**REPORT**

# Kendal Ash Dump Extension

*Surface Water Impact Assessment*

Submitted to:

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Submitted by:

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# Executive Summary

Kendal Power Station (Kendal) is a coal-fired power station situated south west of the town of Ogies that became operational in 1993. It has an indirect dry-cooling system that uses a cooling tower and water. Cooling water (clean water) flowing through these elements, cools down as the cold air passes over them and returns to the condenser. This is referred to as a closed system as there is no loss of water due to evaporation and uses significantly less water in its cooling processes than conventional wet cooled power stations. The power station has six (6) 686 megawatt (MW) units that generate 4 116 MW of energy.

The current Kendal Power Station ash disposal facility (ADF) is running out of space due to the poor quality coal accessible for combustion, which produces more ash than was planned. In addition, the life span of Kendal has been extended to 2058, which would render the available ash disposal space inadequate to accommodate continuation of ash disposal.

Eskom Holdings SOC Ltd (Eskom) was granted an Integrated Environmental Authorisation (IEA) on the 28th of July 2015 for their Kendal Power Station, continuous ash disposal facility (ADF) to accommodate the ash to be produced by the power station up to the year 2030. The integrated Water Use Licence (IWUL) number: 04/B20E/ABEGI/3888 for the extension, including the river diversion, was received in December 2015. One of the conditions of the IEA is that the ADF should be lined with a Class C liner. However, as a way to cater for the extended construction of the ADF a transitional period exemption was applied for and granted in May 2016. This was for Eskom to ash without lining until May 2020, for a period of 4 years (DEA Ref No. 14/12/16/3/3/3/63AM1).

Eskom now intends to extend the exemption authorisation period to continue ashing on the exempted area until the exempted footprint is covered with ash and ensure a smooth transition to the lined area. Green Gold Group has been appointed as an independent Environmental Assessment Practitioner (EAP) to facilitate the Part 2 amendment process in terms of the National Environmental Management Act, Act No. 107 of 1998 (NEMA) as amended, read in conjunction with Chapter 5 of the Environmental Impact Assessment (EIA) Regulations 2014 as amended.

The objectives of this study are to update the baseline study for the surface water and describe the potential impacts and possible mitigation. The following aspects are licensed under IWUL number: 04/B20E/ABEGI/3888 and are not included in the impact assessment as the mitigation is included in the IWUL.

- Continuation of the existing ADF in a north westerly direction, to increase the storage capacity of the existing Emergency-Dump (hereafter referred to as the E-Dump),
- Construction of Pollution Control Dams, Clean Water Dams and Storm Water Management infrastructure,
- Diversion of a natural stream to accommodate the continuous ADF footprint and remedial works to an existing in-stream farm dam within Eskom's property boundary, to address the mixing of flow from the final voids of the adjacent mining operations. The

This report therefore only deals with the potential impact based on the ash disposal to the unlined area exempted in May 2016. i.e ashing beyond the provided period of 4 years but within the same exempted footprint.

The streams surrounding the existing ash disposal area are already impacted by the existing ash disposal facility and the mining activities within the area.

Data from DWS monitoring point 188173, in close proximity to R01, has shown that considerable contamination has occurred upstream of the ADF.

Continued ash disposal to the existing footprint is unlikely to change the impacts currently seen in the Leeuwfonteinspruit and the Schoongezichtspruit. The conditions set as part of the IWUL will assist in mitigating against the cumulative impacts to the water resources. Should the measures not be implemented then it is likely that there will be an impact on the Wilge River from the tributaries flowing downstream from the site.

- All samples collected in November 2018, February 2019 and July 2019 indicate high electrical conductivity (EC) and total dissolved solids (TDS), sodium (Na), chloride (Cl) and sulphate ($SO_4$) concentrations;
- All metals except for aluminium were very low at all sites. Aluminium was elevated at all sites except for the most upstream points on both streams and the most downstream point after the confluence of the two streams.
- Boron and fluoride which were shown to be leachable from the ash, are within the WQPL, except for boron at AP11, the dam west of ash stack in Leeuwfonteinspruit.

The Wilge River catchment (and associated tributaries) is a priority and has been classified as a Class II river and will require water use activities in its catchment to be conducted in a safe and responsible manner so as not to increase the existing impacts on water quality. Adequate stormwater management around the ADF is therefore a priority.

Surface water monitoring in and around Kendal Power Station must continue, to enable early warnings where changing trends are noted and ensure mitigation is implemented timeously. This may mean that Kendal will need to collaborate with the upstream users.

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# 1.0 INTRODUCTION

Kendal Power Station (Kendal) is a coal-fired power station situated south west of the town of Ogies that became operational in 1993. It has an indirect dry-cooling system that uses a cooling tower and water. Cooling water (clean water) flowing through these elements, cools down as the cold air passes over them and returns to the condenser. This is referred to as a closed system as there is no loss of water due to evaporation and uses significantly less water in its cooling processes than conventional wet cooled power stations. The power station has six (6) 686 megawatt (MW) units that generate 4 116 MW of energy.

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Golder Associates Africa (Pty) Ltd (GAA) was appointed by Green Gold Group to update the baseline water quality and quantity assessment for the proposed site for the amendment application of an exemption authorisation for Kendal Power Station ADF. The purpose of this surface water report is to inform the amendment application being undertaken by Green Gold Group.

## 1.1 Study Objectives

The objectives of this study are to update the baseline study for the surface water and describe the potential impacts and possible mitigation. The following aspects are licensed under IWUL number: 04/B20E/ABEGI/3888 and are not included in the impact assessment as the mitigation is included in the IWUL.

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# 2.0 CATCHMENT DESCRIPTION

## 2.1 Project Area

The project is located on the farm Schoongezicht 218 IR, Emalahleni Local Municipality within the Mpumalanga Province, south west of the Eskom Kendal Power Station, at coordinates: 26° 5'56.02"S and 28°56'13.86"E (Figure 1).

Kendal Power station and the associated ADF are located in quaternary B20E which forms part of the Wilge sub-catchment. The two drainage areas relevant to the ADF are the Schoongezichtspruit that drains between Kendal Power Station and the ADF in a north westerly direction to confluence with the Leeuwfonteinspruit below the ADF, flowing in a north westerly direction on the southern side of the ADF. The Leeuwfonteinspruit flows into the Wilge River.

## 2.2 Reserve, Classification of the Resources and Resource Quality Objectives

The protection of water resources is governed by Chapter 3 of the National Water Act (NWA), and Chapter 5 of the National Water Resources Strategy 2 (NWRS2) (DWA, 2013) which prescribe the protection of the water resources through resource directed measures (RDM) and the classification of water resources. These are measures which, together, are intended to ensure the protection of water resources, as well as being measures for pollution prevention and remedying the effects of pollution while balancing the need to use water as a factor of production to enable socio-economic growth and development.

In order to give effect to the concept of sustainability, an understanding of the nature and requirements of aquatic ecosystems under present conditions is needed. In addition, the pressures being placed upon resources, how the resources are being used, the water resources management intent, and finally the objectives which provide a statement (in terms of biota, habitat, flow and water quality) of the conditions that need to be met are also factors that must be considered.

The Reserve, classification of the resources and Resource Quality Objectives have been promulgated for the Upper Olifants Water Management Area (WMA) in which the ADF is located.

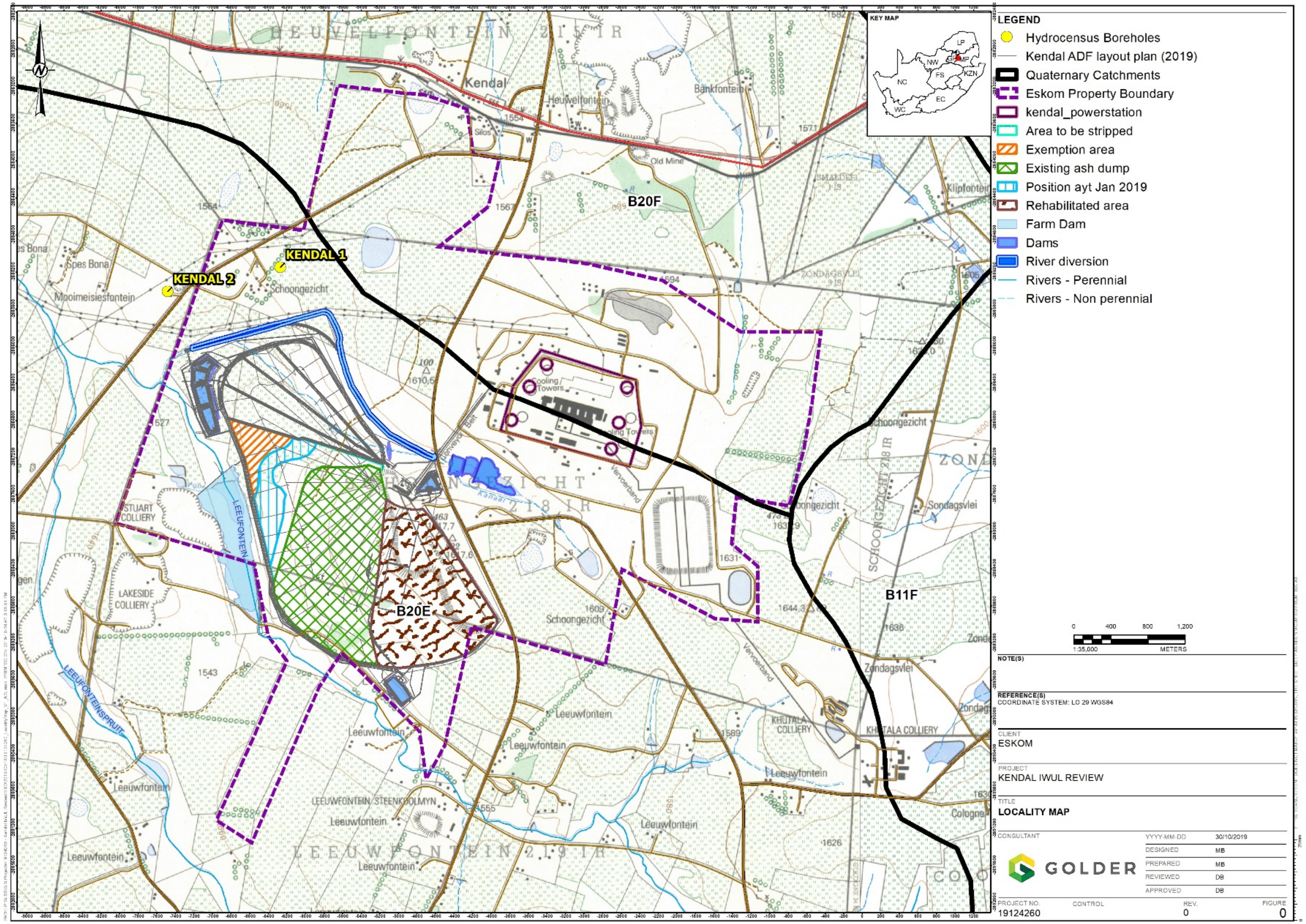


**Figure 1: Kendal Power Station and ADF location**

## 2.3 Classification

The Water Resource Classification Study (WRCS) places the following principles at the forefront of implementation:

1) Maximising economic returns from the use of water resources;
2) Allocating and distributing the costs and benefits of utilising the water resource fairly; and
3) Promoting the sustainable use of water resources to meet social and economic goals without detrimentally impacting on the ecological integrity of the water resource.

The Wilge River catchment has been classified as a Class II River in Government Gazette No 39943, 22 April 2016, Notice No 466, National Water Act, 1998 (Act No.36 OF 1998) Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment (DWS, 2016b), where the classes are described as:

| | |
|---|---|
| Class I | **Minimally used**<br><br>Water resource is one which is minimally used, and the overall condition of that water resource is minimally altered from its pre-development condition |
| Class II | **Moderately used**<br><br>Water resource is one which is moderately used, and the overall condition of that water resource is moderately altered from its pre-development condition |
| Class III | **Heavily used**<br><br>Water resource is one which is heavily used, and the overall condition of that water resource is significantly altered from its pre-development condition |

## 2.4 The Reserve

The Reserve specifies the quantity, quality, habitat and biotic integrity requirements necessary for the protection of the resource, has priority over other water uses, and will vary according to the class of the resource. The Reserve is a protection measure that comprises two components:

- Basic human needs (BHN), ensuring that the essential needs of individuals served by the water resource in question are provided for; and
- The ecological Reserve which is not intended to protect the aquatic ecosystem *per se*, but to maintain aquatic ecosystems in such a way that their integrity remains intact and they can continue to provide the goods and services to society and is specified for groundwater, wetlands, rivers and estuaries.

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: fish, invertebrates and riparian vegetation. The extent to which ecological conditions of an area have been modified from natural conditions (reference) and the Ecological Importance and Sensitivity (EIS) relate 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 classification study. The Bronkhorstspruit, Saalklapspruit and Upper Wilge rivers were found to be in a moderately modified state (category C) with fewer developed areas present in the catchment compared to other parts of the Upper Olifants catchment. The importance of the resources in this catchment was described as being 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.

The Ecological Water Requirements (EWR) for the site located on the Wilge River (EWR4) just downstream of the confluence of the Wilge River and the Saalklapspruit (Figure 2) (DWS, 2016b) are set out in Table 1 and Table 2.

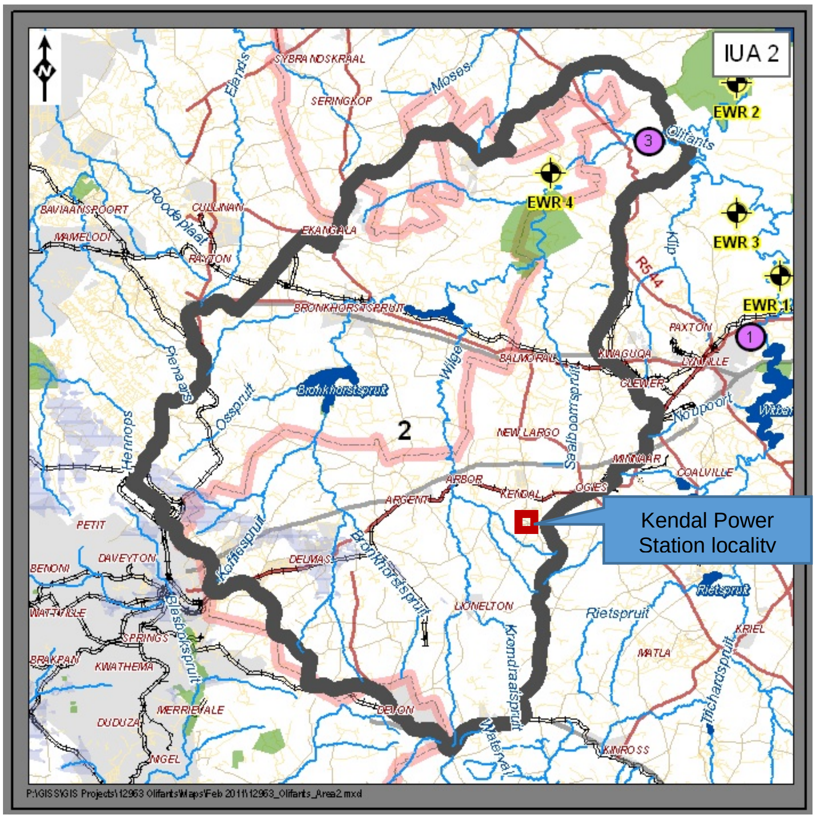


**Figure 2: EWR 4 in relation to the Kendal Power Station and ADF (DWS, 2016b)**

## 2.5 Resource Quality Objectives

Resource Quality Objectives (RQO) have been gazetted for the Wilge River catchment (DWS, 2016b). Site EWR 4 is the site at which RQOs (quantity and quality) have been set (Table 1) and (Table 2) respectively.

**Table 1: River water quantity RQO (DWS, 2016b)**

| River | REC | RQO | Indicator/ measure | Numerical limit | | |
|---|---|---|---|---|---|---|
| | | | | Maintenance low flows ($m^3/s$) (Percentile) | | Drought flows ($m^3/s$) (Percentile) |
| Wilge (EWR site - EWR4, outlet of IUA2) | B | Low flows need to be improved in order to maintain river habitat and the ecosystem. | EWR maintenance low and drought flows: Wilge EWR4 in B20J VMAR = 175.59x10°m3 PES=B category | Oct | 0.806 (50) | 0.206 *(99)* |
| | | | | Nov | 1.094 60) | 0.269 (99) |
| | | | | Dec | 1.235 (60) | 0.298 *(99)* |
| | | | | Jan | 1.476 60) | 0.350 (99) |
| | | | | Feb | 1.862 (60) | 0.436 *(99)* |
| | | | | Mar | 1.733 (60) | 0.405 (99) |
| | | | | Apr | 1.528 (50) | 0.362 *(99)* |
| | | | | May | 1.277 (50) | 0.307 (99) |
| | | | | Jun | 1.121 (50) | 0.275 *(99)* |
| | | | | Jul | 0.961 (60) | 0.239 (99) |

| River | REC | RQO | Indicator/ measure | Numerical limit | | |
|---|---|---|---|---|---|---|
| | | | | Aug | 0.802 (60) | 0.205 *(99)* |
| | | | | Sep | 0.696 (60) | 0.183 (99) |

**Table 2: EWR Site: Lower Wilge: Olifants_EWR4: EcoSpecs relating to Physico-chemical data (DWS, 2017)**

| **River: Lower Wilge** | | **EWR: Olifants_EWR4** Downstream B2H015Q01 Wilge River at Zusterstroom |
|---|---|---|
| **Water quality metrics** | | **ECOSPEC: TEC, PES and RQO** |
| **Major Ions** | Mg | The 95th percentile of the data must be ≤ 20 mg/L |
| | $SO_4$ | The 95th percentile of the data must be ≤ 150 mg/L |
| | Na | The 95th percentile of the data must be ≤ 20 mg/L |
| | Cl | The 95th percentile of the data must be ≤ 30 mg/L |
| | Ca | The 95th percentile of the data must be ≤ 70 mg/L |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 55 mS/m |
| | pH | The 5th and 95th percentiles of the data must range from 5.9 – 8.8 |
| | Temperature | Variation of 2°C or 10% from background average temperature |
| | Dissolved oxygen | The 5th percentile of the data must be ≥ 7.0 mg/L |
| | Turbidity | Vary (small amount) from natural turbidity range; minor silting of instream habitats acceptable. |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.75 mg/L |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.025 mg/L |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be ≤ 20 µg/L |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$ |
| | Ammonia | The 95th percentile of the data must be ≤ 43.75 µg/L. |
| | Atrazine | The 95th percentile of the data must be ≤ 48.75 µg/L |
| | Aluminium | The 95th percentile of the data must be ≤ 62.5 µg/L |
| | Fluoride | The 95th percentile of the data must be ≤ 0.7 mg/L |
| | Manganese | The 95th percentile of the data must be ≤ 99.0 µg/L |

*Notes: TEC: Target Ecological Category; PES: Present Ecological Status and RQO: Resource Quality Objective*

## 2.6 Water Quality Planning Limits

While RQOs have been determined for the Upper Olifants catchment, the determination of Water Quality Planning Limits (WQPL) was also undertaken to support the implementation of the RQOs (DWS, 2017). The setting of WQPLs ensures water quality planning at a finer scale and ultimately assists in achieving the downstream RQOs. The Upper Olifants catchment was sub-divided into management units (MU), and the Wilge River falls into MU22. The limits set out in Table 3 were used to compare the current baseline data.

**Table 3: Water Quality Planning Limits for the Wilge River**

| Variable | | Wilge River (MU22) |
|---|---|---|
| **Calcium (dissolved)** | mg/L | 32 |
| **Chloride (dissolved)** | mg/L | 20 |
| **Total Dissolved Solids** | mg/L | 260 |
| **Electrical Conductivity** | mS/m | 40 |
| **Fluoride (dissolved)** | mg/L | 0.75 |
| **Potassium (dissolved)** | mg/L | 10 |

| Variable | | Wilge River (MU22) |
|---|---|---|
| **Magnesium (dissolved)** | mg/L | 20 |
| **Sodium (dissolved)** | mg/L | 30 |
| **Ammonium ($NH_4$-N)** | mg/L | 0.05 |
| **Nitrate** | mg/L | 0.5 |
| **Total Phosphorus** | mg/L | 0.25 |
| **pH** | | 6.5-8.4 |
| **Ortho-phosphate** | mg/L | 0.025 |
| **Sulphate (dissolved)** | mg/L | 70 |
| **Total Alkalinity** | mg/L | 120 |
| **Dissolved Organic Carbon** | mg/L | 10 |
| **Dissolved Oxygen** | mg/L | 9 |
| **Sodium Absorption Ratio** | | 2 |
| **Suspended Solids** | mg/L | 5 |
| **Chlorophyll a** | µg/L | 1.5 |
| ***Escherichia coli*** | CFU/ 100mL | 130 |
| **Faecal coliforms** | CFU/ 100mL | 130 |
| **Aluminium** | mg/L | 0.02 |
| **Boron** | mg/L | 0.5 |
| **Chromium (VI)** | µg/L | 7 |
| **Iron** | mg/L | 0.1 |
| **Manganese** | mg/L | 0.02 |

# 3.0 DESCRIPTION OF THE PROPOSED ASH DISPOSAL FACILITY EXEMPTION EXTENSION

Eskom proposes to undertake a Part 2 Amendment process for the exemption authorisation that was granted on 5 May 2016. The exemption is valid for a period of 4 years, from 5 May 2016 to 5 May 2020. Project delays have however meant that Eskom will surpass the time-frame granted within the exemption period. Furthermore, the exempted area still has a remaining footprint of 52 hectares to be filled up with ash prior to ashing on the new lined area.

Eskom, therefore, intends to extend the exemption authorisation period to continue ashing on the exempted area until the exempted footprint is covered with ash, in order to proceed to the lined area.

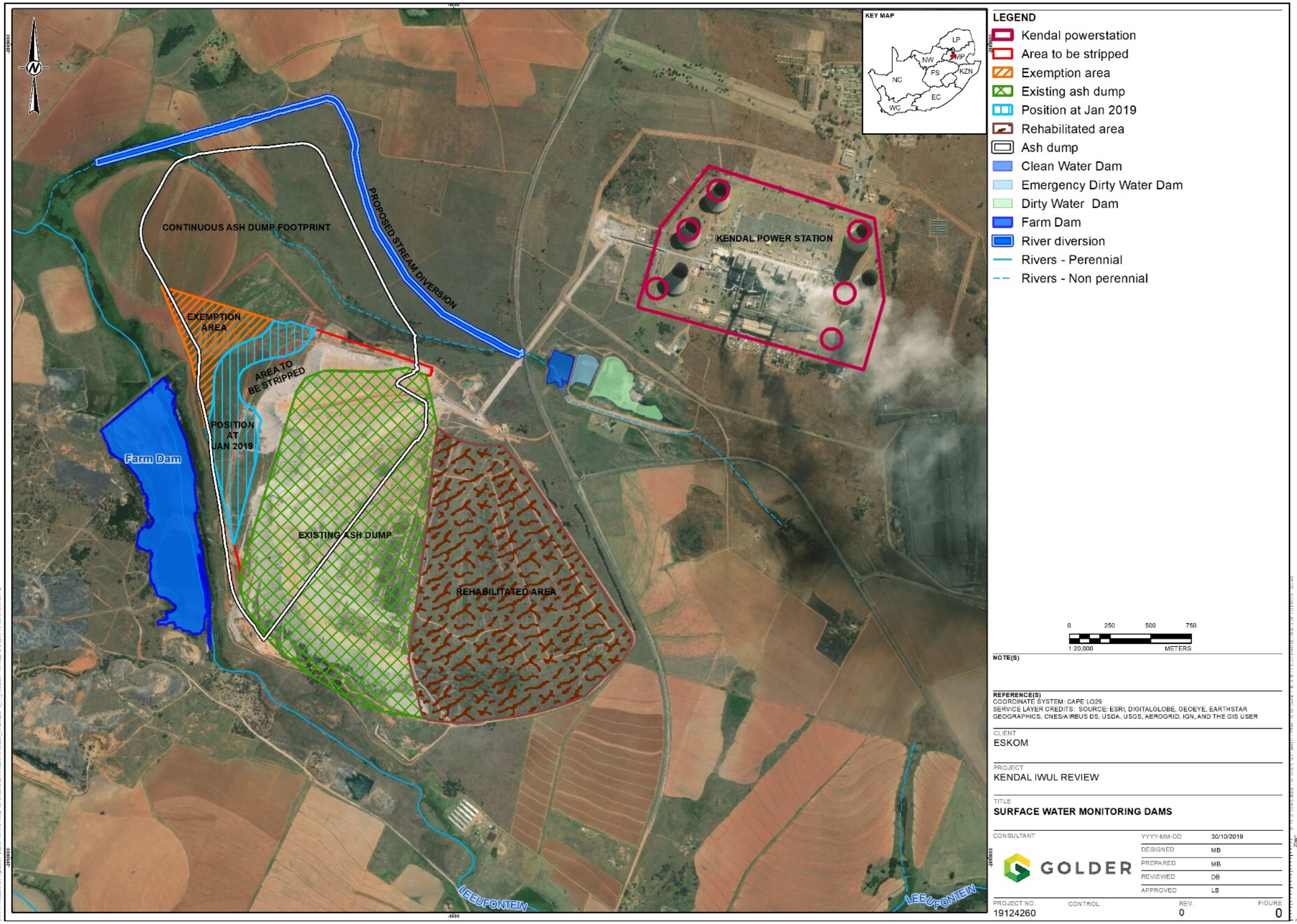


**Figure 3: Existing ADF and extended area including the river diversion to be constructed (licensed under IWUL number: 04/B20E/ABEGI/3888)**

# 4.0 BASELINE WATER QUALITY

## 4.1 Surface water monitoring points

Kendal Power Station has a monitoring programme in place in which monitoring sites have been classified according to their location relative to the infrastructure and natural streams. The sites described in Table 4 are relevant to the impact assessment for the extension period for disposal to the unlined portion of the ADF. In addition, water quality data from three DWS monitoring points on the Wilge River have been included to give an understanding of the larger catchment.

**Table 4: Kendal surface water monitoring sites**

| Monitoring point ID | Coordinates | | Description |
|---|---|---|---|
| R01 | -26.13302 | 28.96332 | Leeuwfonteinspruit upstream of ash operations next to coal mine |
| AS02 | -26.11789 | 28.94753 | Seepage south of ash stack |
| AP11 | -26.10067 | 28.93609 | Large dam west of ash stack in Leeuwfonteinspruit |
| R14 | -26.10468 | 28.97155 | Schoongezichtspruit at road crossing downstream from PP01 (400m) & 40m south from road. |
| PP04 | -26.09900 | 28.96084 | Clean water dam. Run-off from power station area sample at dam wall. |
| PP03 | -26.09930 | 28.96235 | Dirty water emergency dam. Overflow from PP02. |
| R03 | -26.09917 | 28.95976 | Schoongezicht Spruit at road crossing below clean water dam PP04 |
| PP05 | -26.09636 | 28.94791 | Dam in Schoongezichtspruit north of ash stack. |
| R04 | -26.09497 | 28.94717 | Schoongezichtspruit before confluence with Leeuwfonteinspruit. |
| R02 | -26.08992 | 28.92589 | Leeuwfonteinspruit 3km downstream Northwest of from ash stack, downstream confluence with Schoongezichtspruit |
| DWS Monitoring data | | | |
| B20_188173 | -26.124200 | 28.954240 | Upstream of the dump on Leeufonteinspruit, adjacent the coal mine and just downstream of Eskom point R01 |
| B20_189565 | -26.23222 | 28.85611 | On the Wilge River approximately 20 kilometres upstream of the confluence with Leeufonteinspruit at R50 Bridge |
| B20_189564 | -26.04444 | 28.86778 | On the Wilge River approximately 8 kilometres downstream of the ADF on the Wilge River, after the confluence with Leeufonteinspruit |

The surface water sampling points sampled during November 2018 and July 2019 are illustrated in Figure 4. The points were chosen to assess the water quality of the Leeuwfonteinspruit and Schoongezichtspruit in close proximity to the existing ash dump and before the tributaries enter the Wilge River. There is a farm dam to the west of the existing ADF and it is located close to a mining void (Figure 3). It has been observed that water from the mining voids decants into the farm dam thus increasing the size of the dam and possibly also impacting on the quality of the water in the dam. The rehabilitation of this dam is also included in IWUL number: 04/B20E/ABEGI/3888.

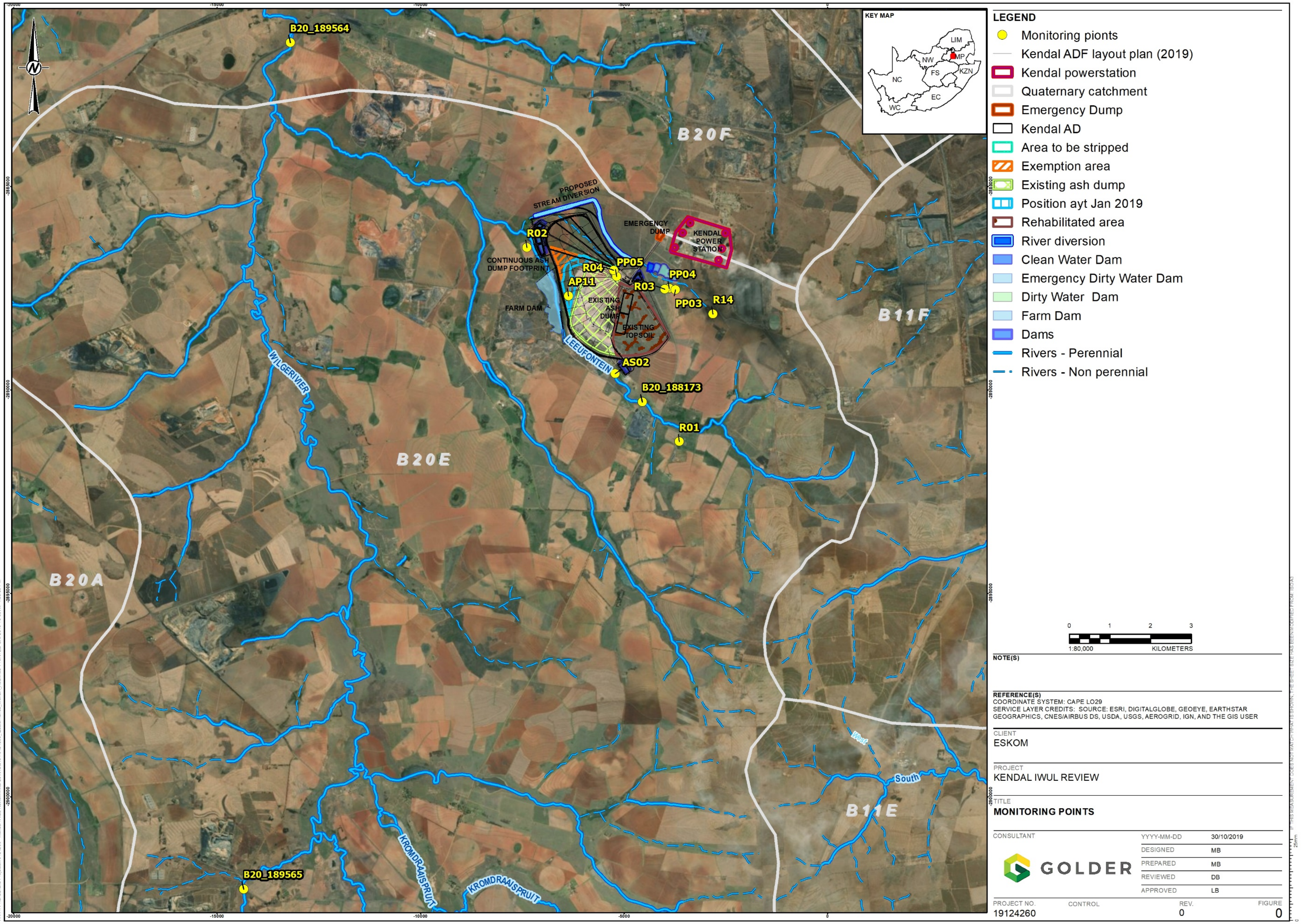


**Figure 4: Surface water monitoring points (Kendal points as well as DWS points)**

### 4.1.1 Water quality in the rivers

The average of data (Table 5) for recent water quality sampling undertaken (Kimopax reports for January, March and July 2019) at the points listed in Table 4 for sampling undertaken in November 2018, February 2019 and July 2019 indicate the following:

- The highest area of contamination is at site R01 on the Leeuwfonteinspruit, upstream of the ash operations which shows upstream impacts from coal mining;
- pH at all sites is within the WQPL (upper and lower);
- Sulphates and total dissolved solids exceeded the WQPL (Figure 5) at all sites except for R14, the most upstream of the sites in the Schoongezichtspruit.

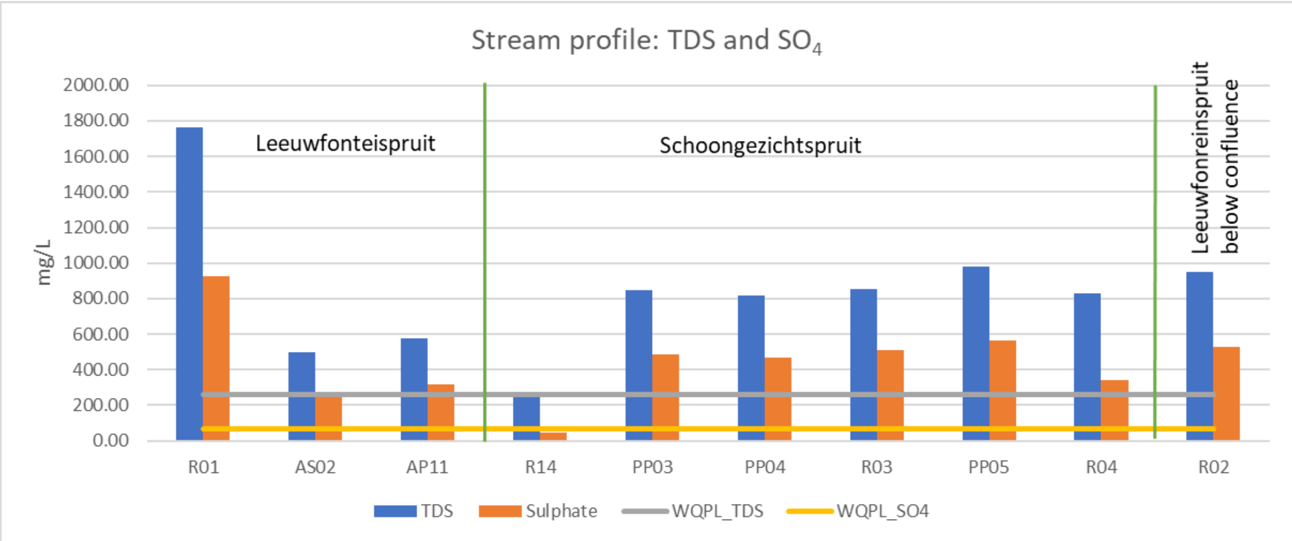


**Figure 5: Water quality profile in the Leeufonteinspruit and Schoongezichtspruit**

- All metals except for aluminium were very low at all sites, aluminium was elevated at all sites except for the most upstream points on both streams and the most downstream point after the confluence of the two streams. Boron and fluoride which were shown to be leachable from the ash, are within the WQPL, except for boron at AP11, the dam west of ash stack in Leeuwfonteinspruit.

Data from the following DWS monitoring points were assessed:

- B20_188173 upstream of the dump on Leeuwfonteinspruit and very close to Eskom point R01, was sampled in September 2004: the water quality data at that time showed that the water quality (Table 6) was within all the WQPLs set for the sub-catchment (Table 3). Compared against the data from R01 there has been considerable deterioration in the water quality upstream of the ADF.
- B20_189565 approximately 20 kilometres upstream of the confluence of Leeuwfonteinspruit with the Wilge River indicates that mining impacts have occurred upstream of the site with very high EC readings ranging from 25 to 142 mS/m and associated calculated TDS values of 200 – 1 136 mg/L, as well as sulphate levels ranging from 36 – 400 mg/L (Figure 6). The contamination appears to be from several abandoned mines in the upper reaches of the Wilge River catchment.
- B20_189564 approximately 8 kilometres downstream of the ADF on the Wilge River after the confluence with the Leeuwfonteinspruit, indicates a slight recovery in the water quality, however sulphate is higher. The water quality improves at the downstream point

**Table 5: Eskom sites water quality data (average of quarter 4, 2018 and quarter 1 and 2, 2019)**

| Variables measured (mg/L unless stated) | WQPL | R01 | AS02 | AP11 | R02* | R14 | PP03 | PP04 | R03 | PP05 | R04 | AC08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Leeuwfonteinspruit | | | | Schoongezichtspruit | | | | | | |
| Electrical Conductivity (mS/m) | 40 | 203.00 | 76.00 | 459.40 | 751.05 | 50.40 | 698.35 | 627.55 | 122.30 | 784.75 | 123.00 | 149.90 |
| pH | 6.5-8.4 | 7.92 | 7.36 | 8.00 | 7.61 | 7.00 | 8.35 | 8.16 | 7.31 | 7.21 | 7.64 | 7.83 |
| Turbidity (NTU) | | 3.08 | 107.00 | 2.12 | 7.44 | 138.00 | 51.90 | 7.77 | 21.90 | 13.10 | 16.40 | 4.96 |
| Total Dissolved Solids | 260 | 1761.00 | 499.00 | 573.50 | 949.50 | 256.00 | 850.50 | 816.50 | 852.00 | 978.50 | 829.00 | 1089.00 |
| Nitrate | 0.5 | 2.92 | 3.26 | 3.04 | 3.13 | 3.05 | 2.28 | 2.17 | 4.36 | 3.97 | 4.15 | 4.10 |
| Nitrite | | 0.020 | 0.030 | 0.020 | 0.030 | 0.040 | 0.980 | 0.030 | 0.030 | 0.030 | 0.040 | 0.210 |
| Chloride | 20 | 46.60 | 21.60 | 17.20 | 8.50 | 3.90 | 12.35 | 12.30 | 10.80 | 9.20 | 7.30 | 11.70 |
| Total Alkalinity | 120 | 146.70 | 66.10 | 86.25 | 85.30 | 217.00 | 50.00 | 58.50 | 34.10 | 65.60 | 45.40 | 36.40 |
| Sulphate | 70 | 928.10 | 257.90 | 316.72 | 525.94 | 46.70 | 488.39 | 469.27 | 509.60 | 565.71 | 340.90 | 639.9 |
| Calcium | 32 | 226.11 | 33.23 | 63.71 | 98.48 | 59.84 | 71.82 | 66.41 | 79.04 | 103.55 | 84.03 | 113.06 |
| Magnesium | 20 | 147.91 | 18.96 | 44.62 | 22.15 | 20.28 | 3.84 | 10.01 | 8.15 | 20.95 | 10.01 | 3.00 |
| Sodium | 30 | 66.61 | 101.35 | 45.82 | 163.97 | 26.86 | 199.38 | 166.14 | 183.47 | 168.11 | 180.99 | 229.31 |
| Potassium | 10 | 21.31 | 3.33 | 8.37 | 3.29 | 2.09 | 5.68 | 4.83 | 5.04 | 3.47 | 4.72 | 8.08 |
| Iron | 0.1 | 0.095 | 7.74 | 0.017 | 0.120 | 3.26 | 0.226 | 0.215 | 1.41 | 0.126 | 0.164 | 0.021 |

| Variables measured (mg/L unless stated) | WQPL | R01 | AS02 | AP11 | R02* | R14 | PP03 | PP04 | R03 | PP05 | R04 | AC08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Leeuwfonteinspruit | | | | Schoongezichtspruit | | | | | | |
| Manganese | 0.02 | 0.012 | 0.596 | 0.006 | 0.247 | 0.963 | 0.080 | 0.003 | 0.391 | 0.281 | 0.042 | 0.001 |
| Aluminium | 0.02 | BDL | 0.166 | 0.030 | BDL | 0.013 | 1.04 | 0.156 | 0.370 | 0.066 | 0.055 | 0.589 |
| Boron | 0.5 | BDL | - | 0.61 | 0.29 | 0.024 | 0.36 | - | - | 0.3 | 0.32 | 0.25 |
| Ammonia | 0.015# | BDL | BDL | BDL | 0.060 | 0.470 | 1.090 | 0.330 | BDL | BDL | BDL | 0.600 |
| Zinc | 0.0036/ 1/ 3# | 0.006 | 0.008 | 0.000 | 0.010 | 0.007 | 0.016 | 0.010 | 0.039 | 0.012 | 0.001 | BDL |
| Copper | 0.002/ 0.2/ 1# | 0.003 | 0.004 | 0.002 | 0.004 | 0.004 | 0.007 | 0.006 | 0.004 | 0.004 | 0.003 | 0.004 |
| Lead | 0.001/ 0.02/ 0.1# | 0.009 | 0.006 | 0.007 | 0.005 | 0.006 | 0.007 | 0.004 | 0.006 | 0.006 | 0.006 | 0.006 |
| Fluoride | 0.75 | 0.000 | 0.000 | 0.300 | 0.250 | 0.001 | 0.551 | 0.400 | 0.001 | 0.250 | 0.000 | 0.001 |

Notes: *the most downstream point below the confluence of the two streams; # no WQPL however the limits to protect ecosystems/ irrigation/ domestic use respectively, are included

**Table 6: DWS Water quality data**

| Parameter | Units | WQPL (DWS, 2017) | 188173_ upstream of ADF (September 2004) | Upstream on Wilge_189565* | Downstream on Wilge_189564** |
|---|---|---|---|---|---|
| Calcium (dissolved) | mg/L | 32 | 13.2 | 75.2 | 37.25 |
| Chloride | mg/L | 20 | 5.2 | 34 | 23.70 |
| Total Dissolved Solids | mg/L | 260 | 146 | 925 | 585.46 |
| Electrical Conductivity | mS/m | 40 | 22 | 116 | 80.20 |
| Fluoride | mg/L | 0.75 | 0.25 | 0.30 | 0.33 |
| Potassium | mg/L | 10 | 2.4 | 3.7 | 5.40 |
| Magnesium | mg/L | 20 | 11 | 73.3 | 23.14 |
| Sodium | mg/L | 30 | 8.6 | 64.92 | 27.53 |
| Ammonium | mg/L | 0.05 | 0.08 | 0.14 | 0.15 |
| Nitrate | mg/L | 0.5 | 0.06 | 1.81 | 0.48 |
| pH | | 6.5-8.4 | 7.84 | 8.50 | 8.40 |
| Ortho-Phosphate as P | mg/L | 0.025 | 0.01 | 0.02 | 0.02 |
| Sulphate | mg/L | 70 | 37 | 443 | 507.91 |
| Total Alkalinity | mg/L | 120 | 57 | 282 | 136.00 |

*WQ data notes: all data for August 2011, except for EC (and calculated TDS) - 95 percentile data for period July 2009 to May 2015; and sulphate and pH – July 2009 to January 2018.

** WQ data notes: all data for August 2011, except for EC (and calculated TDS) - 95 percentile data for period March 2009 to December 2014; and sulphate and pH – March 2009 to June 2018.

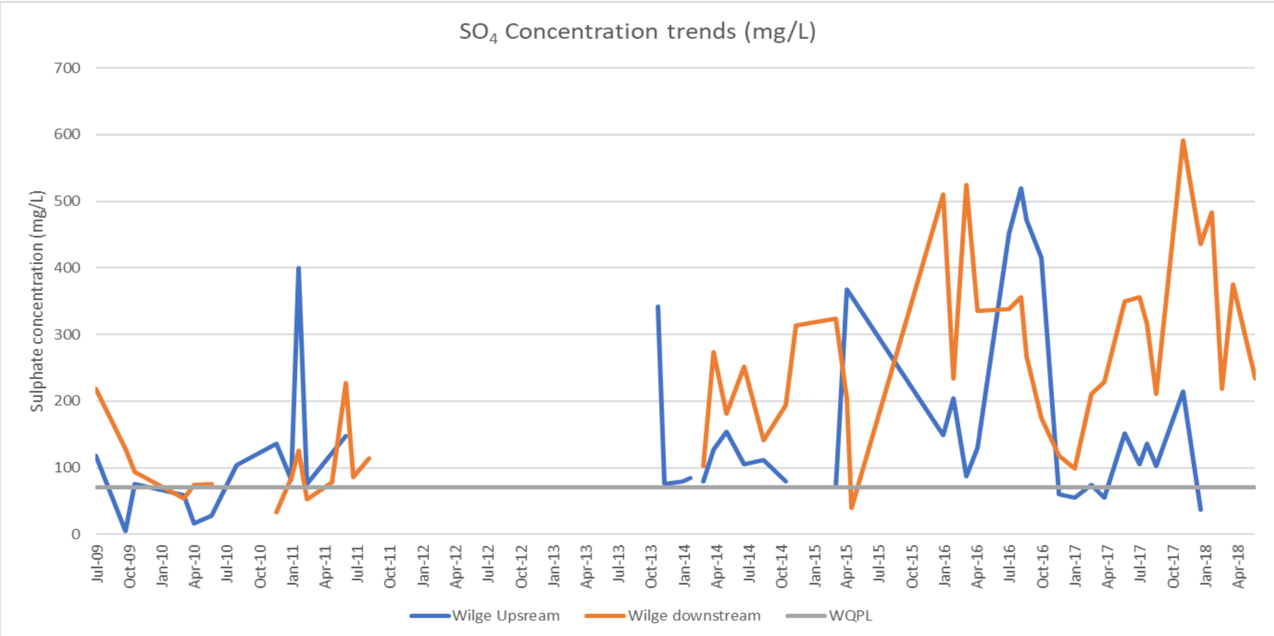


**Figure 6: Sulphate trends in the Wilge River for the period July 2009 to June 2018 (DWS monitoring)**

# 5.0 IMPACT ASSESSMENT

## 5.1 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;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology is used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 7.

**Table 7: Quantitative rating and equivalent descriptors for the impact assessment criteria**

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

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

### 5.1.1 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. A more detailed description of the impact significance rating scale is given in Table 8.

**Table 8: Description of the significance rating scale**

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

### 5.1.2 Spatial Scale

The spatial scale refers to the extent of the impact. In other words, the impact is at a the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 9.

**Table 9: Description of the spatial scale**

| Rating | | Description |
|---|---|---|
| 5 | Global/National | The maximum extent of any impact. |
| 4 | Regional/Provincial | The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level). |
| 3 | Local | The impact will affect an area up to 10 km from the proposed route. |
| 2 | Study Area | The impact will affect an area not exceeding the Eskom servitude. |
| 1 | Isolated Sites / proposed route | The impact will affect an area no bigger than the power line pylon footing. |

### 5.1.3 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 10.

**Table 10: Description of the temporal rating scale**

| Rating | | Description |
|---|---|---|
| 1 | Incidental | The impact will be limited to isolated incidences that are expected to occur very sporadically. |

| Rating | | Description |
|---|---|---|
| 2 | Short-term | The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater. |
| 3 | Medium term | The environmental impact identified will operate for the duration of life of facility. |
| 4 | Long term | The environmental impact identified will operate beyond the life of operation. |
| 5 | Permanent | The environmental impact will be permanent. |

### 5.1.4 Degree of Probability

Probability or likelihood of an impact occurring is described in Table 11.

**Table 11: Description of the degree of probability of an impact occurring**

| Rating | Description |
|---|---|
| 1 | Practically impossible |
| 2 | Unlikely |
| 3 | Could happen |
| 4 | Very Likely |
| 5 | It's going to happen / has occurred |

### 5.1.5 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 12. 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 12: Description of the degree of certainty rating scale**

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

### 5.1.6 Quantitative Description of Impacts

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

***Impact Risk*** = ((SIGNIFICANCE **+** *Spatial* **+** Temporal) ÷ 3) X (Probability ÷ 5)

The impact risk is classified according to five classes as described in the table below (Table 13).

**Table 13: Impact Risk Classes**

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

### 5.1.7 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.

# 6.0 ASSESSMENT OF SURFACE WATER IMPACTS

Ash from Kendal was sampled and 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.

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 its Leach Concentration value of 0.50 mg/ℓ, and barium (Ba) and fluoride (F) exceeded their respective Total Concentrations of 570 mg/kg and 112 mg/kg respectively.

## 6.1 Potential surface water impacts

The potential surface water impacts from the extension of the exemption project are summarised in Table 14**.** While the direct impacts of the project will on the most part impact the groundwater, in summary these potential impacts contribute to overall surface water impacts of deteriorating water quality.

The surface water quality impacts will ultimately impact on the downstream water users, and specifically in respect of the Wilge River classification (Class II).

**Table 14: Potential surface water impacts**

| Aspect | Environmental component potentially affected | | Key Environmental Issue / Potential Impact |
|---|---|---|---|
| | Direct | Indirect | |
| Deposition of ash from the power station onto the ash disposal facility | Groundwater and surface water | Biodiversity, health and safety (of water users) | Seepage from the ash disposal facility may impact on the soil, groundwater and surface water. |

## 6.2 Impact assessment

Table 15 sets out the impacts on the surface water showing that several of the impacts are already occurring and having an impact on the water resource. Table 16 sets out the improvements that could happen after mitigation.

## 6.3 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.

In the bigger Wilge River catchment, historical agricultural and mining practices over the past few decades have had detrimental effects on the surface water environment in the area as indicated in the water quality assessment described in 4.1.1. This is mainly attributed to fertilizer application, erosion, siltation, mining activities and point-source discharges by wastewater treatment works (WWTWs) into the surrounding watercourses. 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. 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 the impacts are already taking place, specifically in respect of the mining activities upstream of and adjacent to the ADF, on the Leeuwfonteinspruit, the significance rating for cumulative impacts will not change considerably as set out in Table 17. However, should mitigation be put in place then the local cumulative impacts would reduce the significance rating for the local dams but may not have much of a positive impact on the broader catchment. This would need to be assessed based on all other users in the catchment.

**Table 15: Assessment of impacts**

| IMPACT | Description | SIGNIFICANCE | SPATIAL SCALE | TEMPORAL SCALE | PROBABILITY | Impact Class | Description |
|---|---|---|---|---|---|---|---|
| Deterioration of water quality in the resource | Upstream impacts, specifically mines have had an impact on the water resources. Decant of water from the mine workings into Farm Dam has affected the quality of water in Farm Dam. | MODERATE | *Regional* | Short Term | *Very likely* | 2.4 | Moderate |
| | Run-off from the ADF to the dams, Leeuwfonteinspruit and the Schoongezichrspruit will contribute further to the deterioration of the resource and ultimately impact on the downstream water users. | 3 | 4 | 2 | 4 | | |

**Table 16: Assessment of impacts after mitigation**

| IMPACT | Description of possible mitigation | SIGNIFICANCE | SPATIAL SCALE | TEMPORAL SCALE | PROBABILITY | Impact Class | Description |
|---|---|---|---|---|---|---|---|
| Deterioration of water quality in the resource | ■ Clean and dirty water around the ADF must be separated to comply with GN 704;<br>■ The functioning of the three dam system should be addressed, so that they function as originally intended and water in the resource will be improved upstream of the ADF;<br>■ Decant of water from the mine workings into Farm Dam must be prevented, as this will also ensure cleaner water to downstream users. | LOW | *Local* | Short Term | *Could happen* | 1.4 | **Low** |
| | | 2 | 3 | 2 | 3 | | |

**Table 17: Assessment of cumulative impacts with no mitigation**

| IMPACT | Description | SIGNIFICANCE | SPATIAL SCALE | TEMPORAL SCALE | PROBABILITY | Impact Class | Description |
|---|---|---|---|---|---|---|---|
| Deterioration of water quality in the resource | Overflow of poor quality water from Farm Dam and clean water dam into the resource will contribute to deteriorating water quality impacting on downstream | HIGH | *Regional* | Medium Term | *Has occurred* | 3.7 | **High** |

| IMPACT | Description | SIGNIFICANCE | SPATIAL SCALE | TEMPORAL SCALE | PROBABILITY | Impact Class | Description |
|---|---|---|---|---|---|---|---|
| | users. Decant of water from the mine workings into Farm Dam has affected the quality of water in Farm Dam. Contaminated run-off from the ADF will contribute further load to an already contaminated resource. | 4 | 4 | 3 | 5 | | |

## 7.0 MONITORING PLAN

Monitoring must continue to be undertaken quarterly at the points described in Table 4 for the following parameters, at an accredited laboratory:

- Electrical Conductivity (mS/m)
- pH
- Turbidity (NTU)
- Total Dissolved Solids
- Nitrate
- Nitrite
- Chloride
- Total Alkalinity
- Sulphate
- Calcium
- Magnesium
- Sodium
- Potassium
- Iron
- Manganese
- Aluminium
- Ammonia
- Zinc
- Copper
- Lead
- Fluoride; and
- Boron

Should increasing trends be noted in any of the parameters measured, then more frequent surface water monitoring must be undertaken, and the source of the problem identified and mitigated.

## 8.0 CONCLUSIONS AND RECOMMENDATIONS

The streams surrounding the existing ash disposal area are already impacted by the existing ADF and the mining activities within the area.

The conditions set as part of the IWUL will assist in mitigating against the cumulative impacts to the water resources. Should the measures not be implemented then it is likely that there will be an impact on the Wilge River from the tributaries flowing downstream from the site.

- All samples collected in November 2018, February 2019 and July 2019 indicate high electrical conductivity (EC) and total dissolved solids (TDS), sodium (Na), chloride (Cl) and sulphate ($SO_4$) concentrations;
- All metals except for aluminium were very low at all sites. Aluminium was elevated at all sites except for the most upstream points on both streams and the most downstream point after the confluence of the two streams.
- Boron and fluoride which were shown to be leachable from the ash, are within the WQPL, except for boron at AP11, the dam west of ash stack in Leeuwfonteinspruit.

Data from the DWS monitoring points were assessed and DWS monitoring point B20_189565 approximately 20 kilometres upstream of the confluence of Leeuwfonteinspruit with the Wilge River indicates that catchment-wide mining impacts have occurred upstream of the site with very high EC readings ranging from 25 to 142 mS/m and associated calculated TDS values of 200 – 1 136 mg/L, as well as sulphate levels ranging from 36 – 400 mg/L. The contamination appears to be from several abandoned mines in the upper reaches of the Wilge River catchment. The DWS monitoring point B20_189564, approximately 8 kilometres downstream of the ADF on the Wilge River after the confluence with the Leeuwfonteinspruit, indicates a slight recovery in the water quality, however sulphate is higher. Data from DWS monitoring point 188173, in close proximity to R01, has shown that considerable contamination has occurred upstream of the ADF.

The Wilge River catchment (and associated tributaries) is a priority and has been classified as a Class II river that will require water use activities in its catchment to be conducted in a safe and responsible manner so as not to increase the existing impacts on water quality. Adequate stormwater management around the ADF is therefore a priority.

Surface water monitoring in and around Kendal Power Station must continue, to enable early warnings where changing trends are noted and ensure mitigation is implemented timeously. This may mean that Kendal will need to collaborate with the upstream users.

The specialist is of the opinion that continued ash disposal to the existing footprint is unlikely to change the impacts currently seen in the Leeuwfonteinspruit and the Schoongezichtspruit, and ultimately the Wilge River, and that the ashing on the exemption area may proceed beyond the exemption authorisation period to cover the full exemption area.

# 9.0 REFERENCES

Department of Water and Sanitation (2016) *Development of an Integrated Water Quality Management Plan for the Olifants River System: Upper Olifants Sub-catchment Plan.* Study Report No. 7, Report No: P WMA 04/B50/00/8916/8

Department of Water and Sanitation (2016a) Classes and Resource Quality Objectives of Water Resources for Catchments of the Olifants in Terms of Section 13(1)(A) and (B) of the National Water Act (Act No.36 Of 1998). Government Gazette No 39943, Notice No 468 (22 April 2016)

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# Signature Page

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APPENDIX A

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