan and the Cullinan diamond mine. Water is released from Bronkhorstspruit Dam to support the abstraction from the Wilge Dam. The proposed ADF are located upstream of the Wilge Dam. The reduction of flow resulting from the construction of the ADF will impact on the yield of the Wilge Dam.

The Wilge River flows through the Ezemvelo Nature Reserve which is located immediately below the confluence of the Wilge and Bronkhorstspruit Rivers. This section of the Wilge River is regarded as Ecologically Important and Sensitive and has been categorised as a B ecological category. The water quality in the Wilge River is currently good and serves to dilute the poorer quality water in the Olifants River impacted by the coal mining activities in the upstream Witbank Dam, Middelburg Dam, Spookspruit and Klipspruit catchments.

The Wilge River catchment is largely developed with agriculture with Bronkhorstspruit being the major urban area in the catchment. There are numerous farm dams in the catchment which support irrigation. The catchment is not as extensively mined as the Witbank and Middelburg Dam Catchments. There are however some coal mines located in the catchment. The available mine plans show that the mining areas are going to grow in the catchment in future. The downstream Loskop Dam supplies large volumes of water for irrigation.

The catchment areas of the B20E, B20F and the Wilge Catchment are listed in Table 1.

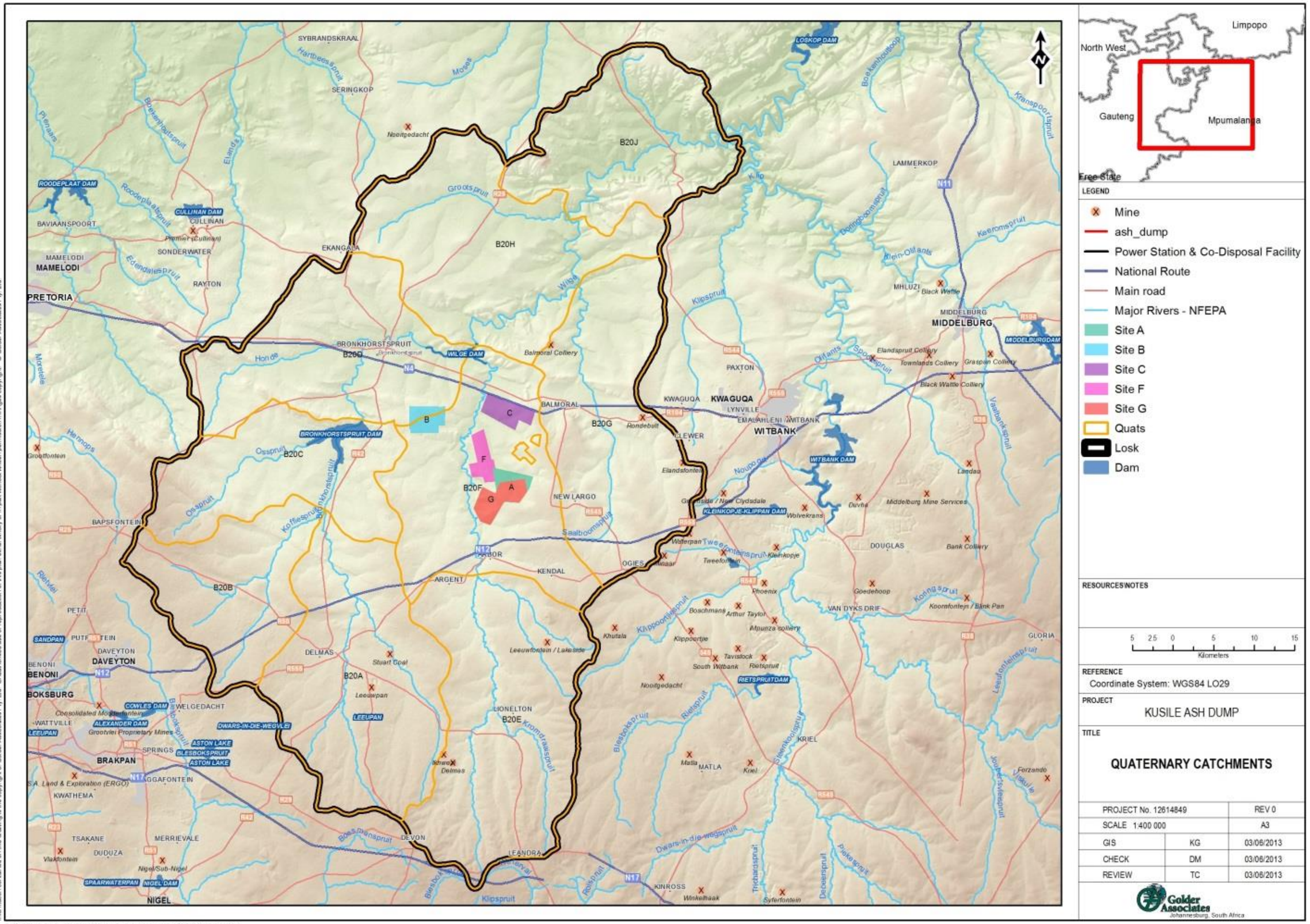

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Figure 1: Location of proposed ash storage facilities

Table 1: Catchment areas of B20E, B20F and Wilge River

Catchment	Area (km^2)
Quaternary B20E	620.0
Quaternary B20F	505.0
Wilge River Catchment	4277.0
Loskop Dam	4356.0

2.2 Classification of the resources

The Department of Water Affairs (DWA) has completed the classification process for the significant water resources of the Olifants WMA. The process included stakeholder engagement for input in recommending the classes for the Integrated Units of Analysis (IUA) defined for the WMA. The management class for the Wilge River was set as a 2 with an overall ecological category of a C for the IUA. A class of 2 implies moderate usage of the water resource in future. In fact the status quo in the river system has to be at least maintained. The recommended classes resulting from the study still have to be gazetted. The classes will be gazetted in 2014 together with the Resource Quality Objectives (RQO). The DWA study to set RQO for the Olifants WMA has started. The RQO set will be based on the classes set during the classification process. The level of protection provided by a Class 2 means that any developments in the Wilge River will have to ensure that loads discharged to the receiving environment and the impacts on the flow are small.

3.0 DESCRIPTION OF ASH STORAGE FACILITIES

The ADF are designed with a liner system which will essentially eliminate seepage from the facilities. The liner has an underdrain system which collects the seepage from the base of the facility and delivers the seepage to the storm water management system for management in the power station circuits. The storm water management system has been designed to meet Regulation 704 and only spills into the river system on average once in 50 years. The ADF are essentially isolated from the catchment area and will contribute very little water to the surface water environment. The catchment isolated by the facilities will no longer contribute runoff or recharge to the groundwater system. The facilities will therefore reduce the volume of water reaching the surface water streams.

The catchment areas of the ADF options and the potentially impacted quaternary catchments are listed in Table 2. The percentage of the areas of the ADF options of the total of the B20E and B20F areas are also given in Table 2. The percentages are relatively low ranging from 1.2% to 2.1%.

Table 2: Areas of ADF Options and quaternary catchments

Catchment/ADF Option	Area (km^2)	% ash storage facility of B20F and B20E
Option A	14.7	1.3
Option B	13.3	1.2
Option C	15.3	1.4
Option F plus G	20.8	1.8
Option F plus small A	23.8	2.1
Option G plus small A	18.6	1.7
Quaternary B20E	620.0	-
Quaternary B20F	505.0	-
Loskop Dam	4 356.00	-

4.0 ASSESSMENT OF THE IMPACTS OF THE ADF ON CATCHMENT FLOWS

4.1 Approach used

The approach followed was to apply the WRSM2000 monthly time step hydrological model to assess the impact of the ADF on the catchment flows. The model was calibrated during the DWA study to develop an Integrated Water Resource Management Plan for the Upper and Middle Olifants Catchments (DWA 2009). The model accounts for the irrigation water use, effects of farm dams and the abstractions from the river. The monthly time series of simulated flows covers the period from October 1920 to September 2005.

The approach followed is summarised as follows:-

- The model schematics were obtained and the impacted catchments identified in the schematics;
- The areas of the impacted WRSM2000 runoff modules were reduced by the area of each of the ADF options;
- The model was run for the base case (as is) and for each ADF option; and
- The resulting time series of flows at the outflow from B20F and below Wilge Dam were analysed and compared to the base case to determine the impacts on the flows.

4.2 Results

For the analysis, the monthly averages of the simulated flows at the two assessment points for the ADF options were compared to the base case. The results of the analysis are given in Table 3 and Table 4. The percentage difference expressed as the ratio of the difference between the ADF option and base case flows and the base flow are also given in the Table 3 and Table 4. The simulations show that the percentage reductions in the average flows from B20F are less than 2%. The percentage reductions are lower (<1%) for the flow below Wilge Dam as the base case flows are larger due to the inflow from the Bronkhorstspruit Catchment.

Table 3: Comparison of average simulated monthly flows (Mm^3/month) at outflow from B20F for base case and ADF options

	Base Case	**Option A**		**Option B**		**Option C**		**Option F**		**Option G**		**Option small A**	
	Average	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff
Oct	1.18	1.16	-1.59	1.17	-0.52	1.16	-1.61	1.16	-1.31	1.18	-0.42	1.17	-1.23
Nov	1.91	1.87	-1.88	1.89	-0.95	1.87	-1.90	1.88	-1.66	1.89	-0.83	1.88	-1.55
Dec	2.48	2.43	-1.85	2.46	-0.89	2.43	-1.89	2.44	-1.62	2.46	-0.78	2.44	-1.57
Jan	4.27	4.20	-1.60	4.24	-0.77	4.20	-1.63	4.21	-1.41	4.24	-0.67	4.21	-1.35
Feb	6.05	5.96	-1.53	6.00	-0.76	5.96	-1.55	5.97	-1.35	6.01	-0.67	5.97	-1.30
Mar	6.02	5.94	-1.32	5.98	-0.60	5.94	-1.34	5.95	-1.15	5.99	-0.51	5.95	-1.09
Apr	3.46	3.41	-1.52	3.43	-0.78	3.41	-1.54	3.41	-1.34	3.44	-0.69	3.42	-1.29
May	2.14	2.11	-1.53	2.12	-0.74	2.11	-1.54	2.11	-1.34	2.13	-0.64	2.11	-1.28
Jun	1.63	1.61	-1.47	1.62	-0.64	1.61	-1.49	1.61	-1.30	1.62	-0.58	1.61	-1.22
Jul	1.37	1.35	-1.49	1.36	-0.63	1.35	-1.52	1.35	-1.26	1.36	-0.52	1.35	-1.20
Aug	1.17	1.15	-2.05	1.16	-1.13	1.15	-2.07	1.15	-1.85	1.16	-1.02	1.15	-1.79
Sep	1.00	0.98	-1.56	0.99	-0.68	0.98	-1.56	0.99	-1.36	0.99	-0.59	0.99	-1.31

Table 4: Comparison of average monthly simulated flows (Mm^3/month) below Wilge Dam for base case and ADF options

	Base	**Option A**		**Option B**		**Option C**		**Option F**		**Option G**		**Option small A**	
	Average	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff	Average	% Diff
Oct	3.54	3.52	-0.60	3.51	-0.64	3.52	-0.60	3.52	-0.50	3.53	-0.25	3.52	-0.49
Nov	7.38	7.35	-0.45	7.33	-0.67	7.35	-0.46	7.35	-0.40	7.37	-0.19	7.35	-0.37
Dec	8.84	8.79	-0.49	8.79	-0.51	8.79	-0.50	8.80	-0.44	8.82	-0.21	8.80	-0.42
Jan	14.10	14.04	-0.47	14.02	-0.56	14.04	-0.48	14.05	-0.41	14.08	-0.19	14.05	-0.40
Feb	17.98	17.89	-0.50	17.88	-0.52	17.89	-0.50	17.90	-0.43	17.94	-0.20	17.90	-0.41
Mar	15.96	15.88	-0.52	15.88	-0.51	15.88	-0.53	15.89	-0.46	15.93	-0.22	15.89	-0.44
Apr	8.73	8.68	-0.55	8.69	-0.46	8.68	-0.56	8.68	-0.49	8.71	-0.23	8.69	-0.46
May	5.39	5.36	-0.56	5.37	-0.38	5.36	-0.57	5.36	-0.49	5.38	-0.24	5.37	-0.45
Jun	3.52	3.49	-0.71	3.50	-0.44	3.49	-0.72	3.50	-0.62	3.51	-0.33	3.50	-0.60
Jul	2.87	2.85	-0.73	2.86	-0.44	2.85	-0.74	2.85	-0.66	2.86	-0.35	2.85	-0.64
Aug	2.16	2.14	-0.88	2.15	-0.52	2.14	-0.90	2.15	-0.76	2.15	-0.42	2.15	-0.75
Sep	2.14	2.13	-0.76	2.14	-0.41	2.13	-0.77	2.13	-0.65	2.14	-0.34	2.13	-0.64

5.0 WATER QUALITY

5.1 Resource Water Quality Objectives in the study area

Interim Resource Water Quality Objectives (RWQOs) have been set for the management units (MUs) in the Upper Olifants WMA (Witbank, Middelburg, Wilge and Loskop Dam Incremental catchments). This was done as part of the development of an Integrated Water Resources Management Plan (IWRMP) for the Upper and Middle Olifants (DWA, 2009). As part of the study, the catchments were subdivided into management units. The RWQO are Interim and will be replaced by the Resource Quality Objectives (RQOs) which will be gazetted towards the end of the RQOs study currently being undertaken by Department of Water Affairs (DWA). Kusile Power Station falls within MU 22. The RWQOs for MU 22 are set out in Table 1. The RWQOs for Wilge catchment (MU 22) were used in the surface water quality assessment.

Table 5: Interim RWQO for Wilge, Management Unit 22

Water quality Variables	Units	Management Units		
		23,24	22	19, 20, 21, 25
PHYSICAL				
Conductivity	mS/m	40 (PS)	40 (PRWQ)	70 (PS)
Dissolved Oxygen	% Sat	70 (AER)	70 (AER)	70 (AER)
pH	-	6.5-8.4 (IMS)	6.5-8.4 (IMS)	6.5-8.4 (IMS)
Suspended solids	mg/ℓ	-	-	-
Turbidity	NTU	-	-	-
CHEMICAL, INORGANIC				
Alkalinity	mg $CaCO_3$/ℓ	120 (PS)	120 (PS)	85 (PS)
Boron	mg/ℓ	0.5 (IMS)	0.5 (IMS)	0.5 (IMS)
Calcium	mg/ℓ	25 (PS)	25 (PS)	80 (PS)
Chloride	mg/ℓ	20 (PS)	20 (PS)	20 (PS)
Fluoride	mg/ℓ	0.5 (PS)	0.5 (PS)	0.5 (PS)
Magnesium	mg/ℓ	20 (PS)	20 (PS)	20 (PS)
Potassium	mg/ℓ	10 (PS)	10 (PS)	10 (PS)
Sodium	mg/ℓ	20 (PS)	20 (PS)	20 (PS)
SAR	$meql^{0.5}$	1.0 (PS)	1.0 (PS)	1.0 (PS)
Sulphate	mg/ℓ	30 (PS)	60 (PS)	120 (AET)
Total Dissolved Solids	mg/ℓ	280 (PS)	280 (PS)	450 (PS)
CHEMICAL, ORGANIC				
Dissolved Organic Carbon	mg/ℓ	10 (DI)	10 (DI)	10 (DI)
METALS, DISSOLVED				
Iron	mg/ℓ	1.0 (DI)	1.0 (DI)	1.0 (DI)
Manganese	mg/ℓ	0.18 (AER)	0.18 (AER)	0.18 (AER)
Aluminium	mg/ℓ	0.02 (AER)	0.02 (AER)	0.02 (AER)
Chromium VI	mg/ℓ	0.05 (DF)	0.05 (DF)	0.05 (DF)
PLANT NUTRIENTS				
Ammonia*	mg/ℓ as N	0.007 (AER)	0.007 (AER)	0.007 (AER)
Nitrate	mg/ℓ as N	6 (DF)	6 (DF)	6 (DF)
Phosphate	mg/ℓ as P	0.05 (AER)	0.05 (AER)	0.05 (AER)
Total Phosphorus	mg/ℓ as P	0.25 (AER)	0.25 (AER)	0.25 (AER)
Total Inorganic Nitrogen	mg/ℓ as N	2.5 (AER)	2.5 (AER)	2.5 (AER)

MICROBIOLOGICAL				
E Coli	# per 100mℓ	130 (RFC)	130 (RFC)	130 (RFC)
Chlorophyll a	mg/ℓ	0.02 (RIC)	0.02 (RIC)	0.02 (RIC)

Where: PS – present water quality status, ie the 95 percentile concentration determined over the period 1997 to 2006 was used; AER – Aquatic Ecological Reserve as determined in the 2001 study; AET – Aquatic ecotoxicological test results; ITWQR – Irrigation TWQR used for salt sensitive crops; □IMS – Irrigation requirement used for moderately salt sensitive crops; SW – Stock watering; DI – Domestic informal water use; DF – Domestic formal use; RIC – Recreation intermediate contact; RFC – Recreation full contact; PRWQ – Current RWQO, based on previous studies; IND – Industrial.

5.2 Baseline water quality

Grab samples were taken at the points indicated in Table 6 during the period 2008 to 2013. Once off sampling was also undertaken on the upper reaches of Wilge River just before the Klipspruit tributary and further downstream on tributaries flowing into the Wilge. This was mainly to determine the baseline water quality in that area as these sampling points are in close proximity to where the alternative Site G and Site B are to be located. A summary of these results showing a comparison of the 95th percentile concentration for each parameter against the interim RWQOs is shown in Table 7 and Table 8.

The overall chemical water quality within the study area is good. However some sampling points indicate high levels of total dissolved solids (TDS), conductivity (EC), fluoride (F), sulphate (SO_4) and iron (Fe), all indicative of pollution from mining activities. These parameters were mainly detected at the following points:

- SW1 and SW7 both of which are tributaries that drain Kusile co-disposal area,
- Spring 6 which is the most downstream point from New Largo mine on Klipfonteinspruit, and
- SW11 which is at the confluence of the Wilge River and the Klipfonteinspruit.

The overall microbiological results show high levels of *E. coli* which is an indication of cattle and human impacts within the study area. In addition tilling of cultivated lands can also play a role in elevating the natural *E.coli* levels in the soil and with run-off would then impact on the surface water resources.

Additional sample taken in February 2013 at points KSA01- KSA09 (Table 8) show good chemical and physical water quality with some exceedances in iron and manganese concentrations), but the bacteriological quality at the time of sampling was generally poor.

5.2.1 Present Ecological State and Ecological Importance & Sensitivity

The Present Ecological State (PES) is defined as the current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates and riparian vegetation. The degree to which ecological conditions of an area have been modified from natural (reference) conditions and the Ecological Importance and Sensitivity (EIS) relates to the presence, representativeness and diversity of species of biota and habitat. Ecological Sensitivity relates to the vulnerability of the habitat and biota to modifications that may occur in flows, water levels and physico-chemical conditions.

PES and EIS were determined during the recently completed classification study. The Bronkhorstspruit, Saalboomspruit and Upper Wilge River were found to be in a moderately modified state (category C) and with less developed areas present in the catchment. The importance of the resources is moderate especially in terms of good water quality contributed to the main stem Olifants River above Loskop Dam. Therefore it was proposed to maintain the current PES category within the catchment. A Management Class II was recommended. This means that the area can be moderately used and that the water resource could be moderately altered from its pre-development condition.

5.3 Sampling points

The surface water sampling points are illustrated in Table 6 and Figure 2. The points were chosen to assess the water quality entering the catchment in the Wilge River and before the tributaries enter the main rivers.

Table 6: Surface water quality monitoring points

Monitoring points	Location (decimal degrees)	
	Latitude (S)	Longitude (E)
CSW01	-26.08818	28.85870
CSW02	-26.06045	28.86524
CSW03	-26.02776	28.87286
CSW04	-26.00155	28.87183
CSW05	-25.94438	28.84700
CSW08	-25.87345	28.86612
CSW09	-25.83545	28.98835
CSW10	-25.92747	29.02437
CSW11	-25.96546	29.02768
CSW12	-26.01184	29.04317
CSW13	-25.98400	29.02659
CSW14	-26.00645	29.02542
Spring 4	-25.94449	28.88893
Spring 6	-25.9476	28.92797
SW 1	-25.92	28.88306
SW 2	-25.8533	28.86847
SW 5	-25.9441	28.9041
SW 6	-25.88797	28.88723
SW 7	-25.92518	28.8935
SW 8	-25.8946	28.90094
SW 9	-25.90245	28.91739
SW 10	-25.87853	28.86982
SW 11	-25.88439	28.8617
SW 16	-25.90237	28.85132
SW 17	-25.87476	28.86313
KSA01	-25.882868	28.8539
KSA02	-25.90708	28.806005
KSA03	-25.868078	28.774775
KSA04	-25.994419	28.886327
KSA05	-26.001549	28.872571
KSA06	-25.991785	28.857316
KSA07	-25.954364	28.867069
KSA08	-25.835688	28.808439
KSA09	-25.855166	28.814226

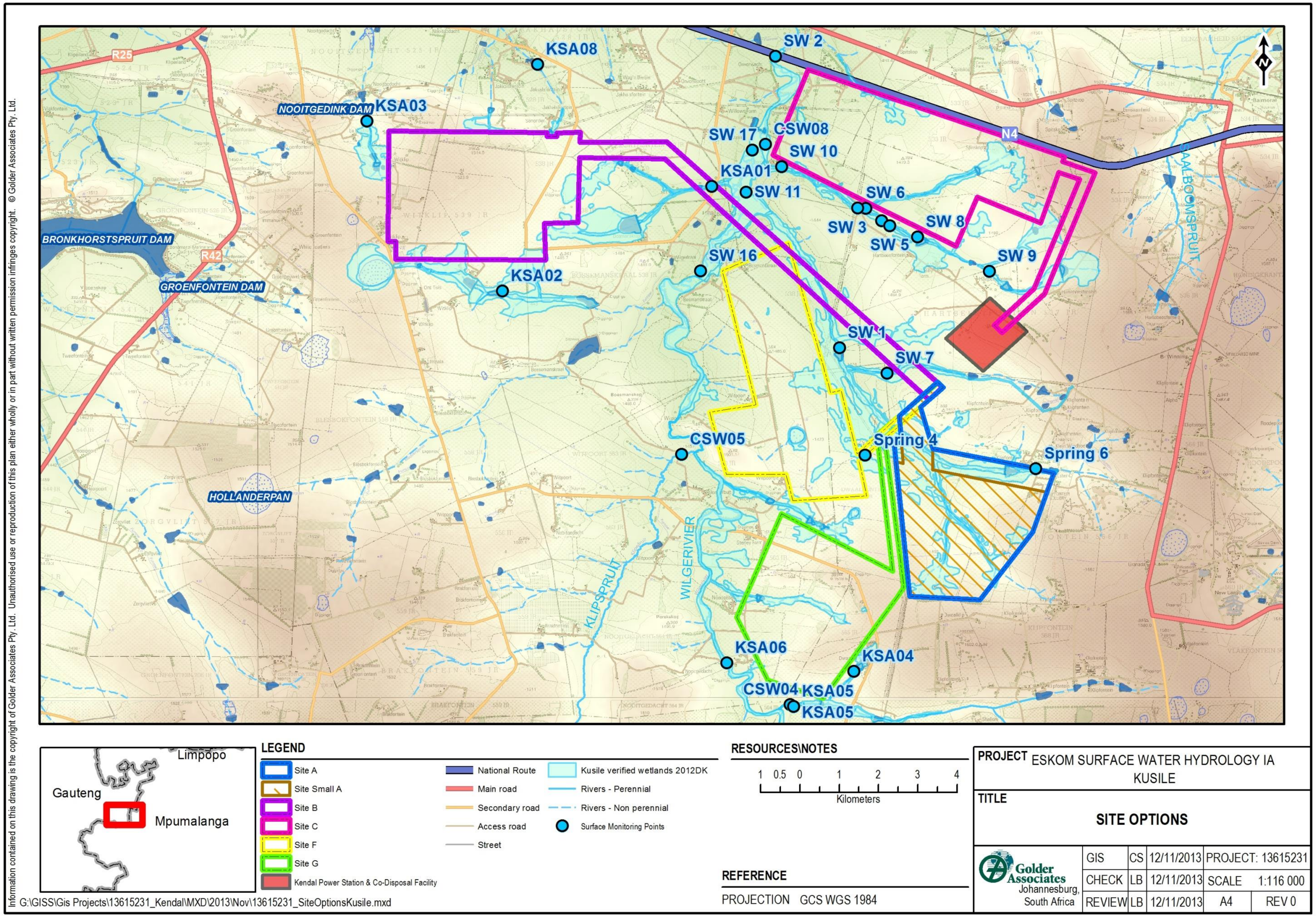

Figure 2: Map showing surface water monitoring points in relation to the alternative sites

Table 7: Water quality results (95th percentile) for the Wilge River and tributaries for the period 2008 – 2013 (the red highlighted blocks refer to those results that exceed the RWQO)

Sample Name	Potassium (K) (mg/L)	Sodium (Na) (mg/L)	Alkalinity as $CaCO_3$ (mg/L)	Total Dissolved Solids (mg/L)	Conductivity (mS/m)	Chloride (Cl) (mg/L)	Fluoride (F) (mg/L)	Nitrate (NO_3) as N (mg/L)	Sulphate (SO_4) (mg/L)	Iron (Fe) (mg/L)	Manganese (Mn) (mg/L)	Calcium (Ca) (mg/L)	Magnesium (Mg) (mg/L)	pH	*E.Coli* 1/100ml
RWQO	**10**	**20**	**120**	**280**	**40**	**20**	**0.5**	**6**	**60**	**1**	**0.18**	**25**	**20**	**6.5-8.4**	**130/100ml**
SW 1	4	11	74	394	52	5	0.7	1	215	2	0.26	76	17	6.6 – 8.2	3695
SW 2	5	24	128	250	40	17	0.7	1	91	2.2	0.31	36	19	6.7 – 8.2	1325
SW 3	3	24	114	173	19	11	0.7	1	21	3	0.25	18	10	6.7 – 8.4	34552
SW 4	4	17	71	156	64	11	0.7	1	20	7.4	0.25	11	8	6.2 – 8.0	2012
SW 5	3	12	60	491	30	7	0.7	1	274	2.7	0.63	97	19	6.6 – 7.7	6125
SW 6	4	17	67	230	21	9	0.7	1	73	2.6	0.23	31	10	6.3 – 8.2	7780
SW 7	8	12	102	134	11	7	0.6	1	18	3.1	0.76	19	10	7.7 – 8.2	3280
SW 8	4	8	40	186	37	7	0.7	1	24	4.5	0.67	11	4	6.9 – 7.9	1706
SW 9	8	16	99	236	14	13	0.6	1	74	3.7	0.40	31	18	7.3 – 8.0	3595
SW 10	6	9	49	216	36	8	0.6	1	31	2.3	0.11	10	5	7.4 – 8.3	895
SW 11	6	9	63	358	41	19	0.7	1	70	2.2	0.28	30	9	6.9 – 8.0	3350
SW 16	6	26	*130*	273	43	19	0.7	1	72	0.4	0.21	30	23	6.6 – 8.2	1820
SW 17	5	23	131	258	40	7	0.7	1	87	0.9	0.38	38	20	6.8 – 8.2	1945
Spring 4	4	10	4	46	8	6	0.1	4	2	0		2		5.7 – 5.7	
Spring 6	2	8	52	594	82	9	0.7	1	392	1.2	0.43	128	0.43	6.4 – 7.8	337

Table 8: Water quality results for the additional samples (the red highlighted blocks refer to those results that exceed the RWQO)

Sample Name	Potassium (K) (mg/L)	Sodium (Na) (mg/L)	Alkalinity as $CaCO_3$ (mg/L)	Total Dissolved Solids (mg/L)*	Conductivity (mS/m)	Chloride (Cl) (mg/L)	Fluoride (F) (mg/L)	Nitrate (NO_3) as N (mg/L)	Sulphate (SO_4) (mg/L)	Iron (Fe) (mg/L)	Manganese (Mn) (mg/L)	Calcium (Ca) (mg/L)	Magnesium (Mg) (mg/L)	pH	*E.coli* 1/100ml
RWQO	**10**	**20**	**120**	**280**	**40**	**20**	**0.5**	**6**	**60**	**1**	**0.18**	**25**	**20**	**6.5-8.4**	**130/100ml**
KSA01	1.6	3.3	73.8	90	15.9	4.5	-	0.4	5.1	3.3	0.2	10.5	10.7	7.5	240
KSA02	1.7	10.4	35.7	91	11	7.6	-	0.4	7.9	1.7	0.13	0.5	0.4	7.8	48
KSA03	5.1	34.8	18.2	87	2.58	2.6	-	0.8	6.9	0.7	0.06	2.7	2.3	6.7	170
KSA04	5.1	8.7	50.5	94	13.4	3.9	-	2.3	7.5	0.1	0.01	16	32	7.3	420
KSA05	1.1	3.2	103.8	93	25	10.1	-	0.7	10.3	0.4	0.46	17	13	7.8	200
KSA06	1.9	3.3	154.6	89	47.1	16.8	-	0.5	60	0.5	0.11	29	21	8.3	490
KSA07	1.6	3.3	50.8	73	18.6	8.7	-	0.4	27	1.9	0.24	9.5	9.6	7.7	29
KSA08	1.7	10.4	45.9	90	10. 2	2.9	-	0.4	7	1.9	0.21	8	4.8	7.1	57
KSA09	5.1	35	59.6	78	13.2	3.7	-	0.4	6.9	2.1	0.33	10.6	6.9	7.5	62

*calculated

5.4 Comparison of alternative sites

The selected alternative sites are indicated in Figure 2. The Wilge River is the dominating surface water resource within the area. This river drains from north to south of the Kusile Power Station site. All of the proposed sites, except site B are located to the east of the Wilge River.

In relation to the location of the 5 alternative sites (6 disposal scenarios) within the catchment (Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7), it is likely that any of the sites could have an impact on the Wilge River from the tributaries running up and downstream of the Power Station site. Except for Site B, the sites are located within quaternary catchment B20F, the same catchment in which the Kusile Power Station is located.

Table 9: Alternative sites

Site	Main water resource	Description	Aspects that may impact water quality
Site A (Figure 3)	Surface water resources within Site A are the Holspruit and Klipfonteinspruit. There is also a tributary that drains Kusile Power Station and flows directly into Klipfonteinspruit.	There are two sample points on the Klipfonteinspruit (Springs 4 and 6) and one sample point on the tributary that emanates from Kusile (SW7). A wetland is located at the headwaters of Klipfonteinspruit. The water quality results at Spring 6 and SW7 show high levels of fluoride (F), sulphate (SO_4), conductivity (EC) and total dissolved solids (TDS), exceeding the RWQOs. This is very possibly due to mining activity upstream of these points and the Kusile co-disposal facility in close proximity. The new New Largo mine is upstream of Spring 6. However Spring 4, which is downstream of Spring 6, shows an improved water quality indicating the functionality of the wetland.	Run-off of contaminated seepage from the ADF described further in Section 7.0; Potential contamination from the conveyor as the route to Site A will cross the Klipfonteinspruit and the Kusile tributary that flows into the Klipfonteinspruit,
Site B (Figure 4)	There are four unnamed non-perennial tributaries draining away from site B into the Bronkhorstspruit in quaternary catchment B20D.	Site B is the only alternative located to the west of the Wilge River and extends into quaternary catchment B20D. Once off sampling was undertaken on this area at sampling points KSA02, 02 and 08. The water quality is good with an indication of conductivity (EC), iron (Fe) and manganese (Mn) levels slightly exceeding the RWQOs. Should the ash dump be located here, it will impact this area that is unaffected by Kusile.	Run-off of contaminated seepage from the ADF; Wilge River crossings - services corridor i.e. conveyors, service roads, power lines
Site C (Figure 5)	There is an unnamed non-perennial tributary that drains westward from site C.	The water quality of the tributary draining this site is generally good with slightly elevated fluoride (F) levels.	Run-off of contaminated seepage from the ADF; The conveyor route to site C will cross this tributary.
Site small A (Figure 3)	Surface water resources within Site A are the Holspruit and Klipfonteinspruit. There is also a	Site small A falls entirely within site A, but is located to the east of the new Kusile access road.	Run-off of contaminated seepage from the ADF; Potential contamination from the conveyor as the route to Site A will cross the Klipfonteinspruit and the

Site	Main water resource	Description	Aspects that may impact water quality
	tributary that drains Kusile Power Station and flows directly into Klipfonteinspruit.		Kusile tributary that flows into the Klipfonteinspruit,
Site F (Figure 6)	Wilge River	This site lies in close proximity to the Wilge River. The water quality at sample point SW16 which is located on the Wilge River, indicates high levels of sodium (Na), calcium (Ca), alkalinity ($CaCO_3$) and fluoride (F).	Run-off of contaminated seepage from the ADF; There is a possibility of two conveyor crossings to site F that cross a large wetland area around the Klipfonteinspruit
Site G (Figure 7)	Wilge River	This site lies in close proximity to the Wilge River. Two unnamed non-perennial tributaries drain site G. The water quality at points KSA 04, 05 and 06 indicates good water quality, however with some microbiological contamination.	Run-off of contaminated seepage from the ADF; The conveyor route to Area G1 will cross the Klipfonteinspruit and the Kusile tributary.

The above table describes the specific sites. However it is important to remember that Site F and G cannot exist separately. In this respect the impact assessment set out in Section 7.0 is undertaken on the 6 disposal combination scenarios or alternatives:

1. Alternative A (Site A);
2. Alternative B (Site B);
3. Alternative C (Site C);
4. Alternative (Site F and Site G);
5. Alternate FA (Site F and small A (in small A, site A was reduced in size to save one of the tributaries)); and
6. Alternative GA (Site G and small A).

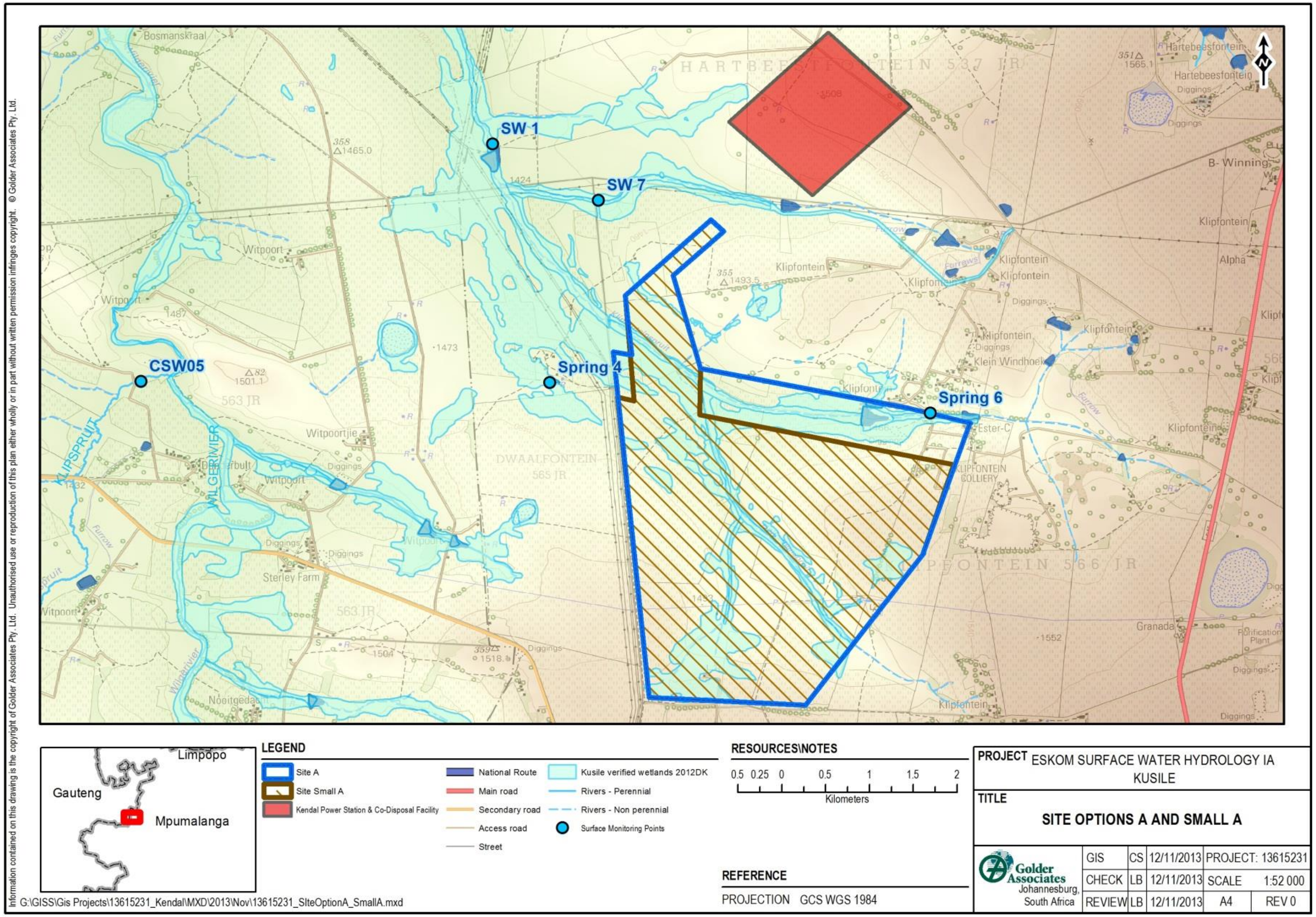

Figure 3: Map showing site A and small A

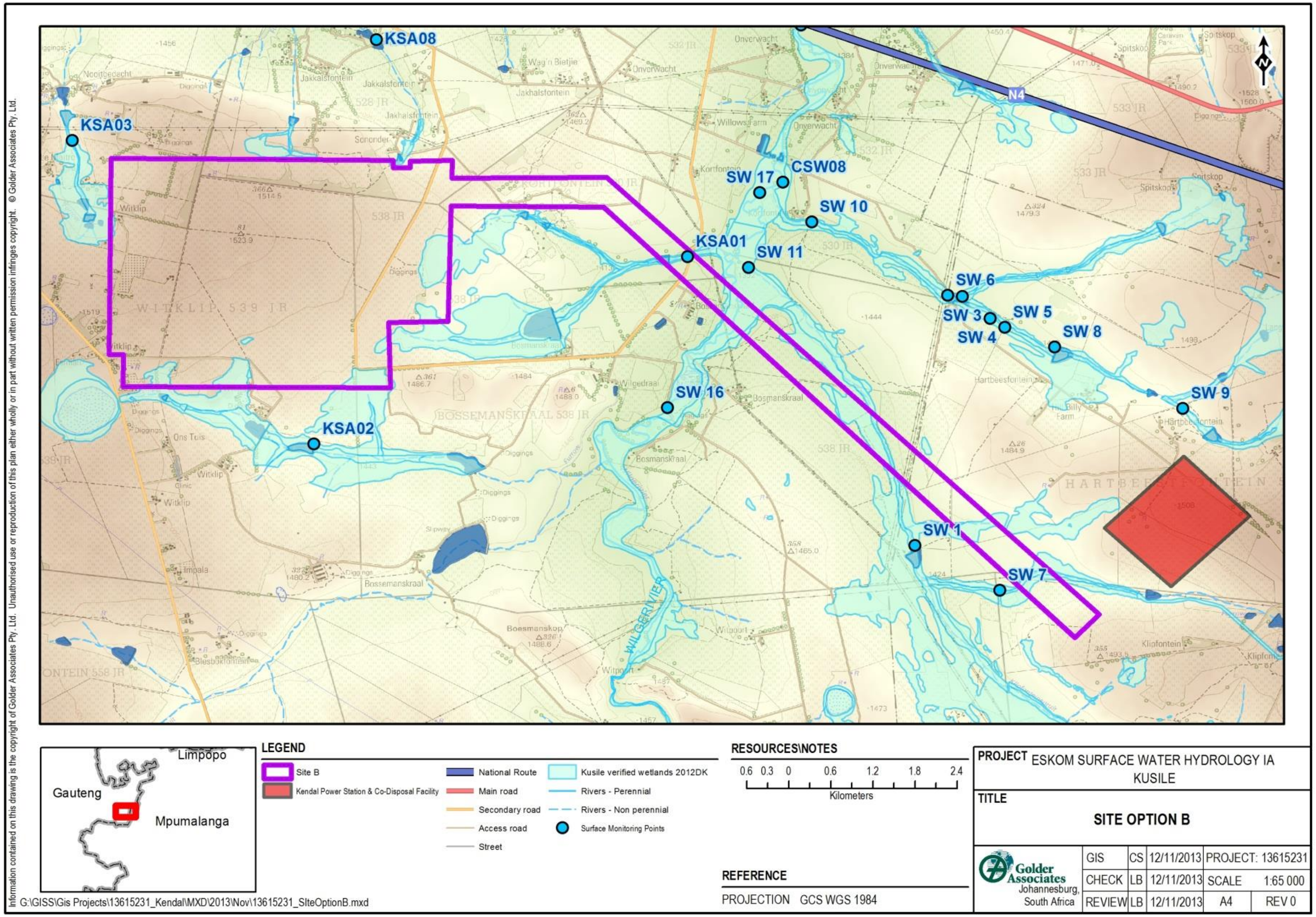

Figure 4: Map showing site B

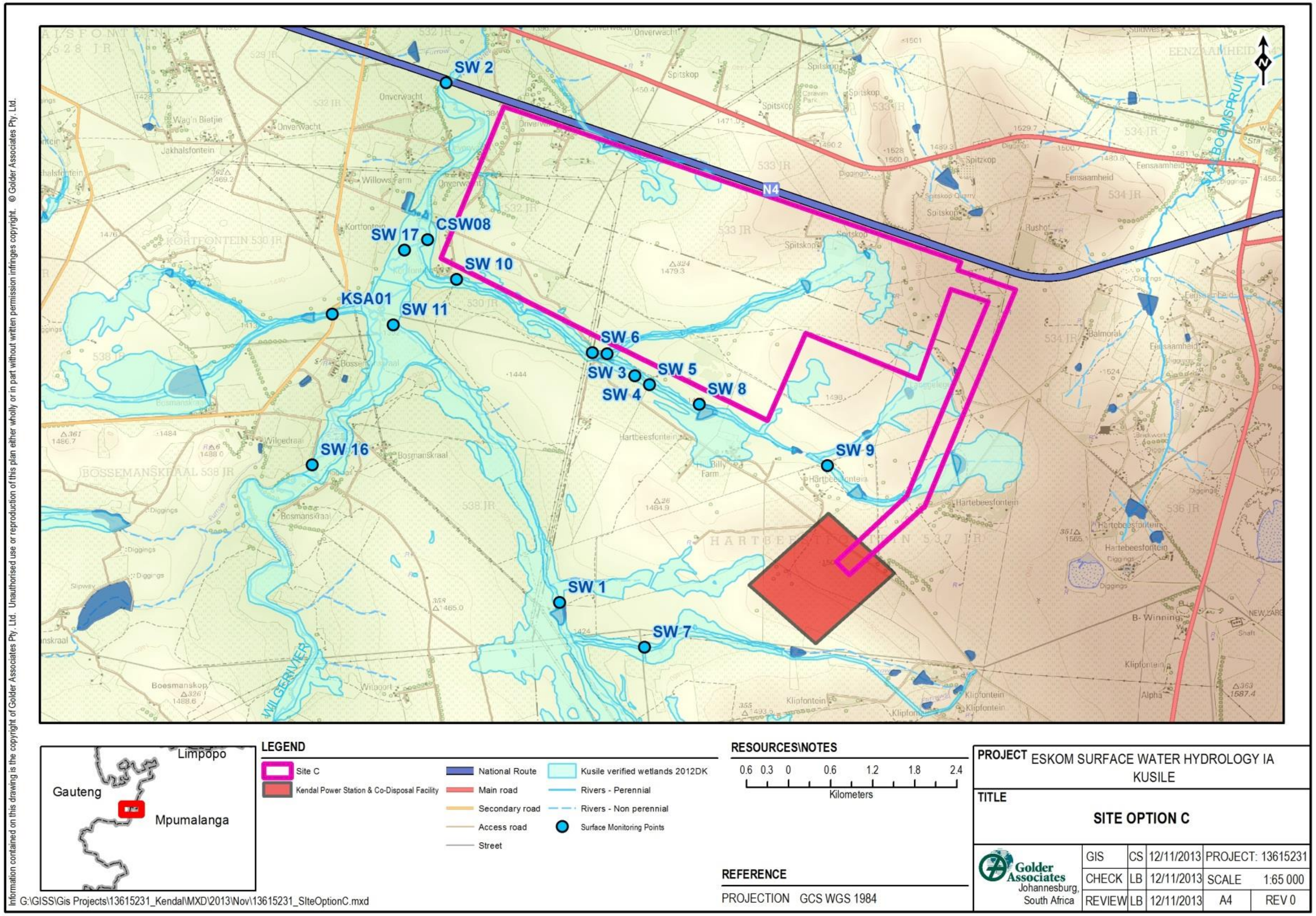

Figure 5: Map showing site C

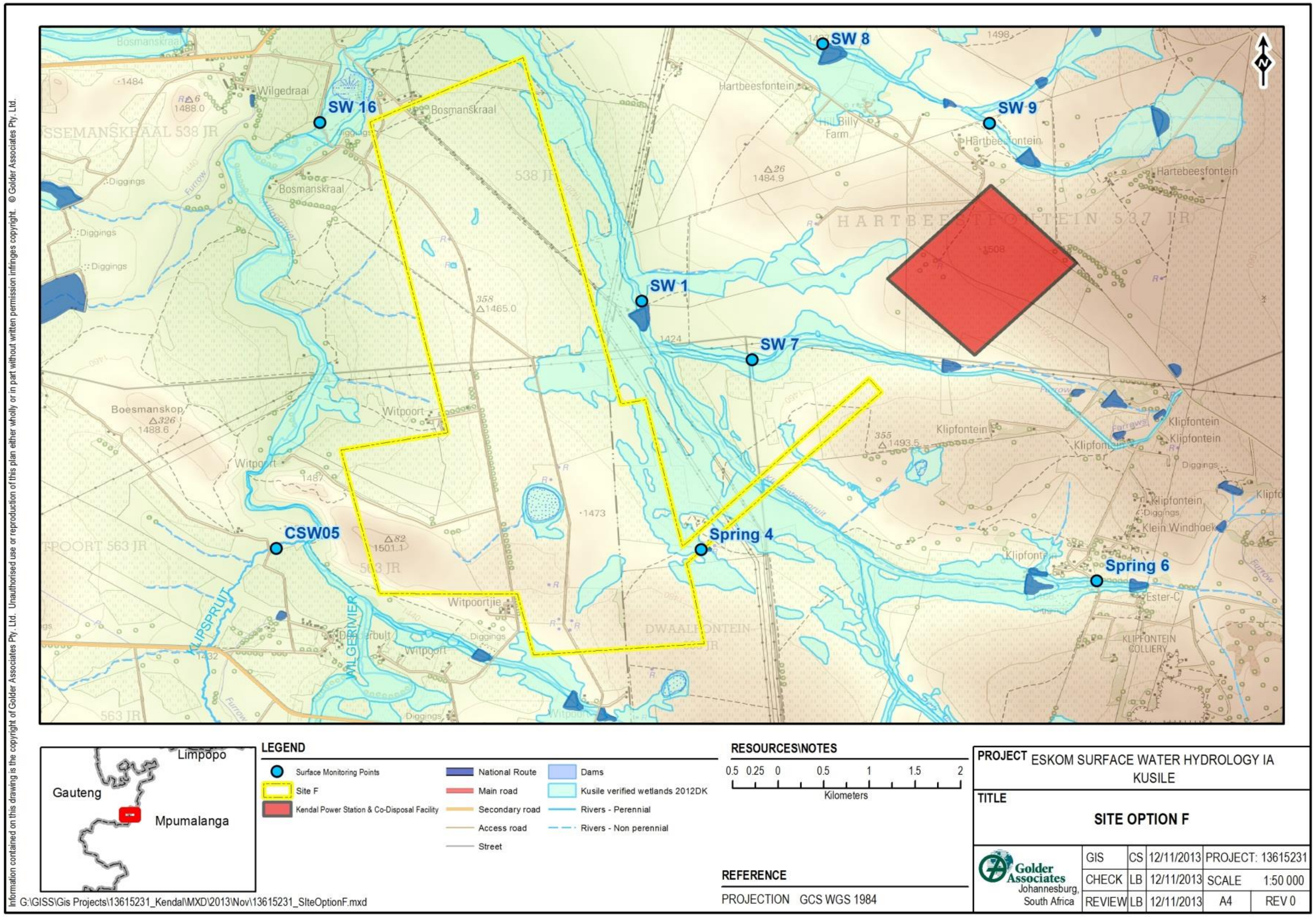

Figure 6: Map showing site F

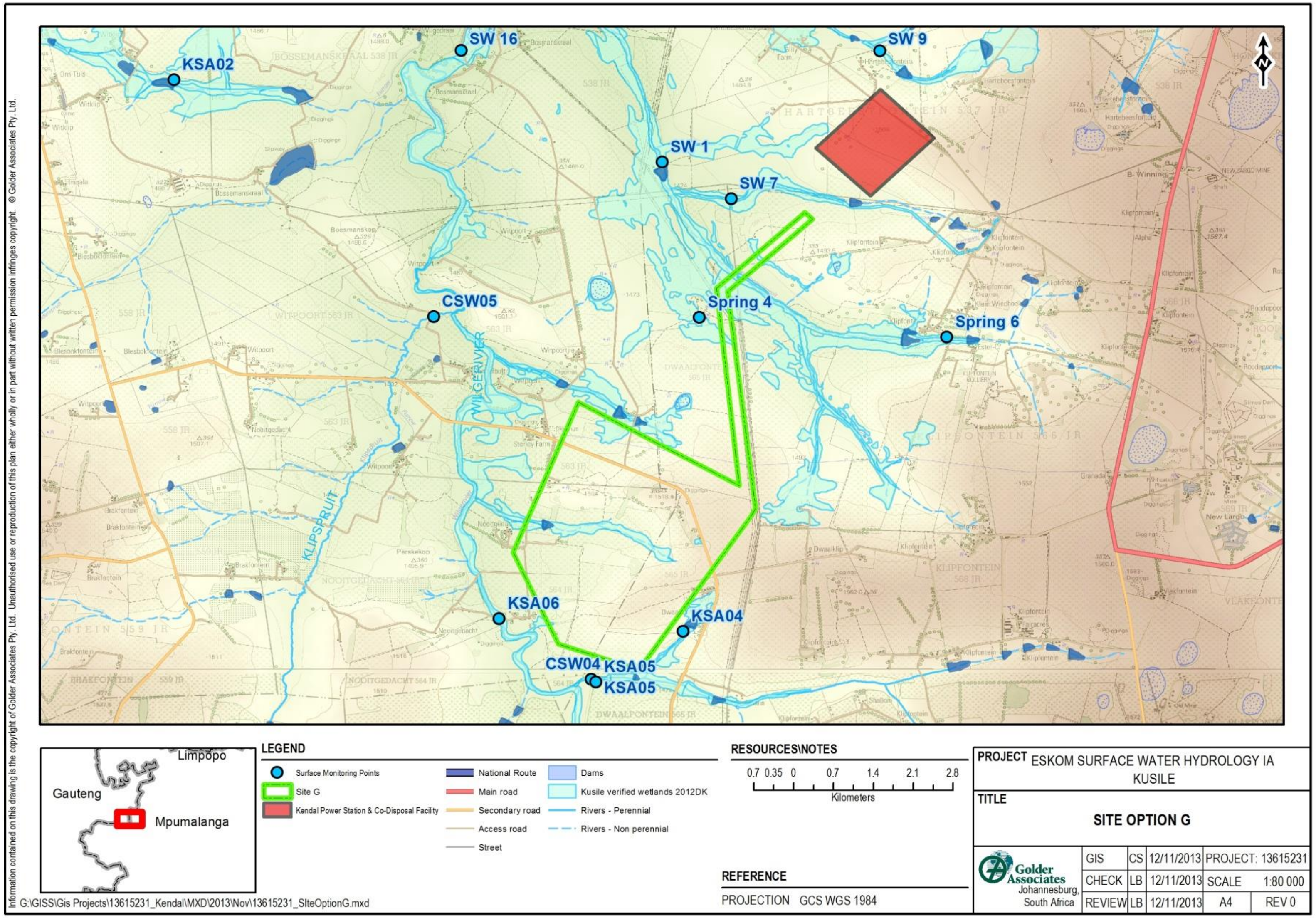

Figure 7: Map showing site G

6.0 IMPACT ASSESSMENT

6.1 Impact assessment methodology

The impact assessment is conducted by determining how the proposed activity will affect the state of the environment previously described. Specific requirements are:

- Undertake a comparative assessment to identify and quantify the environmental and/or social aspects of the various activities associated with the proposed project;
- Assess the impacts that may accrue and the significance of those impacts using the methodology as described below; and
- Identify and assess cumulative impacts utilising the same rating system.

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

- Significance assessment;
- Spatial scale;
- Duration or temporal scale;
- Degree of probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology is used to describe impacts for each of the aforementioned assessment criteria.

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

6.1.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 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 10.

Table 10: 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

Rating			Description
Score	**Code**	**Category**	
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.

6.1.2 Spatial Scale

The spatial scale refers to the extent of the impact. In other words the impact is at a local, regional, or global scale. The spatial assessment scale is described in more detail in Table 11.

Table 11: Description of the spatial 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.

6.1.3 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 12.

Table 12: 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.

6.1.4 Degree of Probability

Probability or likelihood of an impact occurring is described in Table 13.

Table 13: Description of the degree of probability of an impact occurring

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*

6.1.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 14. 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 14: Description of the degree of certainty rating scale

	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.

6.1.6 Impact risk calculation

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

Impact Risk = ((SIGNIFICANCE **+** *Spatial* **+** Temporal) ÷ 2.714) X (Probability ÷ 5)

The impact risk is classified according to five classes as described in the table below (Table 15).

Table 15: 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**

6.1.7 Cumulative Impacts

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

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

7.0 ASSESSMENT OF IMPACTS

Samples of ash from Kendal Power Station were analysed for both organic and inorganic constituents according to the Department of Water Affairs and Forestry (1998) Minimum Requirements. Dry leach assessment was also undertaken mainly to classify waste in terms of the Department of Environmental Affairs (2009) waste classification requirements. It is likely that the ash from the Kusile Power Station will be similarly classified.

In terms of the Minimum Requirements methodology the Kendal coal derived ash was classified as a Hazard Group 1 waste or an Extreme Hazardous waste. This was due to the leachable concentration of chromium VI detected in the ARLP leach solution. However the DEA's draft waste classification system classified it as a Type 3 waste (low hazard waste). The Type 3 waste classification was the result of boron (B) exceeding the Leach Concentration value of 0.50 mg/L, and barium (Ba) and fluoride (F) exceed the respective Total Concentrations of 570 mg/kg and 112 mg/kg respectively.

It can be expected that these variables of concern will impact on the surface water resources. However this will be mitigated by disposing the ash on a barrier system that meets the requirements of hazardous waste disposal and will be sufficient to protect the environment in the long-term.

The watercourses that could be affected depending on the site are:

- Site A and Small A: Holspruit and Klipfonteinspruit;
- Site B: Wilge River;
- Site C: unnamed non-perennial tributary;
- Site F: Wilge River; and
- Site G: Wilge River, Klipfonteinspruit and Kusile tributary.

7.1 Comparative Impact assessment

An initial impact assessment was undertaken (Table 16 – 21) to assess which site would have the least impact on the surface water in relation to:

- Water quality deterioration from potential contaminated seepage and run-off from the ADF; and
- Flow reduction due to the ADF development cutting off flows from streams.

During the operational phase the ADF will be lined; adequate storm water management to comply with GN 704 and ensure separation of clean and dirty water on site with no release of dirty water will in place to ensure water quality deterioration is limited. This will also ensure some flows back to the resource so that the significance of the reduced flows will be minimised as the potential to divert rivers or streams upstream of any of the sites is not feasible. Implementation of well-designed protection of the conveyor crossing the rivers/streams, and in particular the Wilge River for Site B, will limit spills. An extensive monitoring network that would include biomonitoring would need to be put in place for early detection of pollution ands necessary rehabilitation.

The impact risk with mitigation is therefore also included. Table 22 summarises the impact risk for each site. Site A was then selected for a more detailed impact assessment based on it being the most favourable site.

Table 16: Impact description for Site A

IMPACT DESCRIPTION for ***SITE A***		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2 MODH**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	4 VLIKE	**-3.8 MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2 LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5 MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8 LOW**
	OPERATION							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5 MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7 MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5 MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8 LOW**
	CLOSURE							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5 MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7 MODL**

CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

Table 17: Impact description for Site B

IMPACT DESCRIPTION for ***SITE B***		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	No Impact	**Possible**	2 LOW	3 ADJ	1 INCID	2 UNLIKE	**0.9** **VLOW**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
	OPERATION							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS	Negative	**Probable**	2	4	2	3	**-1.8**

	FROM PROJECT, **AFTER MITIGATION**			LOW	LOC	SHORT	LIKE	**LOW**
	CLOSURE							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

Table 18: Impact description for Site C

IMPACT DESCRIPTION for ***SITE C***		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Possible**	2 LOW	3 ADJ	1 INCID	2 UNLIKE	**-0.9** **VLOW**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
OPERATION								
Project Impact 1	Deterioration of water quality in the resource against baseline water	Negative	**Probable**	4	4	4	4	**-3.5**

	quality data			MODH	LOC	LONG	VLIKE	**MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
CLOSURE								
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

Table 19: Impact description for Site FG

IMPACT DESCRIPTION for ***SITE FG***		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
CONSTRUCTION								
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Possible**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**

CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
OPERATION								
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	3 MODL	4 LOC	3 MED	4 VLIKE	**-2.9** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
CLOSURE								
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

Table 20: Impact description for Site FA

IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
	CLOSURE							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

Table 21: Impact description for Site GA

IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnitude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	1 VLOW	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
	OPERATION							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**
	CONSTRUCTION							
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**

CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4	4	4	4	**-3.5**
				MODH	LOC	LONG	VLIKE	**MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2	4	2	3	**-1.8**
				LOW	LOC	SHORT	LIKE	**LOW**

Table 22: Comparative impact risk

IMPACT RISK ASSESSMENT						
Phase	SITE A	SITE B	SITE C	SITE FG	SITE FA	SITE GA
CONSRUCTION						
INITIAL BASELINE IMPACTS TO ENVIRONMENT	-3.2	0.9	-0.9	-3.2	-3.2	-3.2
	MODH	VLOW	VLOW	MODH	MODH	MODH
Deterioration of water quality in the resource against baseline water quality data	-3.8	-3.5	-3.5	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Reduction of flow	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
	LOW	LOW	LOW	LOW	LOW	LOW
Initial impacts to environment + additional impacts from project, before mitigation	-3.5	-3.2	-3.2	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Initial impacts to environment + additional impacts from project, after mitigation	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
	LOW	LOW	LOW	LOW	LOW	LOW
OPERATION						
Deterioration of water quality in the resource against baseline water quality data	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Reduction of flow	-2.7	-2.7	-2.7	-2.9	-2.7	-2.7
	MODL	MODL	MODL	MODL	MODL	MODL
Initial impacts to environment + additional impacts from project, before mitigation	-3.5	-3.2	-3.2	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Initial impacts to environment + additional impacts from project, after mitigation	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
	LOW	LOW	LOW	LOW	LOW	LOW

CLOSURE						
Deterioration of water quality in the resource against baseline water quality data	-3.5	-3.2	-3.2	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Reduction of flow	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7
	MODL	MODL	MODL	MODL	MODL	MODL
Initial impacts to environment + additional impacts from project, before mitigation	-3.5	-3.2	-3.2	-3.5	-3.5	-3.5
	MODH	MODH	MODH	MODH	MODH	MODH
Initial impacts to environment + additional impacts from project, after mitigation	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
	LOW	LOW	LOW	LOW	LOW	LOW

Based on the above alternative comparative assessment sites B and C are the most sensitive in terms of current water quality. While it does not necessarily show in the impact assessment tables, Site B and its associated conveyor is likely to have the highest negative impact on the surface water resources. In terms of the reduction of flow, the main impacts would be during the operational and closure phases, however the impact is still moderate-low, and if mitigation in terms of complying to GN 704 is in place, this impact would reduce to low. Even though the impact risks are very similar in all cases once mitigation is included, in terms of water quality and quantity impacts the following order of sites is recommended:

1) Option A;
2) Option C;
3) Option B;
4) Options GA; FG and FA are all in very close proximity to the main stem of the Wilge River so that the impacts would be more direct, and in addition the footprint of the sites would be larger.

7.2 Environmental impact statements

7.2.1 Site A: Construction Phase

Status Quo

Surface water resources within Site A are the Holspruit and Klipfonteinspruit. There is also a tributary that drains Kusile Power Station and flows directly into Klipfonteinspruit. The footprint of the Site A is currently utilised extensively for agriculture, mostly cultivation, though some livestock grazing is also known to occur. These activities have had limited impact on the streams in the area with some impacts on water quality from agricultural run-off. There are two sample points on the Klipfonteinspruit (Springs 4 and 6) and one sample point on the tributary that emanates from Kusile (SW7). A wetland is located at the headwaters of Klipfonteinspruit. The water quality results at Spring 6 and SW7 show high levels of fluoride (F), sulphate (SO_4), conductivity (EC) and total dissolved solids (TDS), exceeding the RWQOs. This is very possibly due to the limited mining activity upstream of these points and the Kusile co-disposal facility in close proximity. The proposed New Largo mine is upstream of Spring 6. However Spring 4, which is downstream of Spring 6, shows an improved water quality indicating the functionality of the wetland. A number of farm road crossings have also lead to reduction of flow in the streams.

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 ADF and the associated infrastructure such as conveyors, access roads and storm water management facilities:

- Loss of streams;
- Disturbance to streams;
- Increased sediment transport into water resources;
- Increased erosion;
- Water quality deterioration in adjacent water resources; and
- Altered flows.

Water resources falling within the footprint of the ash dam and associated infrastructure will be lost. Earth works relating to the construction of these facilities will permanently destroy the water resources within the construction footprint. Loss of flow at the outlet of catchment B20F due to destruction of streams within the footprint of Site A is expected to be an average reduction of 1,6% of the base flow. Only the footprint required for the first 5 years of ash deposition will be cleared and prepared during the construction phase so the loss of water resources is expected to be greatest during the operational phase.

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 and uncontrolled driving of machinery leading to increased flow velocities off the site, increasing the risk of erosion with sediments potentially transported down the water resources and deposited in the Wilge River.

Construction of potential stream diversions around the ash dam footprint will have similar impacts to those described above.

During the construction phase it is likely that spills and leaks of hazardous substances such as cement, oil and diesel, sewage spills from temporary ablutions may occur. Run-off from the site would therefore lead to water quality deterioration.

The combined weighted project impact to water resources (prior to mitigation) will **definitely** be of a MODERATE-HIGH negative significance, affecting the *local area*. The impact will act in the medium term and is *very likely* to occur. The impact risk class is thus **Moderate to High.**

Cumulative Impact

The agricultural activities on site have had limited impact on the water resources quality. Farm dam construction has resulted in some flow alteration.

The Kusile Power Station construction has had an impact on the water quality. The proposed New Largo Mine is also likely to result in further water quality deterioration.

The baseline impacts are considered to be low 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 MODERATE-HIGH negative significance, affecting the *study area* in extent. The impact *is very likely* and will be medium term. The impact risk class is thus **Moderate to High**.

Mitigation Measures

Mitigation during construction would be to:

- Optimise design of the ADF to minimise the size of the footprint;
- Minimise area of vegetation clearing;
- Where practically possible, undertake the clearing of vegetation during the dry season to minimise erosion;
- Comply with GN704 in relation to storm water measures so that sediment transport off site is minimised and clean water is diverted around the cleared area;
- the storm water management plan should be in place prior to construction being initiated;
- Install sediment traps as part of the storm water management plan where necessary and especially upstream of discharge points where erosion protection measures and energy dissipaters should be in place;
- Clean spills as quickly as possible;
- 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 out of the 1:00 floodlines;

- Locate temporary sanitation facilities out of the 1: 100 year floodlines;
- Design infrastructure for river crossings adequately to prevent spillages; and
- Implement a water quality monitoring programme.

Residual Impact

The residual impact of the construction of the ADF will include the permanent loss of water resources (flow), as well as a potential decline in water quality. Most of these impacts are expected to be mostly restricted to the local scale, however the potential deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to water resources beyond the closure phase of the project will be reduced through mitigation but not to within baseline conditions. After mitigation the impacts to the water resources will **probably** be of a MODERATE LOW negative significance, affecting the *adjacent area* in extent. The impact *is likely* and will be permanent. The impact risk class is however still **Low**.

IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	No Impact	**Probable**	1 VLOW	1 ISO	1 INCID	3 LIKE	**0.7** **VLOW**
Project Impact 1	water quality deterioration	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	flow alteration	Negative	**Definite**	1 MODH	4 LOC	3 MED	2 UNLIKE	**-1.2** **LOW**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	3 MED	4 VLIKE	**-3.2** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3 MODL	3 ADJ	3 MED	3 LIKE	**-2** **LOW**

7.2.2 Site A: Operational Phase

Status Quo

This is detailed under Section 7.2.1.

Project Impact (Unmitigated)

A number of impacts are expected to materialise as consequence of the operations of the ADF and the associated infrastructure. 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 the ADF footprint expands in 5 year sections.

- Loss of streams;
- Disturbance to streams;
- Increased sediment transport into water resources

- Increased erosion;
- Water quality deterioration in adjacent water resources; and
- Altered flows.

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. As described in Section 7.0 the ash is likely to 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 Klipfonteinspruit drains into the Wilge River and any water quality impacts to the Klipfonteinspruit are likely to also affect the Wilge River.

The ADF will be lined and the area treated as a dirty water area so that no surface runoff from the site should enter the adjacent water resources. This will reduce the flow from the site however clean water will be diverted around the site.

The combined weighted project impact to water resources (prior to mitigation) will **definitely** be of a MODERATE-HIGH negative significance, affecting the *local area*. The impact will act in the medium term and is *very likely* to occur. The impact risk class is **Moderate to High.**

Cumulative impacts

The agricultural activities on site have had limited impact on the water resources quality. Farm dam construction has resulted in some flow alteration. The Kusile Power Station construction has had an impact on the water quality. The proposed New Largo Mine is also likely to result in further water quality deterioration.

The baseline impacts are considered to be low and additional project impact (if no mitigation measures are implement) will increase the significance of the existing baseline impacts, the cumulative unmitigated impact will **probably** be of a MODERATE-HIGH negative significance, affecting the *study area* in extent. The impact *is very likely* and will be medium term. The impact risk class is thus **Moderate to High**.

Mitigation Measures

Because of the 5 year footprint extension, mitigation during operation would be similar to the construction mitigation:

- Optimise design of ash dam to minimise size of footprint;
- Minimise area of vegetation clearing;
- Where practically possible, undertake the clearing of vegetation during the dry season to minimise erosion;
- Comply with GN704 in relation to storm water measures so that sediment transport off site is minimised and clean water is diverted around the cleared area;
- Maintain sediment traps as part of the storm water management plan where necessary and especially upstream of discharge points where erosion protection measures and energy dissipaters should be in place;
- Clean spills as quickly as possible;
- 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 waste and hazardous substance storage facilities out of the 1:100 floodlines.
- Locate sanitation facilities out of the 1: 100 year floodlines;
- Maintain infrastructure for river crossings adequately to prevent spillages; and
- Maintain a water quality monitoring programme.

Residual Impact

The residual impact of the construction and operation of the ADF will include the permanent loss of water resources (flow), as well as a potential decline in water quality. Most of these impacts are expected to be mostly restricted to the local scale, however the potential deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to water resources beyond the operational phase of the project will be reduced through mitigation but not to within baseline conditions. After mitigation the impacts to the water resources will **probably** be of a MODERATE LOW negative significance, affecting the *adjacent area* in extent. The impact *is likely* and will be permanent. The impact risk class is however still **Low**.

Rated By:		Site A						
IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	OPERATIONAL							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	No Impact	**Probable**	1	1	1	3	**0.7**
				VLOW	ISO	INCID	LIKE	**VLOW**
Project Impact 1	water quality deterioration	Negative	**Probable**	4	4	4	4	**-3.5**
				MODH	LOC	LONG	VLIKE	**MODH**
Project Impact 2	flow alteration	Negative	**Definite**	2	4	3	4	**-2.7**
				LOW	LOC	MED	VLIKE	**MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4	4	3	4	**-3.2**
				MODH	LOC	MED	VLIKE	**MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3	3	3	3	**-2**
				MODL	ADJ	MED	LIKE	**LOW**

7.2.3 Site A: Closure Phase

Status Quo

This is detailed under Section 7.2.1.

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. Impacts relating to the rehabilitation of the ADF are also applicable to the operational phase of the project, as rehabilitation will take place concurrently. 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.

- Disturbance to streams;

- Increased sediment transport into water resources;
- Increased erosion;
- Water quality deterioration in adjacent water resources; and
- Altered flows.

As described in Section 7.0 the ash is likely to contain a number of pollutants. Contaminated surface water runoff from the ash dam or water seeping out of the ash dam 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.

Rehabilitation of the ADF will include the placement of topsoil on the side slopes and crest of the ADF and the establishment of vegetation on the ADF. Surface runoff on the steep side slopes is likely to erode the topsoil in the initial stages prior to the establishment of sufficient vegetation.

Decommissioning activities along the conveyor route may result in disturbance to the water course that increases the risk of erosion within the affected water resources.

The combined weighted project impact to water resources (prior to mitigation) will **definitely** be of a MODERATE-HIGH negative significance, affecting the *local area*. The impact will act in the medium term and is *very likely* to occur. The impact risk class is thus **Moderate to High.**

Cumulative Impact

The agricultural activities on site have had limited impact on the water resources quality. Farm dam construction has resulted in some flow alteration. The operation of the Kusile Power Station, New Largo Mine and other potential developments in the area are also likely to result in further water quality deterioration. The cumulative impacts of these activities and the ADF are likely to impact on the water resources.

The baseline impacts are considered to be low 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 MODERATE-HIGH negative significance, affecting the *local area* in extent. The impact *is very likely* and will be medium term. The impact risk class is thus **Moderate to High**.

Mitigation Measures

Mitigation during closure would be to:

- Comply with GN704 in relation to storm water measures so that sediment transport off site is minimised and clean water is diverted around the cleared area;
- Maintain sediment traps as part of the storm water management plan where necessary and especially upstream of discharge points where erosion protection measures and energy dissipaters should be in place; and
- Maintain the water quality monitoring programme at closure and post-closure.

Residual Impact

The residual impact of the closure of the ADF will include the permanent loss of water resources (flow), as well as a potential decline in water quality. Most of these impacts are expected to be restricted to the local scale, however the potential deterioration of water quality within the Wilge River will increase the extent of the impacts.

The residual impact to water resources beyond the closure phase of the project will be reduced through mitigation but not to within baseline conditions. After mitigation the impacts to the water resources will

probably be of a MODERATE LOW negative significance, affecting the *adjacent area* in extent. The impact *is likely* and will be permanent. The impact risk class is however still **Low**.

IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 1	Deterioration of water quality in the resource against baseline water quality data	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
Project Impact 2	Reduction of flow	Negative	**Probable**	2 LOW	4 LOC	3 MED	4 VLIKE	**-2.7** **MODL**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	4 VLIKE	**-3.5** **MODH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	2 LOW	4 LOC	2 SHORT	3 LIKE	**-1.8** **LOW**

7.3 Cumulative impacts

The cumulative impact assessment considers the project within the context of other similar land uses, in the local study area and greater regional context.

Historical agricultural and mining practices over the past few decades have had detrimental effects on the surface water environment in the area. This is mainly attributed to fertilizer application, erosion, siltation and point-source discharges by wastewater treatment works (WWTWs) into the surrounding watercourses upstream of the Kusile Power Station site. The presence of several industrial and mining activities within one catchment may have severe effects on the surface water environment. The receiving water resource within the area is the Wilge River, which will soon experience significant water quality concerns if best management practices are not implemented. The Wilge River, a tributary of the Olifants River, flows northwards until it is joined by its main tributary, the Bronkhorstspruit River. The river then flows in a north-easterly direction until it joins the Olifants River upstream of the Loskop Dam. Given the fact that the Olifants River feeds into several water supply storage facilities utilised by local settlements, the impact of deteriorating water quality, which makes the water less fit for use, has significant environmental as well as social and economic implications.

Due to the fact that several upstream impacts are already occurring when considering significance rating for cumulative impacts for each of the proposed sites, the impact class will not change considerably compared to those shown in Table 16. However, should mitigation be put in place then the local cumulative impacts would reduce the significance rating for the local area but may not have much of a positive impact on the broader catchment. This would need to be assessed considering all other users in the catchment.

7.3.1 New Largo

The proposed New Largo mine area straddles the B20F and B20G quaternary catchments. The two main streams that the mine may impact on are the Wilge River in the B20F quaternary catchment and the Saalboomspruit in the B20G quaternary catchment. The mine site contains several pans and springs.

In relation to the location of New Largo within the two quaternary catchments, it is likely that it will have an impact on the Wilge River from the tributaries running up and downstream of the mine area as well as the tributaries flowing to the Saalboomspruit. The impacts from the mine to the Wilge River (B20F) may affect the cumulative water quality impacts in the catchment if adequate best management practices are not implemented.

Using the impact description table if New Largo goes ahead and assuming that the mine does not do best practice and implement mitigation then the impacts to the water resources will **definitely** be of a MODERATE HIGH negative significance, affecting the *district area* in extent. The impact *is very likely* and will be long term. The impact risk class is **Moderate-High**.

Should the mine not go ahead then if Kusile implements best practice and adequate mitigation then the impacts to the water resources will **probably** be of a LOW negative significance, affecting the *adjacent area* in extent. The impact *is likely* and will be medium term. The impact risk class is **Low**.

In the case where New Largo goes ahead and assuming that the mine does not do best practice and implement mitigation then the cumulative impacts, from the mine and Kusile, to the water resources will **definitely** be of a MODERATE HIGH negative significance, affecting the *district area* in extent. The impact *is very likely* and will be long term. The impact risk class is **Moderate-High**.

IMPACT DESCRIPTION		Direction of Impact	**Degree of Certainty**	Magnitude	Spatial	Temporal	Probability	**Impact Risk**
Code	*Phase*							
	CONSTRUCTION AND OPERATION							
Status Quo	Initial Baseline Impacts To Environment	No Impact	**Probable**	3 MODL	4 LOC	4 LONG	4 VLIKE	**-3.2** **MODH**
Project Impact 1	Water quality deterioration by New Largo	Negative	**Definite**	4 MODH	5 DIS	4 LONG	4 VLIKE	**-3.8** **MODH**
Project Impact 2	Water quality deterioration by Kusile (with successful mitigation) if New Largo not there)	Negative	**Probable**	3 MODL	3 ADJ	3 MED	3 LIKE	**-2** **LOW**
Project Impact 3	Cumulative water quality impacts by New Largo and Kusile	Negative	**Probable**	4 MODH	5 DIS	4 LONG	4 VLIKE	**-3.8** **MODH**
Residual impact	Initial impacts to environment + additional impacts from project, after mitigation	Negative	**Probable**	**3** MODL	**4** LOC	**3** MED	**3** LIKE	**-2.2** **MODL**

If Kusile Power Station implements a comprehensive storm water management plan for the power station and the ADF this will help in managing negative effects from the power station. However the power station should work closely with New Largo to ensure that the storm water management plans for the two facilities (power station and mine) complement each other and are sustainable in the long term.

The Department of Water Affairs should work with all the relevant water users in the area to put a rehabilitation and maintenance plan in place for the entire downstream wetland up to Wilge River to increase buffering capacity.

In all cases an adequate surface water monitoring programme that would include biomonitoring must be put in place and implemented in such a way that as soon as pollution incidents occur or negative environmental trends are noticed rehabilitation will kick in.

8.0 CONCLUSIONS

The following conclusions can be made as a result of this study:-

- The analysis has determined the cumulative effect of the ADF options on the flows in the Wilge River. The cumulative effect is based on the current understanding of the catchment development;

- The flow reductions from a quaternary catchment perspective as predicted by the modelling are small (<2%) for all the sites;
- ADF Option C has the largest foot print and therefore the largest flow reduction;
- The Klipfonteinspruit (where site A is located) was identified as being impacted by upstream mining activities and the impact that will emanate from Kusile co-disposal site. This stream receives discharge from the upstream New Largo mine area. In relation to the location of Kusile Power Station within the catchment, it is likely that it could have an impact on the Wilge River from the tributaries running up and downstream of the power station site and the New Largo mine activities are likely to add to the cumulative impacts in the catchment;
- Based on the information above, although site C has the largest footprint and the largest flow reduction it is expected to have the least impact on the water resources. Only one stream drains the area, with only one conveyor stream crossing expected;
- The Wilge River has been classified as a Class II river which means that it needs to be protected and maintained in the state that it currently is. In terms of surface water quality it is therefore important that best practise is employed when undertaking ash disposal activities.

9.0 REFERENCES

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GOLDER ASSOCIATES AFRICA (PTY) LTD.

Lee Boyd
Water Resources Scientist

Trevor Coleman
Senior Water Resources Engineer

SC/TJC/ptk

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APPENDIX A

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
PO Box 6001
Halfway House, 1685
Thandanani Park
Matuka Close
Halfway Gardens
Midrand
South Africa
T: [+27] (11) 254 4800