Appendix G: Specialist reports

Appendix G1: Groundwater Assessment

REPORT

Groundwater Baseline and Impact Assessment of the Proposed Decommissioning and Demolition of Kelvin Power A-Station

Kelvin Power (PTY) Ltd

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Distribution List

1 Electronic copy to Kelvin Power (PTY) Ltd

1 Electronic copy to Golder SharePoint site 20360049

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APPENDICES

1.0 INTRODUCTION

Kelvin Power (Pty) Ltd (hereafter Kelvin Power) appointed Golder Associates (PTY) Ltd (Golder) as an independent environmental consulting firm to conduct the environmental regulatory process for the proposed decommissioning and demolition of the Kelvin Power Plant A-Station (Kelvin A-Station) situated in the Ekurhuleni Metropolitan Municipality in Gauteng (Figure 1).

Kelvin Power Station consists of two separate power plants, namely the A-Station and the B-station. The A-Station was in operation for approximately 60 years, until 2012 when it was placed under extended care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-Station.

The proposed decommission and demolition of the A-Station and auxiliary infrastructure (Figure 1) will require an application for environmental authorisation and associated Environmental Impact Assessment (EIA) process.

The most recent groundwater assessment report (reference: 497520/1) for the site was compiled by SRK Consulting in March 2016. The groundwater is currently being monitored at 21 monitoring boreholes on a quarterly basis by Aquatico Scientific (Figure 7).

This report documents the current groundwater baseline and assessment of potential impacts that the proposed decommissioning and demolition of the Kelvin Power A-Station might have on the groundwater regime.

2.0 OBJECTIVE

The main objective of the Kelvin Power A-Station groundwater impact assessment was to:

- Document the current groundwater baseline;
- Determine possible impacts that the proposed project might have on the groundwater regime;
- Develop mitigation measures (if required); and
- To support the environmental authorisation process.

3.0 GROUNDWATER SCOPE OF WORK

The groundwater scope of work included:

- Desktop study;
- Groundwater Conceptual Model; and
    - Groundwater Monitoring Programme;
- Groundwater Qualitative Impact Assessment;
- Groundwater Baseline and Impact Assessment Report and Recommendations.

4.0 DESKTOP STUDY AND SITE DESCRIPTION

A desktop study was undertaken of the investigation area to gather and collate available relevant information pertaining to the entire study area. Monitoring data, existing groundwater and hydrological reports, geological information, borehole logs, maps, existing groundwater quality data, etc. was obtained and studied.

The following information and data were utilised during the desk study and information review task:

- 1:250 000 Geological Map series;
- 1:2 500 000 Groundwater Resources map of RSA –Sheet 1 (WRC/DWAF 1995);

- 1:4 000 000 Groundwater Resources map of RSA – Sheet 2 (WRC/DWAF 1995);
- 1: 500 000 Hydrogeological Map Series of RSA (1996); and
- Review of existing reports as referenced in section 7.0.

4.1 Locality

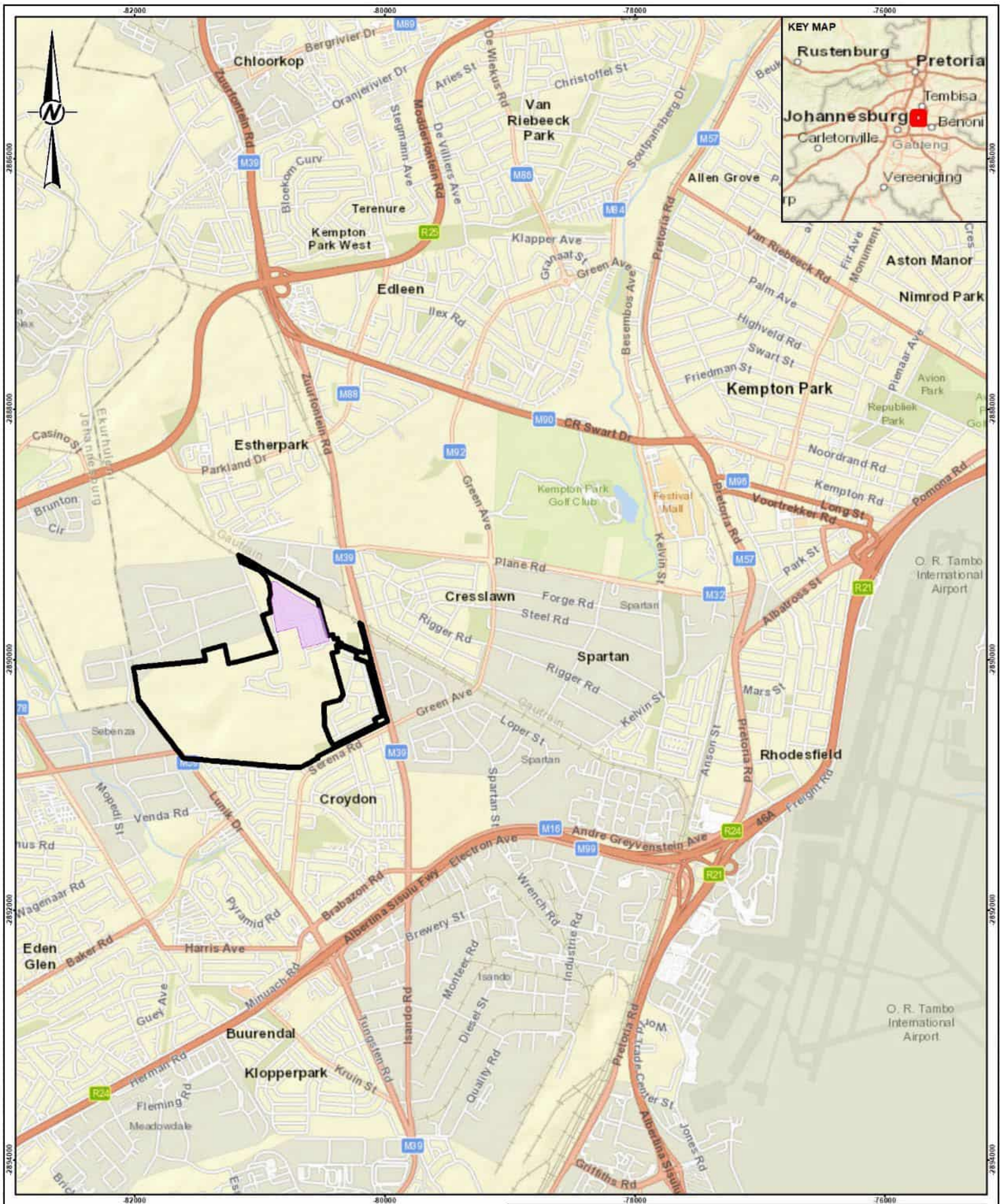
Kelvin Power Station is located in the Ekhurhuleni Metropolitan Municipality in the Province of Gauteng on the property Zuurfontein 331IR, Erf Re 82 zoned for an electrical power station.

The Kelvin Power site is surrounded by industrial areas to the north and west, and residential areas towards the south and east of the site (Figure 1 and Figure 7). The site is situated on the boundary of two quaternary catchments, namely A21C and A21A, with 97% of the site in quaternary catchment A21C, the Jukskei River catchment (Figure 7).

4.2 Surface Water Drainage

The surface water resources in the two catchments (A21C and A21A) are known to be impacted by mainly residential and industrial activities (DWA, 2012). The main river system in this area is the Jukskei River and its tributaries, one of which is the Modderfontein Spruit.

The Modderfontein Spruit is fed by several water sources, including discharge from the Kelvin Power site and runoff from the surrounding industrial and residential areas (SRK, 2016).



LEGEND

☐ Kelvin Power Station Boundary

🟪 Kelvin A-Station Power Plant

0 400 800

1:43 000 METRES

NOTE(S)

REFERENCE(S)

1. COORDINATE SYSTEM: WGS LO29
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI

CLIENT
KELVIN POWER STATION

PROJECT
A-STATION POWER PLANT

TITLE
LOCALITY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021/08/19
DESIGNED	
PREPARED	TS
REVIEWED	MS
APPROVED	MS

PROJECT NO.	CONTROL	REV.	FIGURE
20360049			

Figure 1: Locality Map

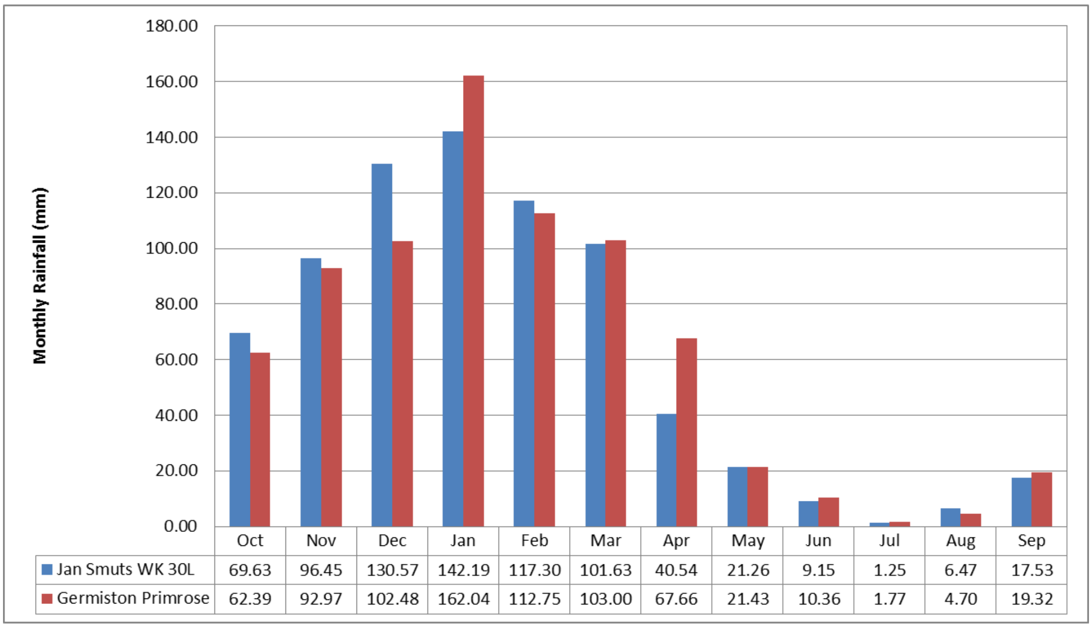
4.3 Climate and Rainfall

4.3.1 Temperature

The average daily maximum temperatures for the area show that the average midday temperatures for Kempton Park in the Ekurhuleni Metropolitan Municipality range from 16.8°C in June to 26°C in January. The region is the coldest during July when the mercury drops to 0.9°C on average during the night.

4.3.2 Rainfall

The rainfall data for Kelvin Power Station is informed by two nearby weather stations namely, Jan Smuts WK 30L, (0476399W) located at the OR Tambo International Airport, approximately 5km southeast of the site, and Germiston Primrose, approximately 7km south of the site. The highest rainfall is during the months of October to April, with an average annual rainfall at Station 0476399W is 753mm.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
🟦 Jan Smuts WK 30L	69.63	96.45	130.57	142.19	117.30	101.63	40.54	21.26	9.15	1.25	6.47	17.53
🟥 Germiston Primrose	62.39	92.97	102.48	162.04	112.75	103.00	67.66	21.43	10.36	1.77	4.70	19.32

Figure 2: Average Monthly Rainfall in the Area of Kelvin Power Station

4.4 Geology

4.4.1 Regional Geology

Based on the 1:250 000 geological map series (2628 East Rand) the investigation area is largely underlain by Halfway House granites (Archaean Granites Swazian Period) comprising of grey medium grained granodiorites as well as mafic and ultramafic rocks of the Barberton Sequence/Greenstone Belt (Swazian Period) to the north-west and south-east of the site (Figure 5).

4.4.2 Local Geology

The local geology is evident in borehole drilling logs which were provided for the site (KPS-MON boreholes). These indicate that the site is generally underlain by 1-4 m of topsoil, followed by residual or weathered calc-schist with greenstone to depths varying between 12-19 m below ground level (mbgl), which is then followed by harder residual greenstone (SRK, 2016a).

It is unconfirmed as to whether the mineral residue storage facilities, and associated infrastructure, were constructed directly on the topsoil layer, or whether the topsoil was removed and/or compacted or re-engineered in-situ, prior to construction, as this may affect the effective permeability of the underlying geology to seepage infiltration. The unlined Ash Dams are underlain by greenstones and mica-schists (Golder, 2015a). The residual clay-rich soils resulting from the weathering of these rocks, have a lower permeability and hydraulic conductivity to that of weathered granodiorite, which reduces the rate at which seepages to groundwater occurs from these facilities. However, the residual soil layer is not particularly thick, and allows some seepage through to the underlying competent fresh rock, where there is flow along faults and fracture zones. This is evident from the occurrence of reed beds along the base of the Ash Dams, as well as the chemistry being picked up in water samples in the adjacent boreholes (SRK, 2016a).

4.4.3 Structural Geology

No geological structures (fault zones and dolerite dykes) are mapped on the geology map intersecting the Kelvin Power Station site. The regional geological map series (2628 East Rand) of the area indicate a north-west to south-east trending fault adjacent to the site, thus indicating the potential for additional relay fault systems in the area.

A dolerite dyke, however, is noted in the borehole logs to be located between 3 – 12 mbgl, west of Ash Dam B (KPS-MON04). Dykes or fault structures could potentially provide a preferential flow path(s) for contaminants from the site, although no geophysical survey data is currently available for the site to confirm the presence of such structures (SRK, 2016a).

Dolerite sill intrusions are reported to be present in the borehole logs and cross-sections at monitoring boreholes KPS-MON09 (19 mbgl to 27 mbgl), KPS-MON11(12 mbgl until 25 mbgl), KPS-MON13 (7 to 12 mbgl) and KPS-MON14 (SRK, 2016b).

4.4.4 Geological Cross Sections

Geological cross sections were compiled from the onsite drilling logs and historical records as shown in (Figure 3 and Figure 4) (Adapted from SRK, 2016).

The geological cross sections show the different geology encountered during the drilling, as well as the estimated contact area between the more weathered rocks and fresher rocks, which defines where the shallow aquifer occurs (Figure 3 and Figure 4) (SRK, 2016b).

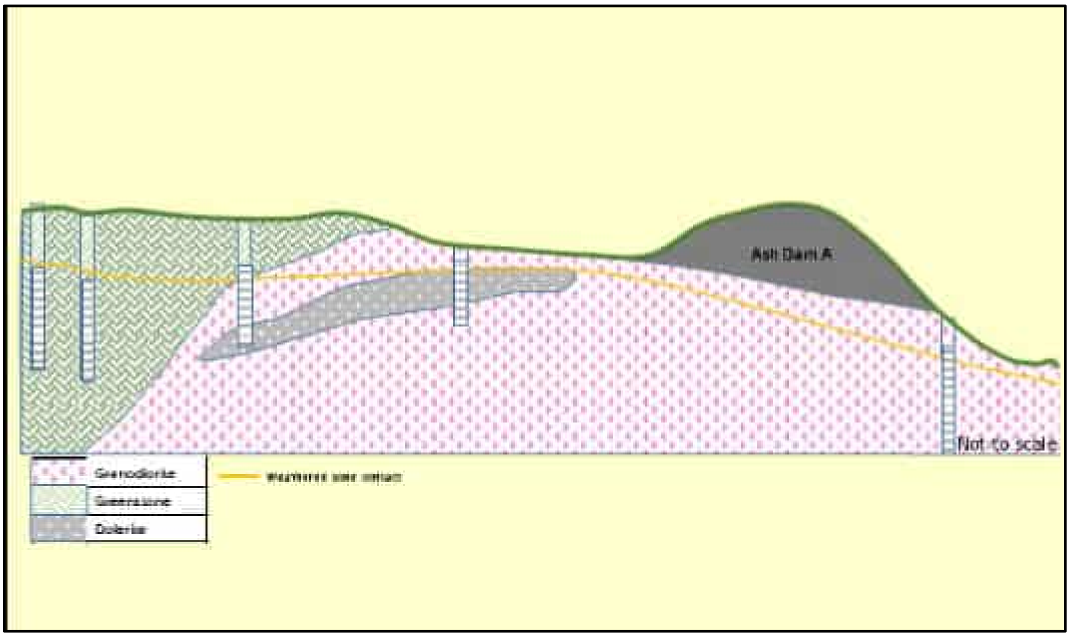


Figure 3: Cross Section North to North-east (Adapted SRK, 2016)

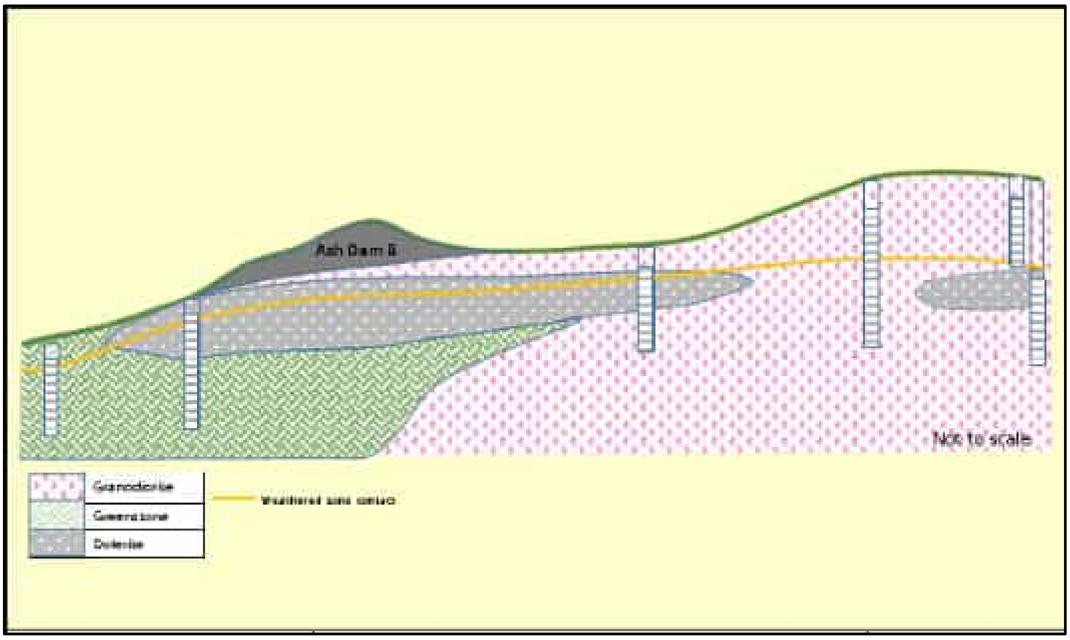


Figure 4: Cross Section West to East (Adapted SRK, 2016)

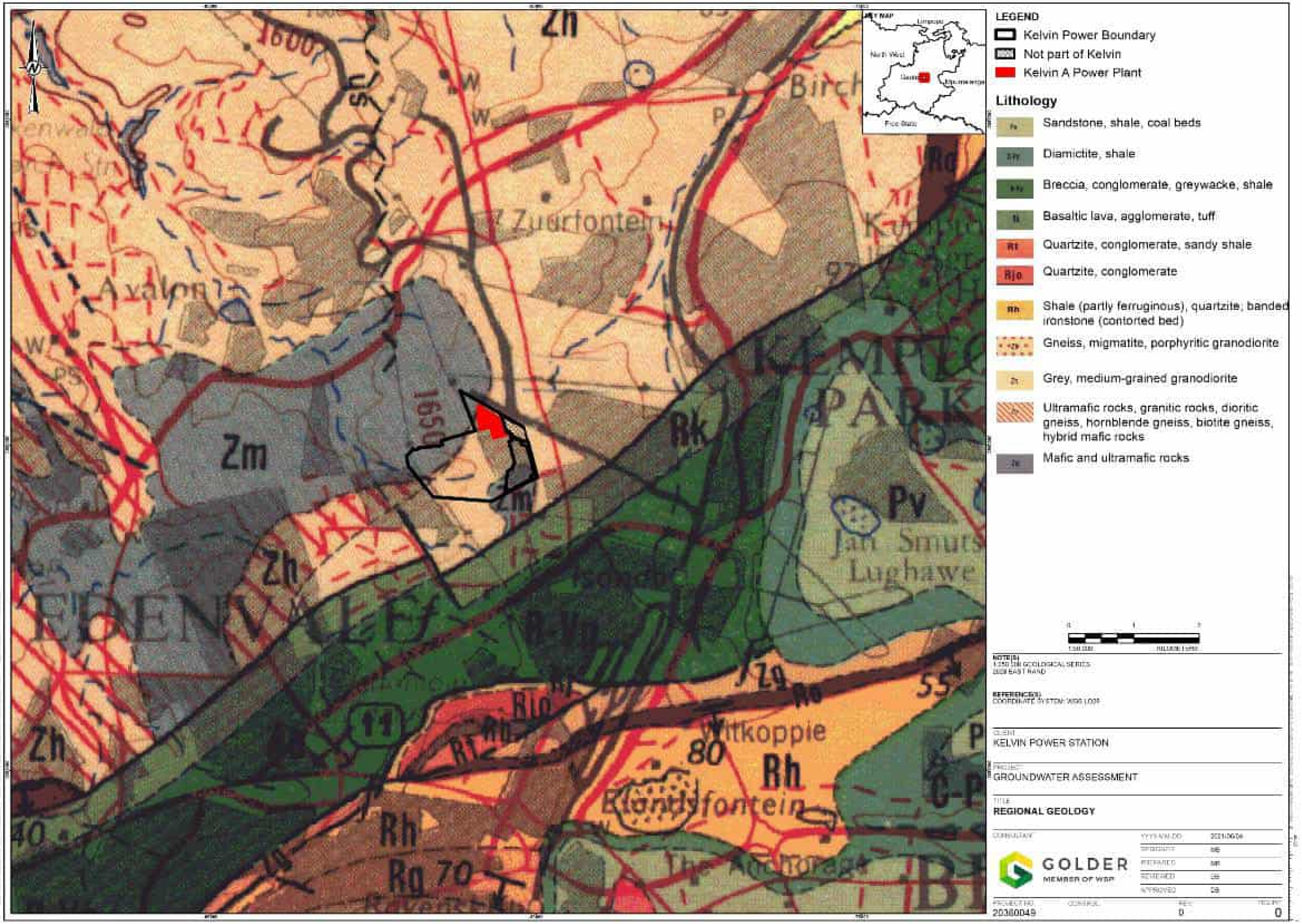


Figure 5: Geology

4.5 Existing Groundwater Information

4.5.1 Existing Groundwater Database Boreholes

Existing borehole information was obtained within a 2km radius of Kelvin Power from Golder's in-house groundwater database, namely Aquabase, on which existing groundwater information is captured. Information on eighteen (18) existing boreholes were sourced within the 2km radius as summarised in Table 1 and depicted on Figure 6. The information available are mainly in the residential areas to the north, east and south of the site. These existing residential boreholes, however, are upgradient (Figure 7) of Kelvin Power Station A with groundwater flow west towards the Modderfontein Spruit (Figure 10).

The existing boreholes with reported depths, range between 21 to 50m, with an average depth of 45.8m. Reported borehole yields range between 0.3 and 3.15 l/s (average yield of 1.7 l/s)).

Table 1: Existing Aquabase Borehole Information

Site ID	Latitude	Longitude	Coordinate Accuracy	Altitude (mamsl)	Drainage Region	Site Name	Name Owner	Borehole Diameter (m)	Depth (m)	Reporting Institution	Date Constructed	Yield (l/s)
2628AA01023	-26.10639	28.17238	2	1586.10	A21C	MODDERFONTEIN LANDFILL	-	-		WA-G		
2628AA00953	-26.10151	28.18758	1	1636.90	A21C	ESTHERPARK	FR SMITH	140	36	WA-G	19841206	0.5
2628AA00952	-26.10630	28.18796	1	1652.80	A21C	ESTHERPARK	FC DU PLESSIS	140	49	WA-G	19851109	0.88
2628AA00864	-26.10658	28.18848	1	1654.70	A21C	ESTHERPARK	JG DE BRUIN	152	46	WA-G	19851026	1
2628AA00859	-26.10045	28.18881	1	1640.50	A21C	ESTHERPARK	LB LATEGAN	203	60	WA-G	19840810	0.3
2628AA00607	-26.12692	28.19049	1	1659.10	A21C	GROYDON X1	GM JAMESON	152	75	WA-G	19841025	
2628AA00951	-26.10183	28.19384	1	1666.00	A21C	ESTHER PARK	PWD JORDAAN	152	52	WA-G	19850817	0.9
2628AA00515	-26.12852	28.19424	1	1667.90	A21C	CRAYDON	MRS D RUDI	152	20	WA-G	19850316	0.37
2628AA01021	-26.11806	28.19510	2	-	-	-	-	-		WA-G		
2628AA00514	-26.13386	28.19529	1	1672.40	A21C	CRAYDON	MJ BAUER	152	21	WA-G	19860124	0.5
2628AA00950	-26.10208	28.19622	1	1669.70	A21A	ESTER PARK X1	JJN COETZER	164	51	WA-G	19850814	0.58
2628AA00858	-26.10045	28.19720	1	1670.60	A21A	ESTHERPARK	AP MOLLER	164	41	WA-G	19851202	0.57
2628AA00948	-26.10970	28.19810	1	1661.00	A21A	CRESSLAWN	MF HORN	152	28	WA-G	19000000	1.38
2628AA00949	-26.11006	28.19948	1	1656.70	A21A	CRESSLAWN	W MACMOHAN	140	37	WA-G	19851101	0.63
2628AA00956	-26.11302	28.19987	1	1659.80	A21A	CRESSLAWN	G NEEDHAM	152	40	WA-G	19860211	1.11
2628AA00957	-26.11129	28.20050	1	1657.10	A21A	CRESSLAWN	MNR LC VISSER	203	42	WA-G	19841213	3.15
2628AA00716	-26.11342	28.20132	1	1661.20	A21A	CRESSTOWN	A STRIJDOM	152	56	WA-G	19000000	3
2628AA00394	-26.11389	28.20623	1	1667.40	A21A	CRESSTOWN	CRESSLAWN PRIMARY SCHOOL	-	80	WA-G	19840401	10

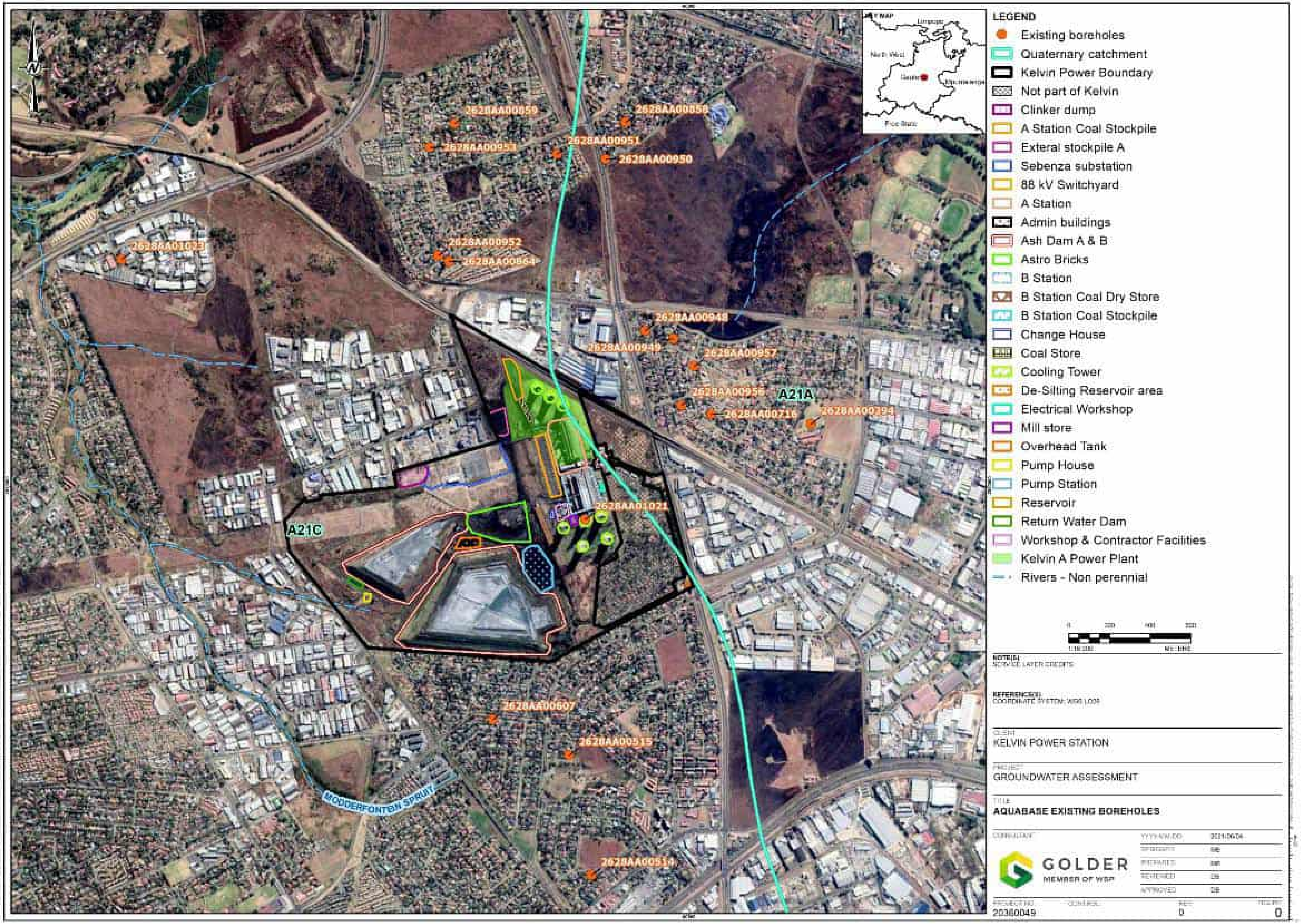


Figure 6: Aquabase Existing Boreholes

4.5.2 Existing Monitoring Boreholes

The existing monitoring boreholes at Kelvin Power comprises of 21 monitoring boreholes of which two, KPS-BH03 and KPS-BH06 have been demolished due to construction activities in the area. All the monitoring boreholes are within the site boundary as indicated on Figure 7.

4.6 Hydrogeology

4.6.1 Regional Aquifer Classification

The published hydrogeological maps series by DWAF (1996) was used to define the regional aquifer classification (Figure 8). The aquifer associated with the Kelvin Power site is classified as minor aquifer system (Figure 8).

The Kelvin Power A-Station aquifer zone comprises mainly of an intergranular and fractured aquifer zone with an average borehole yield between 0.5l/s and 2.0l/s (Figure 8), whereas the aquifer zone to the west of the Kelvin Power site is classified as intergranular and fractured with an average borehole yield between 0.1l/s and 0.5/s (Figure 8).

4.6.2 Aquifer Zones

Based on previous groundwater studies (SRK, 2016), the aquifer system at the Kelvin Power site comprises out of two aquifer zones, namely:

- Shallow weathered unconfined aquifer zone; and
- Fractured semi-confined aquifer zone below the weathered zone.

4.6.2.1 Shallow Weathered Aquifer Zone

This weathered unconfined aquifer zone comprises mainly out of 1 to 4m topsoil/overburden followed by very weathered (granodiorite and greenstones) up to ~ 15 to 20 mbgl.

The aquifer conditions of the weathered aquifer zone are unconfined, intersection seepage to significant water strikes (KPS-MON09, from 11 mbgl and at 16 mbgl) and with high water strikes can contribute significantly to the yield potential of boreholes.

4.6.2.2 Fractured Aquifer Zone

The average depth of the fractured aquifer zone below the weathered zone are from ~ 15m below the surface to approximately 30m (SRK, 2016). The aquifer conditions of the fractured aquifer zone are semi confined.

4.6.3 Hydraulic Parameters

The hydraulic conductivity (K), calculated from the test data for the Kelvin Power site range between 5×10^{-1} m/d (KPS-MON04) and 4 m/d (KPS-MON05). These values are typical of fractured igneous and metamorphic rock and of silty sand respectively (SRK, 2016a).

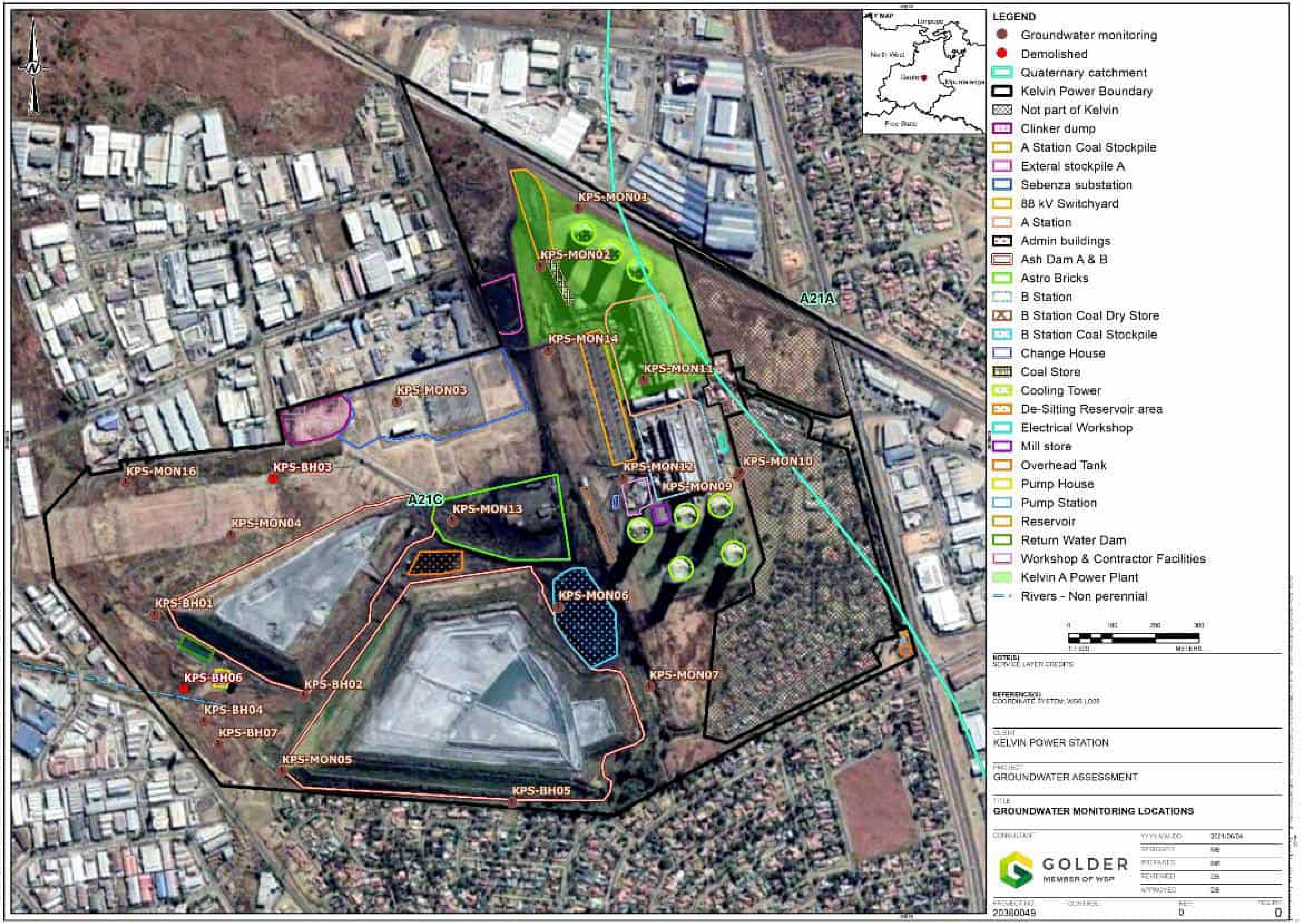


Figure 7: Existing Monitoring Boreholes and Infrastructure

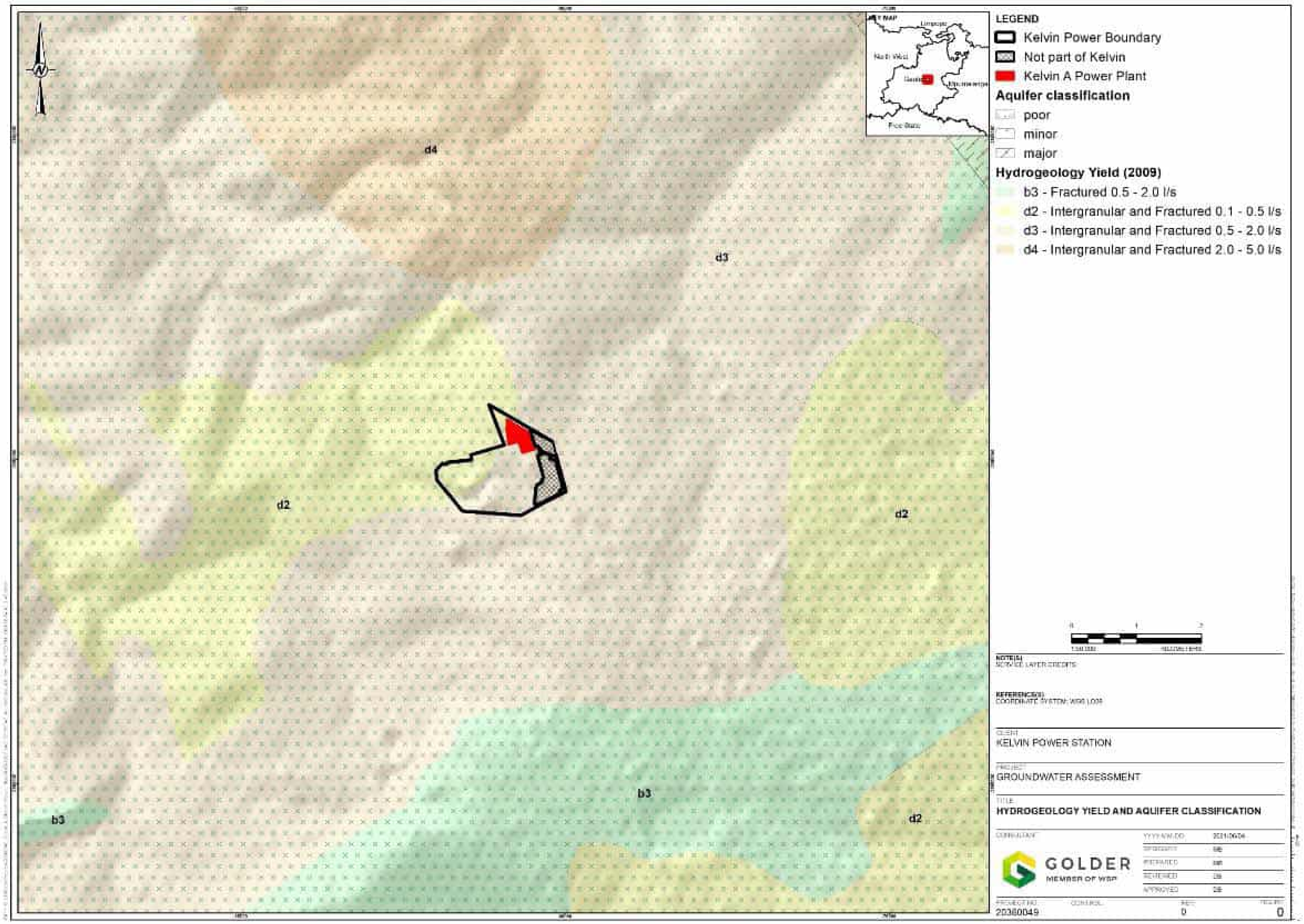


Figure 8: Aquifer Classification

4.6.4 Vulnerability

Groundwater vulnerability gives an indication of how susceptible an aquifer is to contamination. Aquifer vulnerability is used to represent the intrinsic characteristics that determine the sensitivity of various parts of an aquifer to being adversely affected by an imposed contaminant load.

A national scale groundwater vulnerability map of South Africa was prepared by the Water Research Commission (WRC), using the DRASTIC methodology that includes the following components:

- Depth to groundwater;
- Recharge due to rainfall;
- Aquifer media;
- Soil media;
- Topography;
- Impact of the vadose zone; and
- Hydraulic conductivity.

Groundwater vulnerability was classified into six classes ranging from very low to very high.

Based published hydrogeological maps series by WRC/DWAF (1996), the Kelvin Power A-Station has a low to medium (north-eastern section) vulnerability rating (Figure 9), whereas the remainder of the Kelvin Power site has largely a low groundwater vulnerability rating (Figure 9).

From the groundwater quality results (November 2020), it is evident that the Kelvin Power A-Station infrastructure has no or limited impact on groundwater regime.

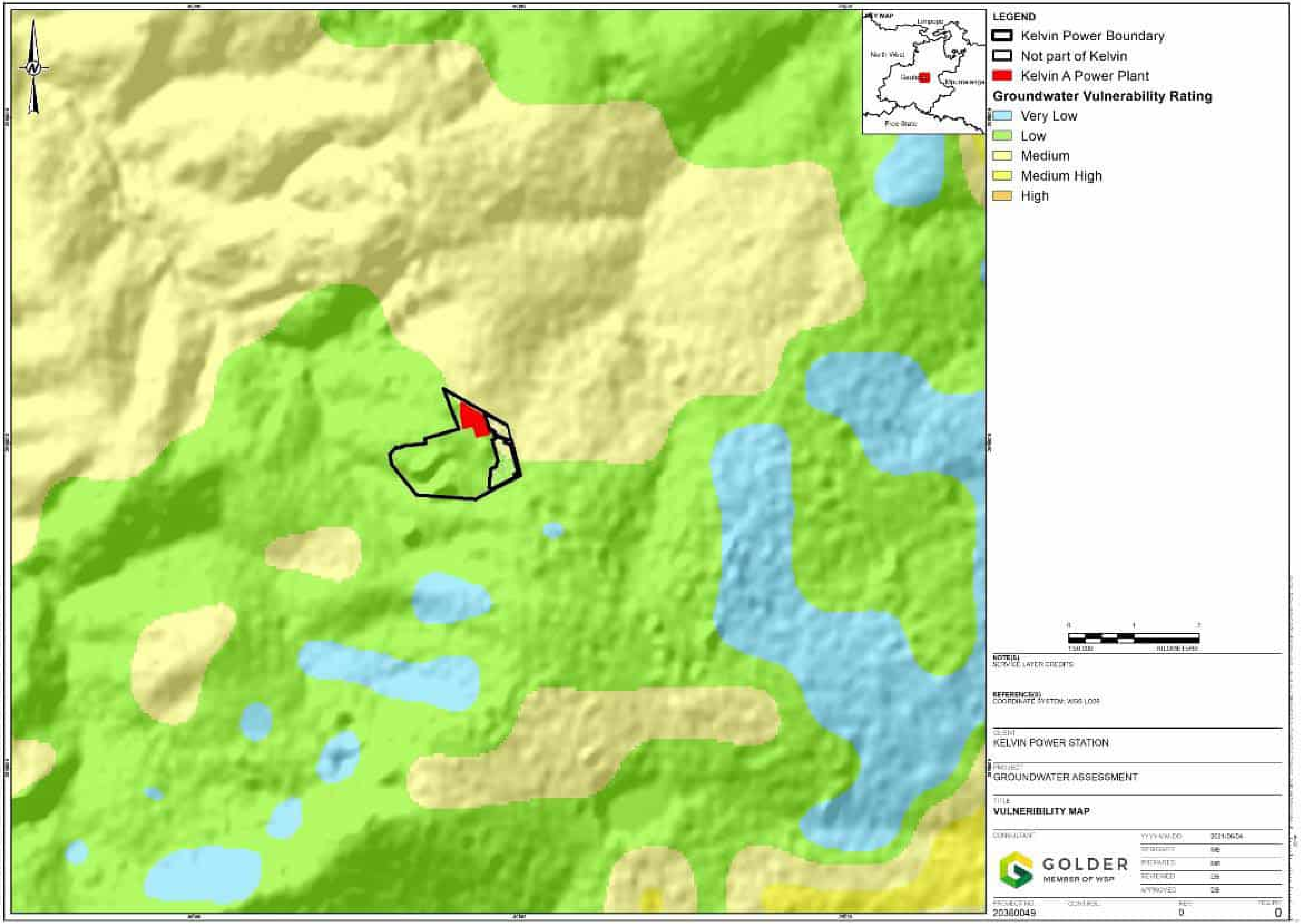


Figure 9: Groundwater Vulnerability

4.6.5 Groundwater Levels and Flow Direction

The groundwater levels at the site range between 1.25 (KPS-BH02) to 10.22 mbgl (KPS-MON01), with an average of 3.9 mbgl (November 2020). The latest available groundwater water level data (November 2020) have been used to prepare the groundwater level contour map (Figure 10). The groundwater contours mimic the surface topography with groundwater flow west towards the Modderfontein Spruit (Figure 10).

4.6.6 Regional Groundwater Recharge

From the published hydrogeological map series (DWAF 1996), the annual groundwater recharge at the site is ranging from 75 to 110 mm/annum (Figure 11).

4.6.6.1 Chloride Ratio Method

The Chloride Ratio Method was used to estimate the aquifer recharge on site. The Chloride Method calculates the recharge using the ratio between the average chloride in rainfall and the average chloride in the groundwater.

The chloride concentration should only result from the natural, hydrological, and evaporative processes as expressed below:

$$\mathbf{RE}\ \% = \frac{\mathbf{Clr}}{\boldsymbol{Clgw}}\boldsymbol{X}\mathbf{100}$$

Where: Cl_r is the concentration of chloride in rainfall (mg/l)

Cl_{gw} is the concentration of chloride in the groundwater (mg/l)

= 1.0 mg/l / 56 mg/l (Harmonic Mean groundwater samples)

=1.8%

The Harmonic Mean of chloride was calculated from the 19 groundwater samples (Aquatico, November 2020). The current accepted concentration of chloride concentration in rainfall for the area is 1.0 mg/l.

Recharge =1.8 % of the MAP 753mm = 14mm per annum. This recharge value is much lower than the regional recharge value of 75 to 110mm per annum indicated on the published hydrogeological maps (Figure 11). This value however is more representative of the site being in an industrial area, with paved and covered surfaces with a high rainfall run off towards storm water systems.

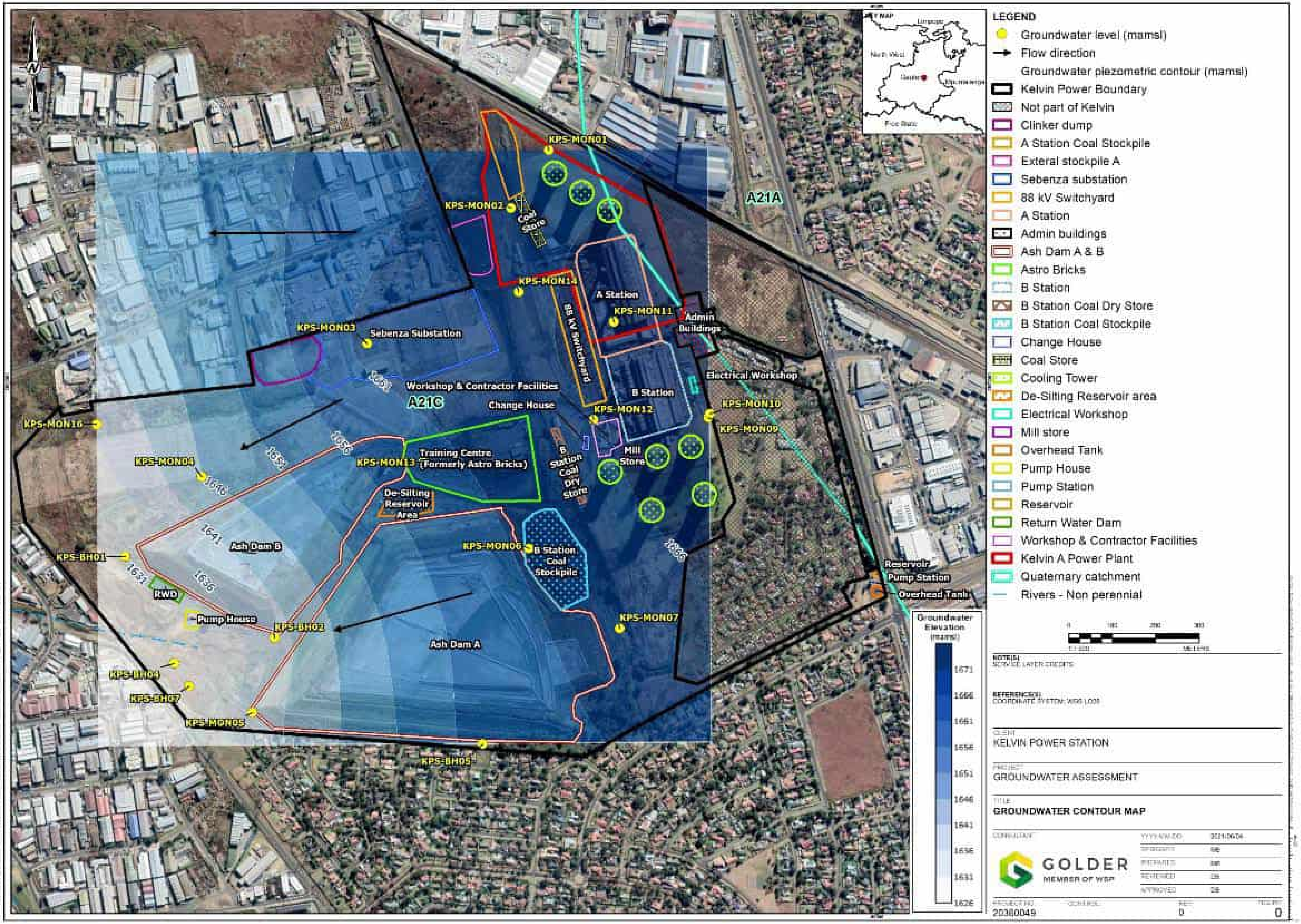


Figure 10: Groundwater Piezometric Contour Map

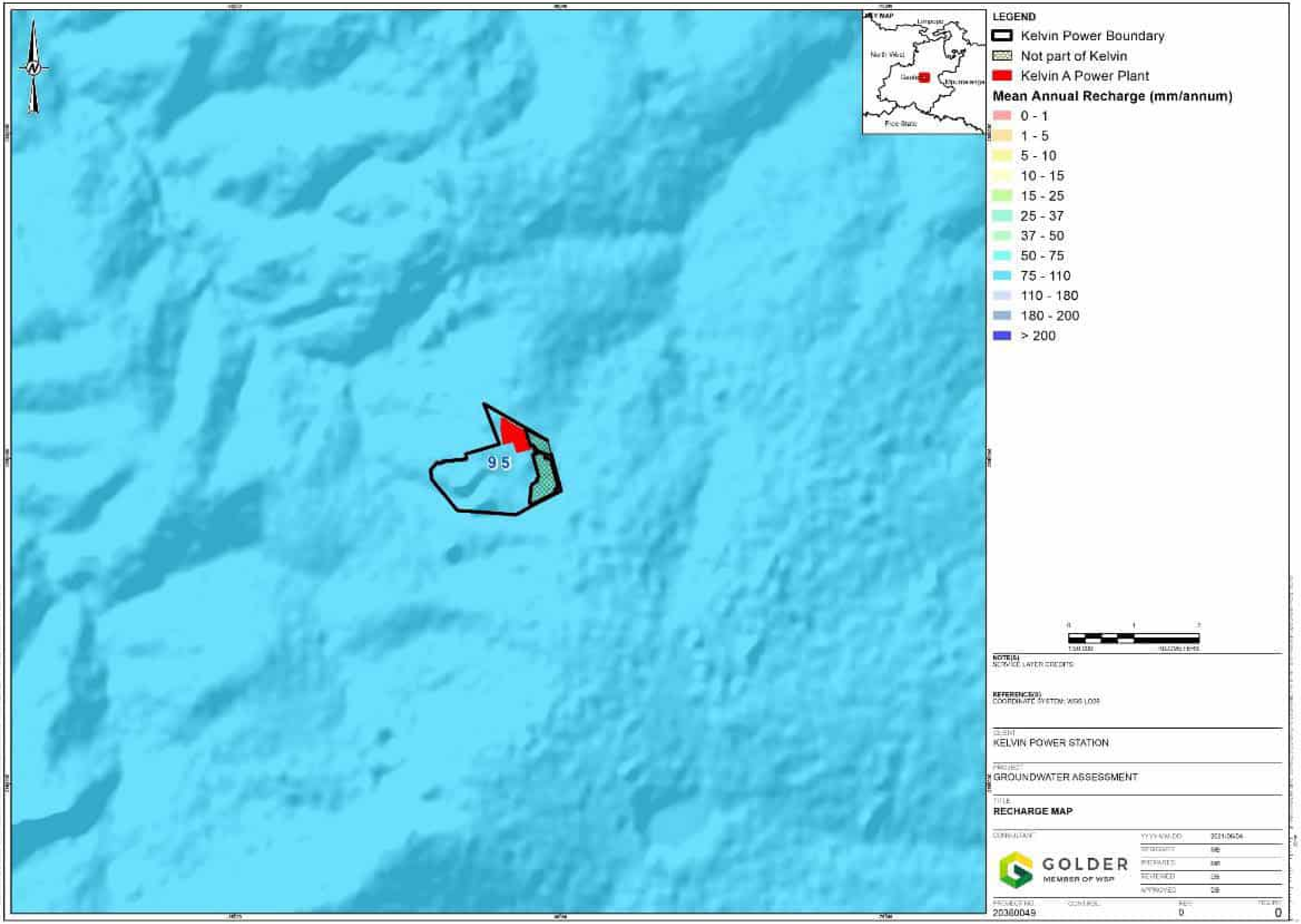


Figure 11: Regional Groundwater Recharge

4.7 Groundwater Quality

Nineteen (19) groundwater samples (Aquatico, November 2020) were used to describe the current groundwater quality on site.

4.7.1 Water Quality Standards

The analytical results of the groundwater samples were compared to the following standards:

- Department of Water Affairs and Forestry, Domestic Water Quality Guidelines, Volume 1,1996 and Water Research Commission, Water Quality Guidelines, 1998; and
- South African National Standards, Drinking Water Standards, 2015 (SANS 241:2015).

The SANS 241:2015 drinking water standard is used as reference guideline, whereas the DWAF 1998 guidelines were used to classify and discuss the water quality classes (**Table 2**). The analytical results are summarised in Table 3. A highlighted value in red exceeds the SANS 241:2015 maximum allowable limit, whereas the water quality classes are classified using the DWAF (1998) drinking water standards.

Two of the Kelvin Power monitoring boreholes (KPS-MON09 and KPS-MON10) have ideal (Class 0) water quality. These two (2) boreholes are located on the eastern side of the Kelvin Power Station (Figure 10) and represent the upgradient/baseline groundwater quality of the site (**Table 2**).

Most of the monitoring boreholes are of good water quality (Class 1), and marginal water quality (Class 2) with slightly elevated EC, TDS, Mg, Cl, nitrate and sulphate concentrations (**Table 2**).

Monitoring boreholes KPS-BH01, KPS-MON07, KPS-MON16, located outside the A-station footprint, however, are of poor water quality (Class 3) and KPS-MON13 is unacceptable water quality Class 4 (**Table 2**). These boreholes have elevated TDS, Mg and sulphate concentrations and are probably impacted by on-site activities.

Monitoring boreholes KPS-MON01 (Class 2), KPS-MON02 (Class 1), KPS-MON11 (Class1) and KPS-MON14 (Class 2), representative of monitoring at the Kevin Power A-Station area, are of good water quality (Class 1), and marginal water quality (Class 2) with slightly elevated EC, TDS, Mg, Cl, nitrate and sulphate concentrations.

Table 2: DWAF Water Quality Classes (1998)

Water quality class	Description	Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

Table 3: Summarised Analytical Results (November 2020)

Borehole No.	Physical Determinants			Chemistry											
	pH	EC mS/m	TDS mg/l	MALK mg/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	Cl mg/l	NO_3 as N mg/l	SO_4 mg/l	F mg/l	Fe mg/l	Mn mg/l	Class
KPS-BH01	7.5	254	**1865.0**	390	175	38.7	**185**	182	**114.0**	<0.459	**913**	<0.466	0.032	0.199	3
KPS-BH02	7.7	**112**	**660.0**	216	44.6	0.6	**119**	16.1	**151.0**	1.2	156	<0.466	<0.009	0.024	2
KPS-BH04	8.0	**121**	**777.0**	352	57.2	1.4	**131**	23.7	95.0	0.7	**218**	<0.466	<0.009	0.024	2
KPS-BH05	8.0	**91.7**	**550.0**	268	29.1	2.3	**105**	8.2	97.2	<0.459	98.5	<0.466	<0.009	0.044	2
KPS-BH07	7.7	**87.8**	**566.0**	237	32.8	0.4	**99.8**	11.2	68.0	2.8	145	<0.466	<0.009	<0.001	1
KPS-MON01	7.7	**158**	**1060.0**	253	30.1	4.7	**137**	130	**152.0**	**7.8**	**365**	<0.466	<0.009	0.18	2
KPS-MON02	8.2	**79.0**	**529.0**	106	17.7	2.4	**94.7**	9.8	41.2	2.5	**250**	<0.466	<0.009	0.189	1
KPS-MON03	8.6	**74**	**452.0**	216	15.7	2.3	**89.2**	7.4	55.7	**9.7**	83.3	<0.466	<0.009	0.093	1
KPS-MON04	7.9	**116**	**773.0**	247	33.1	0.7	**146**	12.3	57.9	1.6	321	<0.466	<0.009	0.038	2
KPS-MON05	8.7	**149**	**967.0**	99.6	62.9	**38.4**	23.7	197	**157.0**	4.5	**397**	<0.466	<0.009	0.076	1
KPS-MON06	9.2	**145**	**942.0**	29.8	**83.1**	**35**	3	189	**171.0**	**15.8**	**360**	<0.466	<0.009	0.005	2
KPS-MON07	7.6	**178**	**1251.0**	539	66.8	1.3	**236**	39.2	69.6	2.6	**457**	<0.466	<0.009	0.209	3
KPS-MON09	8.1	39.7	260.0	161	7.1	0.8	48.1	4.4	24.9	2.3	21	<0.466	<0.009	0.03	0
KPS-MON10	7.5	43.1	287.0	142	6.6	0.5	51.5	5.8	30.5	2	51.3	<0.466	<0.009	0.003	0
KPS-MON11	7.6	50.4	323.0	99.5	9.9	1.7	47	21.4	28.6	**7.7**	93.6	<0.466	<0.009	0.015	1
KPS-MON12	7.6	**112**	**785.0**	269	59	2.4	**113**	33.3	34.0	**13.1**	**270**	<0.466	<0.009	0.001	2
KPS-MON13	7.4	**257**	**2097.0**	286	50.1	0.6	**400**	58	61.7	**7.9**	**1268**	<0.466	<0.009	0.008	4
KPS-MON14	8.0	**95.4**	**686.0**	126	14.2	0.8	**133**	6	32.7	5.2	**358**	<0.466	<0.009	0.027	2
KPS-MON16	7.5	**165**	**1254.0**	209	**95.3**	0.3	**207**	14.3	81.9	5	**648**	<0.466	<0.009	0.005	3
SANS241: 2015 Max. Allowable Limit	5.0 to 9.7	<170	1200	-	150	50	70	200	300	12	500	1.5	2.0	0.4	
Class 0 Max. Allowable Limit	7-9.5	<70	<450	-	<80	<25	<70	<100	<100	<6	<200	<0.7	<0.01	<0.1	0
Class 1 Max. Allowable Limit	9.5-10	70-150	450-1000	-	80-150	25-50	70-100	100-200	100-200	6 to 10	200-400	0.7-1.0	0.01-0.2	0.1-0.4	1
Class 2 Max. Allowable Limit	10-10.5	150-370	1000-2400	-	150-300	50-100	100-200	200-400	200-600	10 to 20	400-600	1.0-1.5	0.2-2.0	1.0 to 4.0	2
Class 3 Max. Allowable Limit	10.5-11	370-520	2400-3400	-	>300	100-500	200-400	400-1000	600-1200	20-40	600-1000	1.5-3.5	2 to 10	4.0 to 10.0	3
Class 4 Max. Allowable Limit	>11	>520	>3400	-		>500	>400	>1000	>1200	>40	>1000	>3.5	>10.0	>10.0	4

4.7.2 WUL Groundwater Quality Standards - WUL no. 03/A21C/FGH/1110 – 24/06/2011

The site's Water Use Licence (WUL), no. 03/A21C/FGH/1110 (date: 24/06/2011), state that the groundwater monitoring programme shall include water level monitoring, rainfall records, ash deposition data, and hydrochemistry. The Licensee shall monitor groundwater quality at the boreholes set out in the Table 4. No limits are specified in the WUL.

Table 4: WULA Groundwater Monitoring Points

Borehole no	Monitoring Boreholes Status	Monitoring Frequency	Constituents to be sampled
KPSMON01	Monitoring Borehole	Quarterly	pH, EC, TDS, Alkalinity, SO_4, Ca, Mg, Na, Cl, K, F, Si, V, Al, Fe, Mn, NO3, Ammonia, E.coli
KPSMON02	Monitoring Borehole		
KPSMON03	Monitoring Borehole		
KPSMON04	Monitoring Borehole		
KPSMON05	Monitoring Borehole		
KPSMON07	Monitoring Borehole		
KPSBH1	Monitoring Borehole	Annually	As, Ni, Fe, Al, As, Cu, Cd, Cr, Zn
KPSBH2	Monitoring Borehole		
KPSBH4	Monitoring Borehole		
KPSBH5	Monitoring Borehole		
KPSBH6	Demolished/Destroyed		
KPSBH7	Monitoring Borehole		

4.8 Groundwater Classification

The groundwater quality results of the sampled boreholes at Kelvin Power Station (November 2020) are visually represented on an expanded Durov and Piper diagrams to distinguish between the different water quality classes/types.

4.8.1 Expanded Durov

Expanded Durov diagrams graphically represent the relative percentages of anions and cations in water samples. The cation percentages are plotted in the top part of the diagram and the anion percentages in the left part. A projection of these cation and anion percentages onto the central area presents the chemical signature of the major ion composition of the water. The chemical signature can be related to various hydrochemical environments and conditions.

Four of the samples, KPS-MON03, KPS-MON09, KPS-MON10, and KPS-BH-05, plot on the blue sector of the diagram and represent background groundwater quality, calcium magnesium bicarbonate type of water $(Ca,Mg)(HCO_3)_2$).

Most of the sample's plot on green sector of the diagram is representative of magnesium sulphate type of water $(Mg)SO_4$. The plot position on the diagram indicates impacted water with magnesium and sulphate enrichment. These types of enrichment are typical of environments involving coal mining and associated activities. KPS-MON01, KPS-MON02, KPS-MON11 and KPS-MON14, samples representative of monitoring at the Kevin Power A-Station section, are part of the green sector.

The red sector of the diagram (KPS-MON05 and KPS-MON06) is representative of sodium potassium sulphate water type (i.e. Na/K–SO_4). The plot position on the diagram indicates water with sodium and sulphate enrichment.

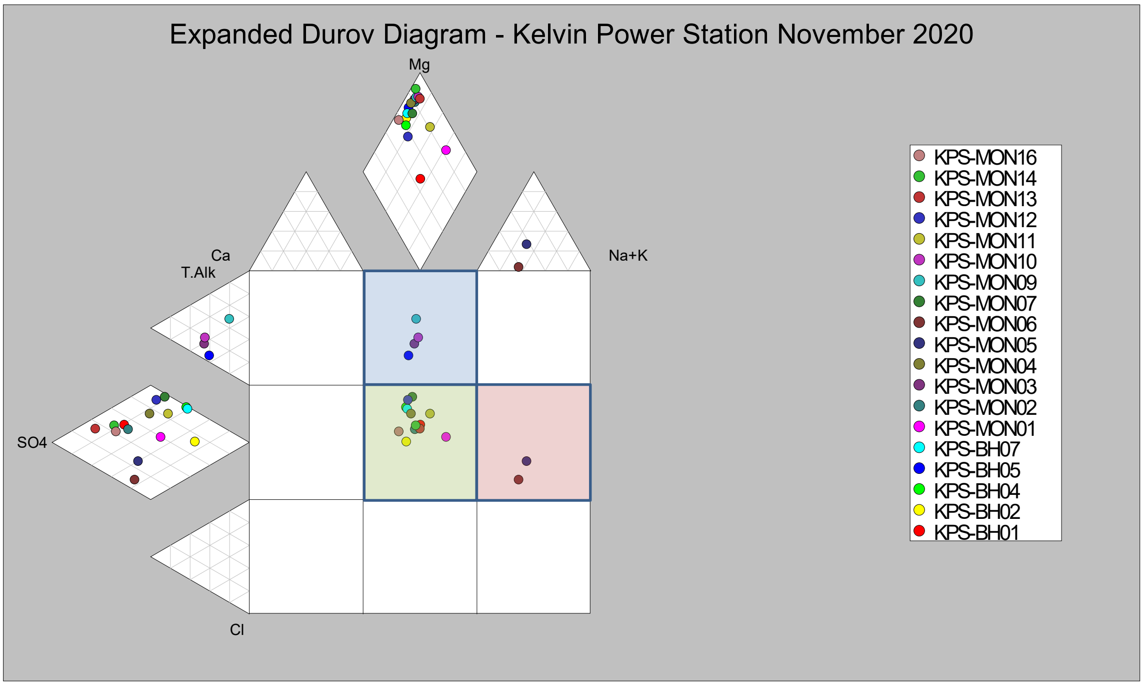


Figure 12: Expanded Durov Diagram

4.8.2 Piper Diagram

Piper diagrams graphically represent the relative percentages of anions and cations in water samples. The cation percentages are plotted in the left triangle and the anion percentages in the right triangle. A projection of these cation and anion presentations onto the central diamond presents the chemical signature of the major ion composition of the water.

Four of the samples (KPS-MON03, KPS-MON09, KPS-MON10, and KPS-BH-05) plot on the blue sector of the Piper diagram and show a signature of calcium magnesium bicarbonate type of water $(Ca,Mg)(HCO_3)_2$. This type of water is associated with recent rainfall recharge and not impacted groundwater.

Most of the sample's plot on the green sector of the diagram and represents a signature of calcium/sodium sulphate $(Ca,Na)SO_4$ type of water. KPS-MON01, KPS-MON02, KPS-MON11 and KPS-MON14 samples representative of monitoring at the Kevin Power – A-Station section, are part of the green sector.

Samples KPS-MON05 and KPS-MON06, plot on the red sector of the Piper Diagram and shows a signature of sodium potassium chloride type of water ((Na,K)Cl).

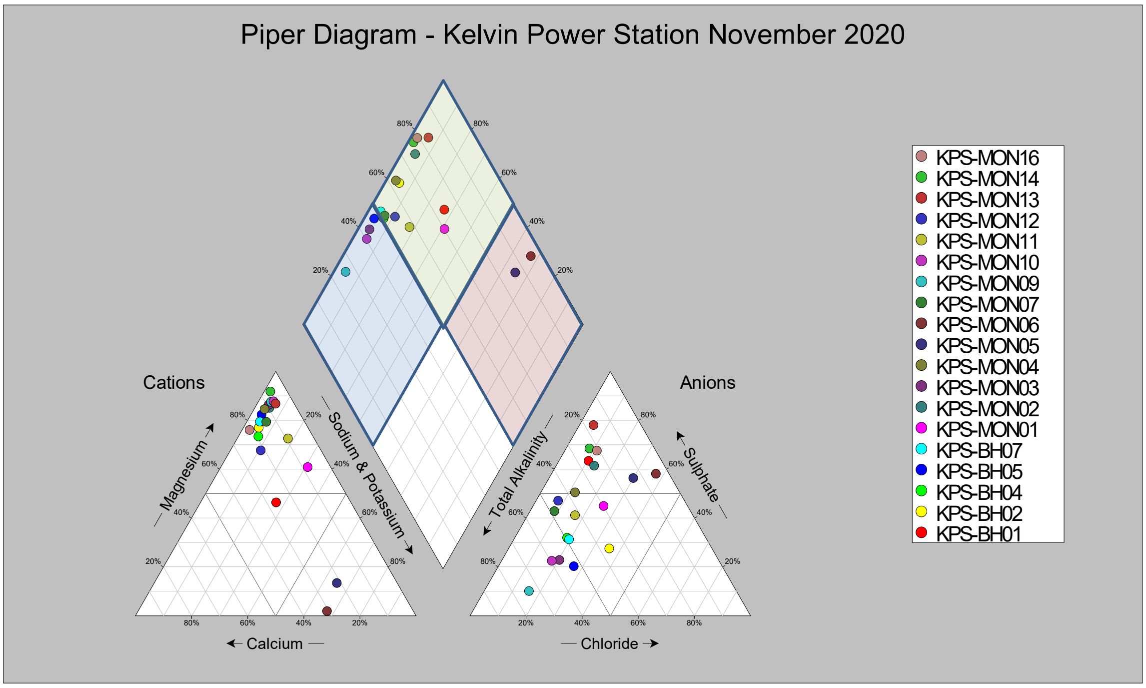


Figure 13: Piper Diagram

4.8.3 Baseline and Background Groundwater Quality 2020

The current baseline/background groundwater quality is based on macro chemistry analyses of the 19 groundwater samples collected during the November 2020 monitoring programme.

The properties of groundwater are overwhelmingly determined by hydrogeochemical processes taking place as rain or surface water enter the ground and react with rock-forming minerals. This natural baseline quality will vary between geological formations (rock types); therefore, each area will be characterised by an almost unique groundwater quality type resulting from the influence of the local geology. The baseline may vary spatially within aquifers of the same type due to variations in the original sediments known as lithofacies. The chemistry also evolves with time as the water moves along flow lines. A number of geochemical processes for example oxidation and reduction (controlling natural levels of Fe, Mn, As and Cr), mineral solubility (controlling F and Ba concentrations), and sorption and exchange with mineral surfaces (affecting the concentrations of many metals and ionic constituents) may help shape the unique natural characteristics of groundwater.

Baseline concentrations of a substance in groundwater may be defined in several different ways. It is impossible to determine if groundwater is polluted/impacted unless the baseline is known. An ideal starting point is to locate waters where there are no traces of anthropological impacts. If the sampled boreholes are already impacted by existing pollution activities it will represent a background water quality or current groundwater conditions, which can be used as a benchmark against which the results of future groundwater quality can be monitored to evaluate any associated impacts from the proposed project on the groundwater system.

The hydrochemical concentrations are compared to the SANS 241:2015 water quality standard and the baseline quality are represented by the median of the concentrations. The background water quality representative of the November 2020 sampled boreholes are summarised in Table 5 below. Monitoring boreholes (KPS-MON09 and KPS-MON10) have ideal (Class 0) water quality and represent the upgradient/baseline water groundwater quality of the site (4.7).

Table 5: Background Groundwater Quality2020

Item	**Physical Parameters**			**Macro Determinants (Major Ions and Trace Metals)**								**Minor Determinant**		
	pH	**EC**	**TDS**	**Ca**	**Mg**	**Na**	**K**	**Cl**	**SO_4**	**NO^3**	**MALK**	**F**	**Fe**	**Mn**
		mS/m	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**Mg/l**	**mg/l**	**mg/l**	**mg/l**
No. of Records	19	19	19	19	19	19	19	19	19	19	19	19	19	19
10% Percentile	7.50	43.1	287	7.1	23.7	5.8	0.4	28.6	51.3	0.459	99.5	0.466	0.009	0.001
Median Baseline Water Quality	**7.70**	**112**	**773**	**33.1**	**113**	**16.1**	**1.4**	**68**	**270**	**2.8**	**216**	**0.466**	**0.009**	**0.027**
Average	7.92	122.5	847	46.9	124.7	51.0	7.1	80.2	340.72	4.911	223.468	0.466	0.01	0.062
90% Percentile	8.7	254	1865	95.3	236	189	38.4	157	913	13.1	390	0.466	0.009	0.199
Max. Allowable Limit (SANS 241:2015)	<5 >9.7	<170	<1200	<150	<70	<200	<50	<300	<500	<12	-	<1.5	<2.0	<0.4

4.9 Groundwater Qualitative Impact Assessment

The potential impact of the proposed decommissioning and demolition of the Kelvin Power A-Station on the groundwater system was assessed on a qualitative basis. No numerical modelling was conducted. The environmental significance of each potential impact was calculated as described below.

4.9.1 Impact Assessment Process and Methodology

The significance of each identified impact was determined using the approach outlined below (terminology adapted from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Probability	**Duration**
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (5 - 10 years)
2 - Low probability	2 - Short-term (0 - 3 years) (impact ceases after the decommissioning and rehabilitation activities)

1 - Improbable	1 – Immediate
0 - None	

Scale	**Magnitude**
5 - International	10 - Very high/don’t know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence, and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >60	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 60	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions

For the methodology outlined above, the following definitions were used:

- **Magnitude** is a measure of the degree of change in a measurement or analysis (e.g., the severity of an impact on human health, well-being, and the environment), and is classified as none/negligible, low, moderate, high, or very high/unknown;
- **Scale/Geographic** extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- **Duration** refers to the length of time over which an environmental impact may occur i.e. immediate/transient, short-term, medium term, long-term, or permanent; and
- **Probability** of occurrence is a description of the probability of the impact occurring as improbable, low probability, medium probability, highly probable or definite.

4.9.2 Source, Pathway and Receptors

To describe the impacts on the groundwater system, the risk profile must be described in terms of the source of contamination, the pathway to exposure and the profile of the receptor.

Kelvin Power A-Station has a low contamination risk rating (SRK, 2016), with only the A-Station coal stockpile and the weigh bridge with a medium rating (Figure 14).

The November 2020 onsite sulphate and TDS concentration maps also support the low contamination risk of the A-Station (Figure 15 and Figure 16).

4.9.2.1 Source

Possible pollution sources at the A-Station are associated with seepages during the proposed demolition of the following infrastructure:

- The A-Station boiler, turbine house and associated two stacks;
- Three cooling towers;
- Workshops and storage facilities;
- External Stockpile A;
- Dry coal storage;
- Old switch yard or high voltage yard; and
- Train wagon tippler or rail tippler.

4.9.2.2 Pathway

The pathway is described as a sequence of pathways between the point of release at the source and the receptor i.e., in this case the pathway is the aquifer system connecting the sources with the receptors (streams). Groundwater contamination is present within the shallow weathered (<15 mbgl) and fractured aquifer (>15 mbgl) systems as well as within the deeper fractured aquifer. This moves off-site in a westerly direction towards the Modderfontein Spruit.

4.9.2.3 Receptor

The receptor profile is described in terms of receiving water bodies and ultimate end user human receptors. Possible receiving water bodies to contamination include the following:

- Modderfontein Spruit; and
- Jukskei River.

Possible human receptors include:

- Groundwater users downgradient of the Kelvin Power site (not confirmed). The area is supplied with municipal water; therefore, the likelihood of domestic groundwater use is low.

4.9.3 Possible Impacts on the Groundwater Regime

The Kelvin Power A-Station have been under care and maintenance since 2012 with minimal if any additional impacts expected on the groundwater system during the final decommissioning phase.

During the demolition phase, the main activities that could impact on groundwater is the demolition of existing infrastructure and clearing of the site for future development.

The demolition phase of the Kelvin Power A-Station infrastructure, poses the following potential impacts on the groundwater:

- A change in the groundwater quality.
- A change in the volume or recharge of groundwater, previously covered areas will be exposed with associated change in water level.
- Changes in land use.
- Possible change in the groundwater flow regime (building excavation).
- A change on the quality of the surface water (receptor).
- Possible spills from construction vehicles.

The potential impact of the decommissioning and demolition of the A-Station on the groundwater system was assessed on a qualitative basis and is listed in Table 6.

4.9.3.1 Cumulative Impacts

Cumulative impacts can be defined as changes to the environment caused by the combined impact of past, present and future human activities and natural processes.

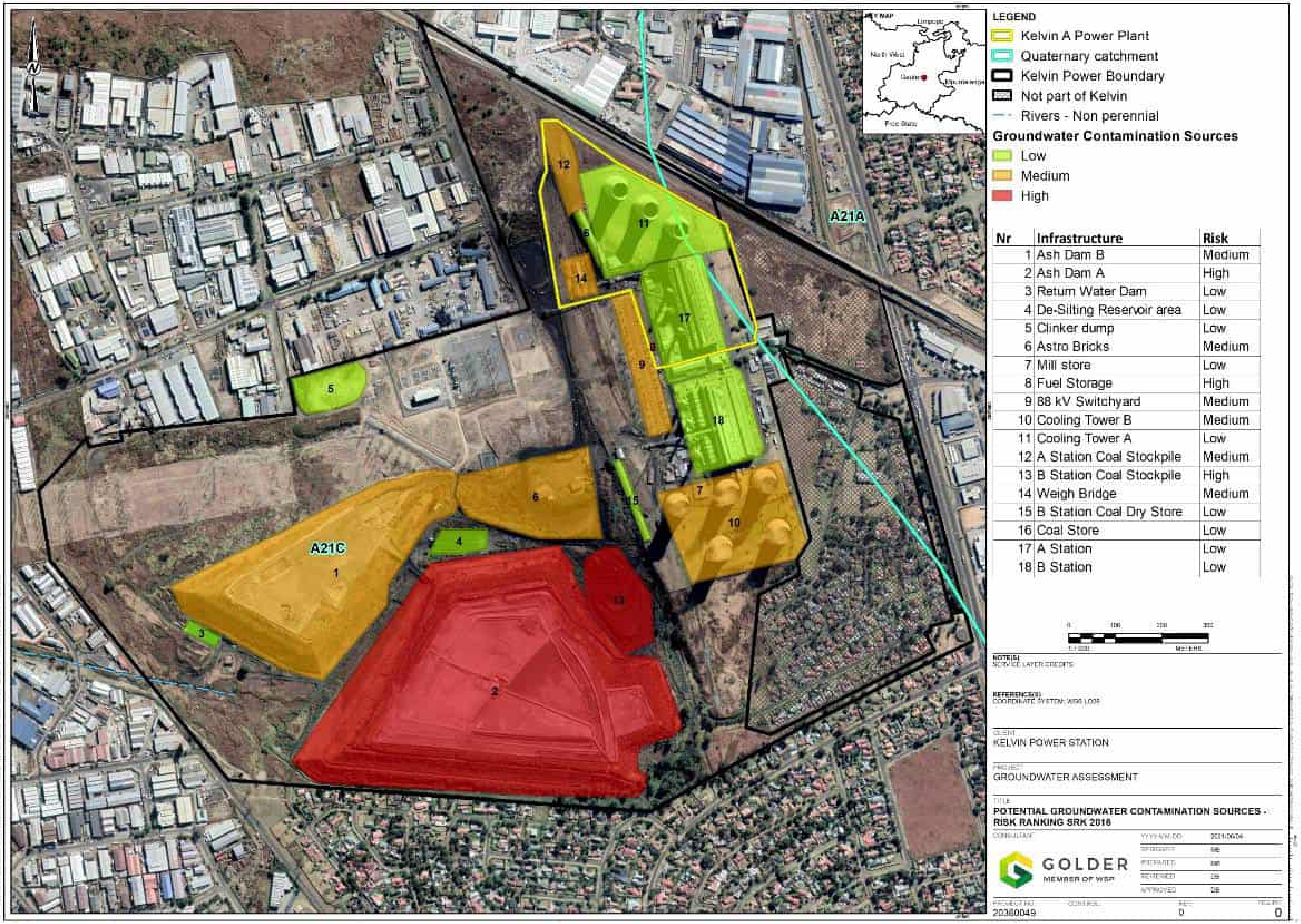
The cumulative impacts impact of the decommissioning and demolition of the A-Station on the groundwater regime (quality and quantity), if no mitigation is implemented, may potentially be low to moderate. However, with mitigation and good management practices during decommissioning no negative change is expected in the groundwater regime.

4.9.3.2 Residual Impacts

Residual impacts refer to those impacts that remain after implementation of mitigation measures. The residual impact from the decommissioning phase will be low on the groundwater regime, if good management practices are maintained.

Table 6: Kelvin Power A-Station Groundwater Impact Assessment

		Occurrence		Severity		Significance without Mitigation	Occurrence		Severity		Significance with Mitigation	Mitigation Measures
Activity	**Potential Impact**	**Probability**	**Duration**	**Scale**	**Magnitude**	**SP (significance points) without Mitigation**	**Probability**	**Duration**	**Scale**	**Magnitude**	**SP (significance points) without Mitigation**	
Decommissioning	A change in the groundwater quality	1	1	1	2	4	0	1	1	2	0	No noticeable impact change expected during the decommissioning phase (Kelvin Power A-Station was under care and maintenance since 2012), no mitigation required during Decommissioning Phase - Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.
	A change in the volume or recharge of groundwater/change in water level	1	1	1	2	4	0	1	1	2	0	
	Changes in land use	0	1	0	2	0	0	1	0	2	0	
	Possible change in the groundwater flow regime	0	1	0	2	3	0	1	0	2	0	
	A change on the quality of the surface water (receptor).	1	1	1	2	4	0	1	1	2	0	
Demolition	A change in the groundwater quality	3	3	1	6	30	1	1	1	4	6	• Groundwater monitoring (water levels and quality). • Monitor for changes in water quality down gradient from Kelvin Power A-Station (KPS-MON03, KPS-BH-03, KPS-MON16 and KPS-MON04. • All vehicles and machinery to be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. • Vehicle repairs to be carried out in a dedicated repair area only, unless in-situ repairs are required. • Drip trays shall always be placed under vehicles that require in-situ repairs. • Drip trays to be emptied at designated containers and be disposed at licensed hazardous material disposal facility. • Soil spills will be treated in-situ using sand, soil, or cold coal-ash as absorption medium.
	A change in the volume or recharge of groundwater, previously covered areas will be exposed with associated change in water level	3	2	1	4	21	3	2	1	4	21	
	Changes in land use	4	1	1	2	16	4	1	1	2	16	
	Possible change in the groundwater flow regime (building excavation)	2	1	1	4	12	2	1	1	4	12	
	A change on the quality of the surface water (receptor).	3	3	1	4	24	1	1	1	2	4	
	Possible spills from construction vehicles	3	1	1	4	18	1	1	1	2	4	



Nr	Infrastructure	Risk
1	Ash Dam B	Medium
2	Ash Dam A	High
3	Return Water Dam	Low
4	De-Silting Reservoir area	Low
5	Clinker dump	Low
6	Astro Bricks	Medium
7	Mill store	Low
8	Fuel Storage	High
9	88 kV Switchyard	Medium
10	Cooling Tower B	Medium
11	Cooling Tower A	Low
12	A Station Coal Stockpile	Medium
13	B Station Coal Stockpile	High
14	Weigh Bridge	Medium
15	B Station Coal Dry Store	Low
16	Coal Store	Low
17	A Station	Low
18	B Station	Low

Figure 14: Potential Groundwater Contamination Sources - Risk Rating SRK 2016

4.9.4 Sulphate (SO_4) and TDS Borehole Concentrations

The latest (November 2020) sulphate (SO_4) and TDS concentrations of the monitoring boreholes have been used to map potential pollution plumes on the Kelvin Power site as shown on Figure 15 and Figure 16.

The sulphate concentration map shows the highest concentrations to be present at KPS-MON13 (Astro Brick, at ~ centre of the site) and KPS-BH-01 (western site border).

The TDS concentration map correspond with the sulphate concentration map with the highest concentrations to be present at KPS-MON13 (Astro Brick, at ~ centre of the site) and KPS-BH-01 (western site border). The groundwater flow is west towards the Modderfontein Spruit.

Both the sulphate and TDS concentrations of the monitoring boreholes at the A-Station (KPS-MON01, KPS-MON02, KPS-MON11 and KPS-MON14) are below the SANS 241: 2015 maximum allowable limits of >500 mg/l sulphate and TDS concentrations of >1 200mg/l respectively.

Any associated groundwater pollution will migrate with the groundwater flow west towards the Modderfontein Spruit.

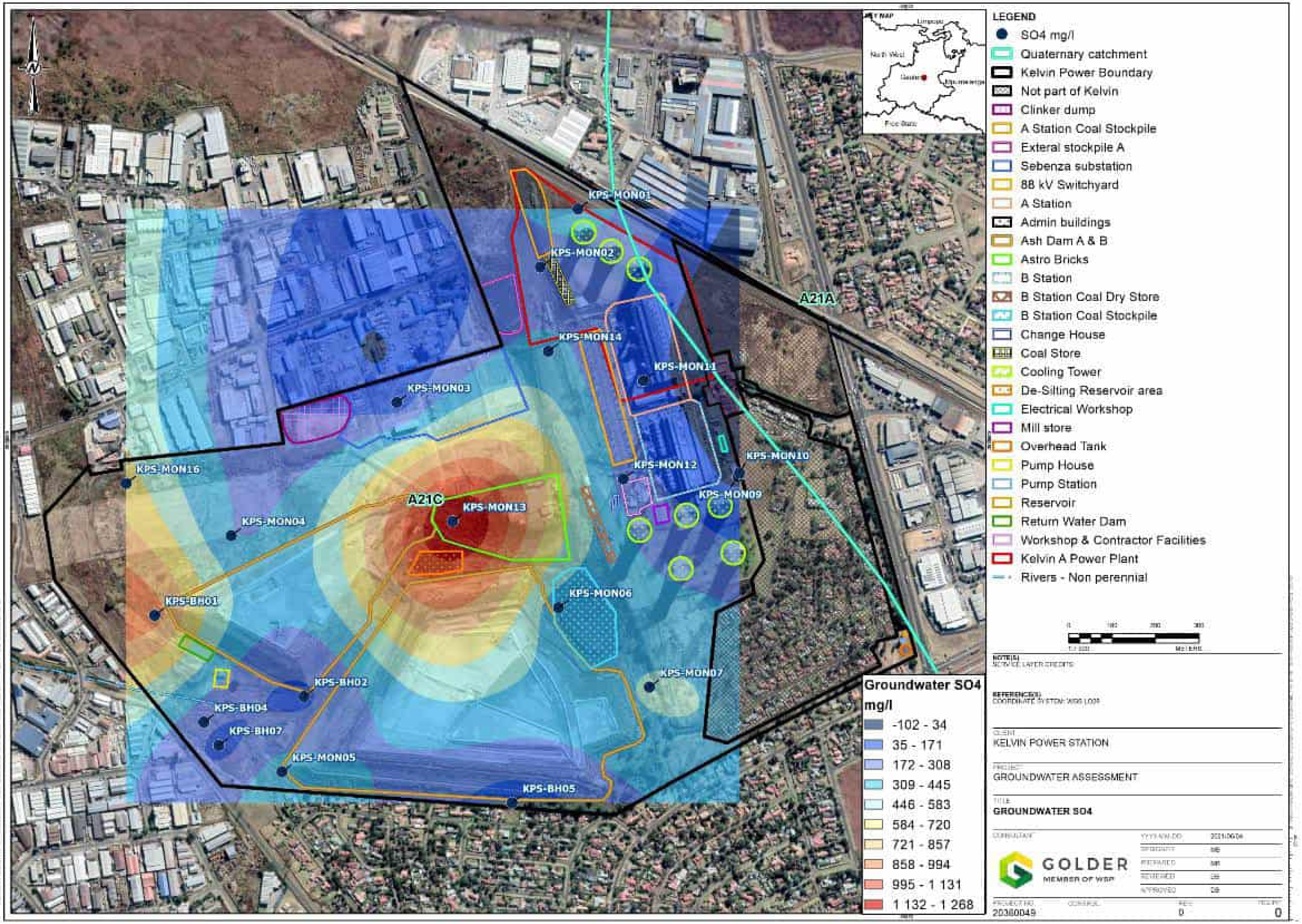


Figure 15: Sulphate Concentrations (November 2021)

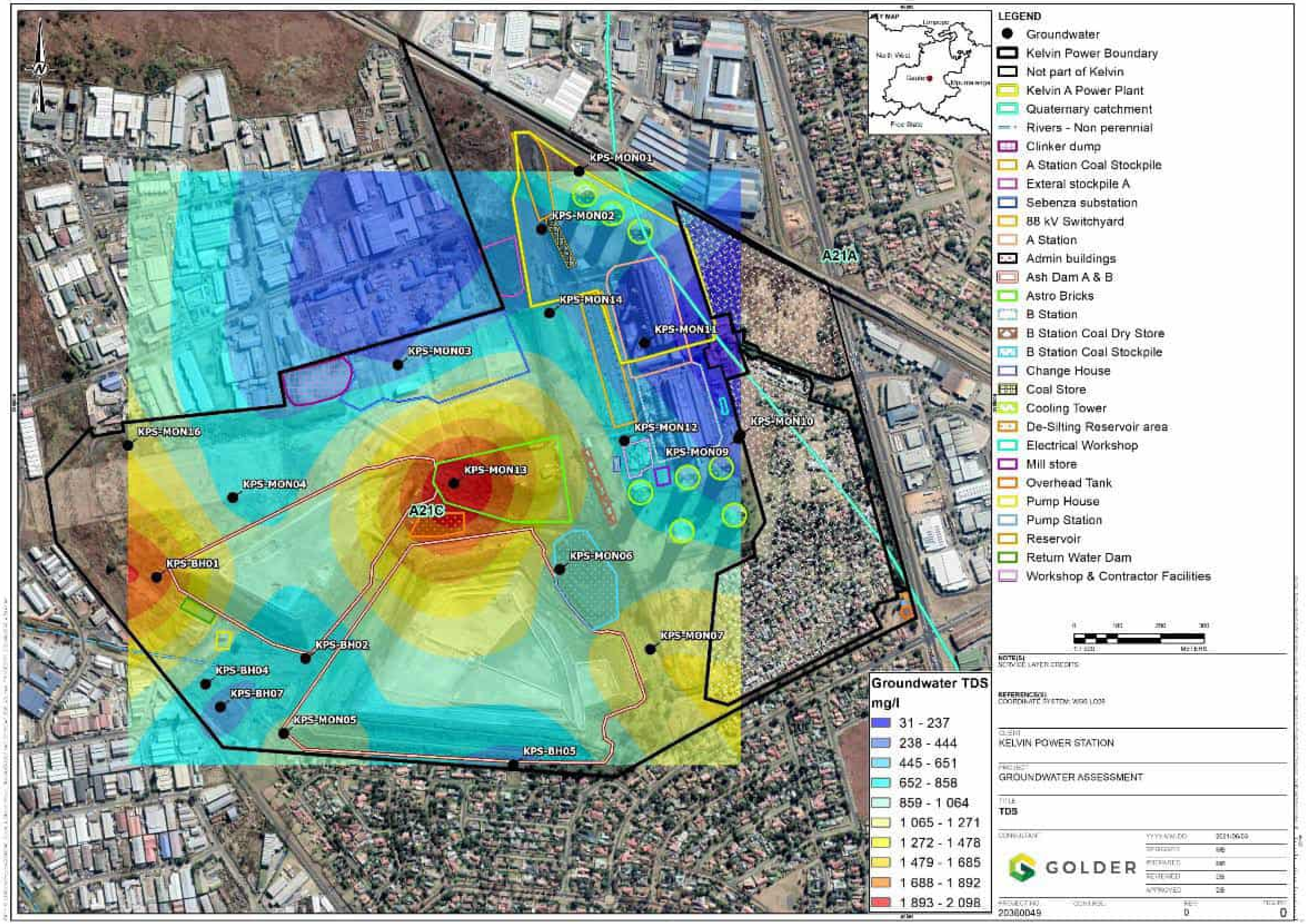


Figure 16: TDS Concentration (November 2020)

4.10 Groundwater Conceptual Model and Understanding

The existing groundwater conceptual model (SRK, 2016a) was adapted to gain an understanding of the site hydrogeology (Figure 17). The conceptual model indicates the dynamics of the groundwater system, aquifer distribution, role of geological structures and groundwater flow directions.

A conceptual model consists of a set of assumptions that reduce the real problem and the real domain to simplified versions that are acceptable in view of the objectives of the modelling and of the associated management problem.

Conceptual understanding derived from existing groundwater information and the Kelvin Power conceptual model:

- The groundwater flow mimics the topography and is west towards the Modderfontein Spruit;
- Aquifer comprises of shallow weathered (un-confined) and deep fractured (semi-confined) aquifer systems;
- Monitoring boreholes (KPS-MON09 and KPS-MON10) located upgradient on the eastern boundary, have ideal (Class 0) water quality and represent the upgradient/baseline water groundwater quality of the site;
- Existing infrastructure on site probably contribute to the deteriorating of groundwater as it flows through the Kelvin Power site;
- Groundwater mounding is associated with ash dams, change in water level;
- The presence of geological structures (dolerite dykes/sills and fault zones) acting as preferred groundwater flow paths are not confirmed. No geological structures were mapped on the 1:250 000 geological map series, intersecting the Kelvin Power Site. However, the presence of dolerite dykes and sills are reported in the borehole logs (SRK, 2016); and
- The Modderfontein Spruit acts as receptor of groundwater contaminants origination from site and surrounding areas.

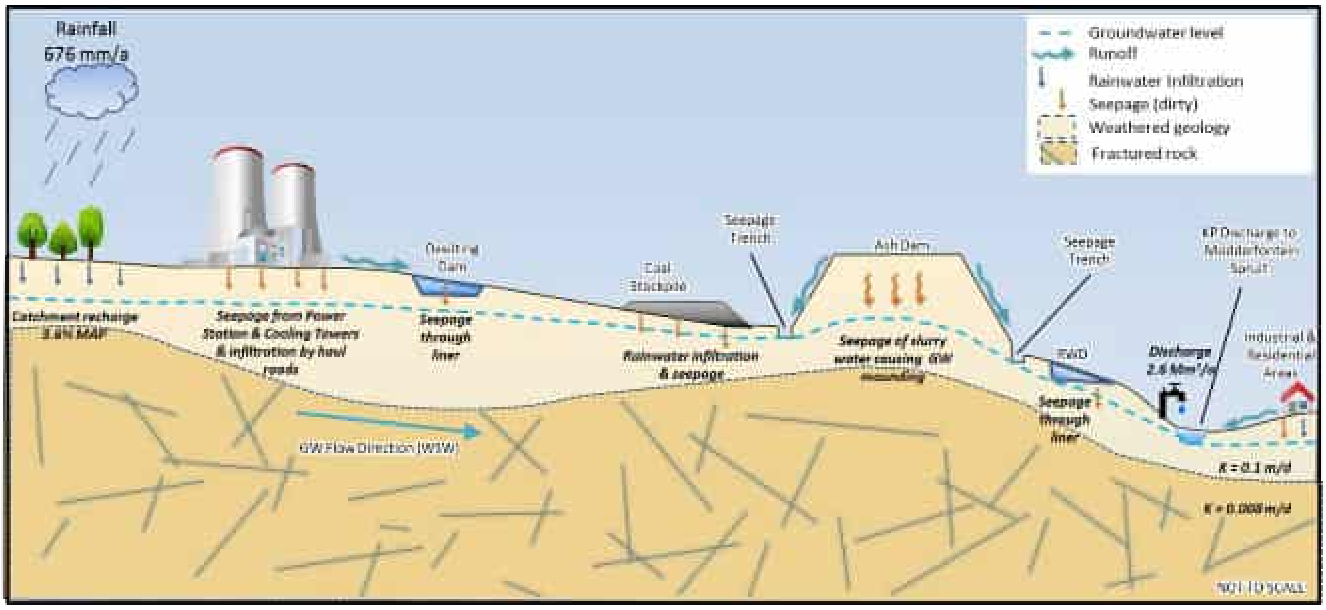


Figure 17: Groundwater Conceptual Model (adapted SRK, 2016a)

4.11 Groundwater Monitoring Programme

Any groundwater monitoring network design should be guided by a risk-based source-pathway-receptor principle. A groundwater monitoring network should contain monitoring positions which can assess the groundwater status at certain areas. Both the impact on water quality and water quantity should be catered for in the monitoring system. The boreholes in the network should cover the following:

- Source monitoring – monitoring close to possible contaminant sources;
- Plume (pathway) monitoring – monitoring along identified contamination plumes (if any);
- Impact (receptor) monitoring – monitoring at expected sensitive receptors; and
- Monitoring of the background water quality and levels.

The existing groundwater monitoring network at the A-Station is effective to monitor both the impacts from the decommissioning and demolition activities on the groundwater regime. However, after demolition of the A-Station and auxiliary infrastructure, the monitoring network might need to be updated, as some of the existing monitoring facilities are likely to be destroyed as part of the demolition process.

The proposed replacement borehole positions (if destroyed) for the A-Station are indicated in Figure 18. These positions are close to the existing borehole positions and can be selected hydrogeologically. The Kelvin Power site falls partially onto two quaternary catchment areas namely, A21C and A21A and it is important to install an additional monitoring borehole to the east in catchment A21A (currently no monitoring facility) as indicated on Figure 18.

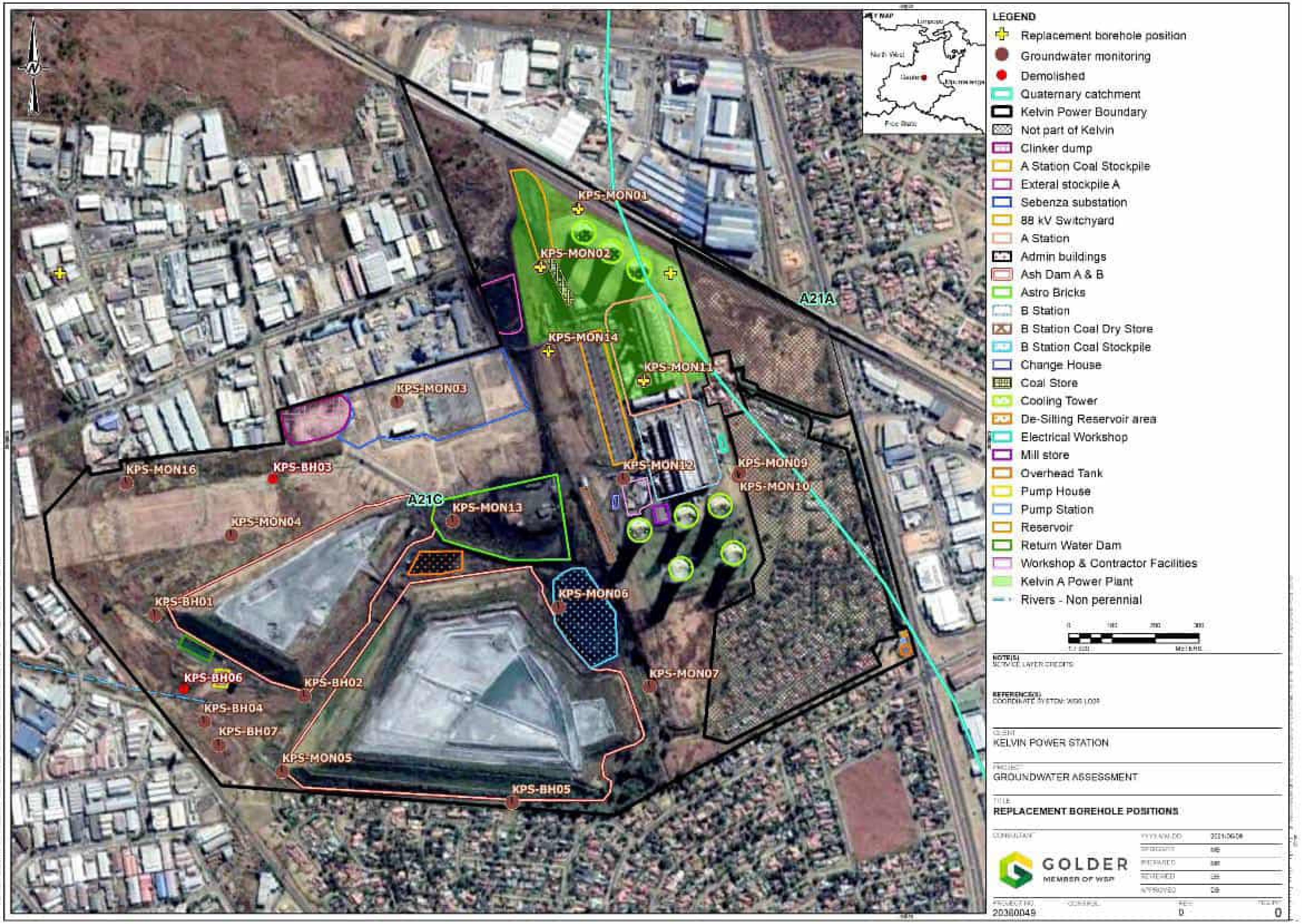


Figure 18: Kelvin Power A-station Replacement Borehole Positions

4.11.1 Possible Mitigation Measures to Reduce the Impact on the Groundwater.

The following mitigation measures are proposed:

- Groundwater monitoring of water levels and quality should continue as per WUL no. 03/A21C/FGH/1110 – 24/06/2011 on quarterly and annual frequency. Monitor for changes in water quality down gradient from Kelvin Power A-Station (KPS-MON03, KPS-BH-03, KPS-MON16 and KPS-MON04; and
- Demolition vehicles and machinery to be kept in good working order and use of drip trays as describe in Table 6.

5.0 CONCLUSIONS

The following conclusions are made:

- The Kelvin Power A-Station investigation area is underlain by Halfway House granites.
- The aquifer associated with the Kelvin Power A-Station is classified as minor aquifer system and comprises mainly of an intergranular and fractured aquifer zone with an average borehole yield between 0.5l/s and 2.0l/s.
- Two aquifer systems are distinguished (SRK 2016), namely:
  - Shallow weathered unconfined aquifer zone; and
  - Fractured semi-confined aquifer zone below the weathered zone.
- The groundwater contours mimic the surface topography with groundwater flow, west towards the Modderfontein Spruit.
- Two of the Kelvin Power monitoring boreholes (KPS-MON09 and KPS-MON10) have ideal (Class 0) water quality. These two (2) boreholes are located on the eastern side of Kelvin Power Station (Figure 10) and represent the upgradient/baseline groundwater quality of the site (Table 2).
- Most of the monitoring boreholes are of good water quality (Class 1), and marginal water quality (Class 2) with slightly elevated EC, TDS, Mg, Cl, nitrate and sulphate concentrations (Table 2).
- Monitoring boreholes KPS-BH01, KPS-MON07, KPS-MON16 are of poor water quality (Class 3) and KPS-MON13 is unacceptable water quality Class 4 (Table 3). These boreholes have elevated TDS, Mg and sulphate concentrations and are probably impacted by on site activities.
- The following constituents of the groundwater samples are of concern; EC, TDS, Mg, Cl, nitrate and sulphate.
- The baseline water quality at Kelvin Power site is represented by KPS-MON03, KPS-MON09, KPS-MON10, and KPS-BH-05 represent calcium magnesium bicarbonate type of water $(Ca,Mg)(HCO_3)_2$).
- The proposed decommissioning, and demolition of the A-Station, will have a **low** environmental significance impact on the groundwater regime. Redevelopments on site, would also implement best available technology and measures to limit any on-site and off-site impacts.

6.0 RECOMMENDATIONS

The following groundwater monitoring recommendations are made:

- Mitigation measures contained in Table 6 above should be included in the EMPr.

- Installation of replacement groundwater monitoring boreholes (if required) at positions as indicated in Figure 18 after demolition of the A-Station. These boreholes to be installed prior to construction and marked clearly with maker poles to monitor any construction related impacts;
- Aquifer testing of all new monitoring boreholes drilled to determine hydraulic parameters to improve hydraulic parameter accuracy for future groundwater model updates; and
- Groundwater monitoring of water levels and quality should continue as per WUL no. 03/A21C/FGH/1110 – 24/06/2011 on a quarterly and annual frequency.

7.0 REFERENCES

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Signature Page

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APPENDIX A

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Declaration of Independence by Specialist

I, **Danie Brink**, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

Danie Brink

Appendix G2: Noise Assessment

REPORT

Noise Screening Assessment for the A-Station Decommissioning and Demolition Project

Kelvin Power (Pty) Ltd

Submitted to:

Kelvin Power Station

Submitted by:

Golder Associates Africa (Pty) Ltd.
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August 2022

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- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document.

Record of Issue

Client Contact	Version	Author	Reviewer and Approver	Date Issued	Method of Delivery
Kelvin Power	Draft	N. Reddy	M. Schlechter	March 2022	Electronic Copy
Kelvin Power	Final	N. Reddy	M. Schlechter	August 2022	Electronic Copy

Executive Summary

Overview

Kelvin Power (Pty) Ltd (Kelvin Power) consists of two separate power plants, namely the A-station and the B-station. The A-station was in operation for approximately 60 years, until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into a cleaner technology power plant.

Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), was appointed by Kelvin Power as an independent environmental consulting firm to conduct the environmental regulatory process for the decommissioning and demolition of the A-station power plant situated in the City of Ekurhuleni in Gauteng. This includes conducting or updating a number of specialist studies to inform the Basic Assessment Report (BAR). As such, this report presents the Environmental Noise Screening Assessment on nearby sensitive receptors associated with the Project.

Baseline Assessment

The most current noise monitoring data was provided by the Client for the period January to March 2021. Noise monitoring was undertaken at fifteen locations (representative of the prevailing ambient noise levels on the boundaries of the property), with points 14, 15 and 16 consolidated in one measuring point, 340m direct south of MP16. Measurement procedures were undertaken according to the SANS 10103:2008 standards with a Larsen Davis Integrated Sound Level Meter Type 1 and environmental monitoring kit.

During the day, noise levels were below the 70 dB(A) day-time guideline rating level, with the exception of location 8 (above the day-time guideline rating level during January, February and March 2021) and location 9 (above the day-time guideline rating level during March 2021). These exceedances were only slightly above the guideline rating level with a maximum of 1.3 dB(A) in January 2021.

During the night-time, noise levels were below the 70 dB(A) night-time guideline rating level, with the exception of location 8, which was above the night-time guideline rating level during January, February and March 2021. Although above the night-time level, these exceedances were only slightly above the guideline rating level with a maximum of 1.1 dB(A) in March 2021.

Elevated levels of noise at monitoring point 8 and 9 can be attributed to the boilers and cooling towers at the power station, operating under normal circumstances.

It must be noted that the background noise such as traffic noise, aircraft noise in the vicinity of the power station, Gautrain noise, and industrial activities in the vicinity of the power station was excluded from the noise results to assess the noise impact from the power station only.

Impact Assessment

Noise propagation calculations were applied in order to assess the noise climate at the receptor locations. The changes in noise levels at each receptor were calculated and the resultant impact on the communities determined.

Comparisons of the existing (measured noise levels) and proposed (calculated) noise levels at the key specified sensitive receptors (a total of 39 receptors were identified and selected) enabled an assessment of changes in noise levels at these locations as a result of the decommissioning and demolition activities. Such changes were then assessed against the South African National Standard (SANS) community/ group responses in order to assess the anticipated impacts as a result of such increases.

During the day-time, increases in noise levels, from the decommissioning activities at the receptor locations will range from 1.5 to 17.6 dB(A). Such increases will result in “little” to “very strong” community response when the activities are occurring in closest proximity to each of the locations. It is likely that complaints will arise from receptors 1, 2, 4, 6, 7 and 8 given their proximity in location to the decommissioning and demolition activities. It must be noted that this is a worst-case scenario, which is unlikely to occur in reality.

All impacts of the proposed project were also evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology.

- During the decommissioning and demolition phase, the impact is predicted to be “moderate” at receptors 1, 2, 4, 6, 7 and 8 (Figure 2), given their proximity in location to the decommissioning and demolition activities, whilst the impact is predicted to be “low” at the remaining receptors.

Conclusion and Recommendations

Based on the findings of the assessment, Golder’s professional opinion is that this project can be authorised with the recommended mitigation measures implemented and adhered to, especially when working in close proximity to receptors 1, 2, 4, 6, 7 and 8. It is further suggested that a noise survey be conducted monthly over the decommissioning and demolition phase at receptors 1, 2, 4, 6, 7 and 8 to establish the noise levels during this period and to ensure that noise is kept within acceptable limits. Should noise levels exceed the limits additional noise mitigation measures may need to be implemented and adhered to.

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1.0 INTRODUCTION

Kelvin Power (Pty) Ltd (Kelvin Power) consists of two separate power plants, namely the A-station and the B-station. The A-station was in operation for approximately 60 years, until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into a cleaner technology power plant.

Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), was appointed by Kelvin Power as an independent environmental consulting firm to conduct the environmental regulatory process for the decommissioning and demolition of the A-station power plant situated in the City of Ekurhuleni in Gauteng. This includes conducting or updating a number of specialist studies to inform the Basic Assessment Report (BAR). As such, this report presents the Environmental Noise Screening Assessment on nearby sensitive receptors associated with the Project.

1.1 Terms of Reference

The terms of reference, for the assessment are summarised below:

- A baseline assessment of the current noise climate for the Project;
- Compilation of an noise inventory to account for all sources of noise during the decommissioning and demolition phase of the Project;
- Noise propagation calculations to determine the impact of the noise during the decommissioning and demolition phase of the Project;
- Submission of an Environmental Noise Screening Assessment report (this report), detailing all findings from the baseline assessment, noise inventory and noise calculations; and
- Recommendations on the scope of any mitigation measures that may be applied to reduce noise associated with the Project, if deemed necessary.

2.0 PROJECT BACKGROUND

2.1 Locality

Kelvin Power is located in the City of Ekurhuleni and is situated adjacent to, but west of the Zuurfontein Road. The power station is also approximately 5 km north-west of the O.R. Tambo International Airport (Portion RE 82 Farm Zuurfontein 33IR). The total extent of the plant is 226.18 ha and the surrounding neighbouring properties zoning description can be classified as industrial. The location map is presented in Figure 1.

2.2 Project Description

The battery limits for the decommissioning and demolition of the A-station power plant will include:

- The A-station boiler house, turbine house and associated two stacks;
- Three cooling towers;
- Workshops and storage facilities;
- External Stockpile A;
- Dry coal storage;
- Old switch yard or high voltage yard; and
- Train wagon tippler or rail tippler.

The current project scope does not include the decommissioning of any waste management facilities as the one currently on site are still in use by the B-station power plant.

2.3 Sensitive Receptors

Noise impacts are typically experienced at relatively close proximities to the emitting source. The noise sensitive receptors considered by South African National Standard (SANS 10328:2008) include residential dwellings, institutional and culturally important sites, such as schools, hospitals and places of worship. Kelvin Power is surrounded by neighbouring commercial and residential properties. These receptors are presented in Table 1 and illustrated in Figure 2.

Table 1: Sensitive receptor locations for the Project

No.	Sensitive Receptor	UTM mE	UTM mS	Direction from Site
1	Esther Park	618794	7111886	North
2	Croydon	619233	7109996	South
3	Spartan	619937	7110847	East
4	Sebenza Area 1	618334	7110119	South-west
5	Sebenza Area 2	618003	7110713	West
6	Cresslawn Residential Area	619870	7111151	North-east
7	Cresslawn Primary School	620596	7111060	East
8	Kempton Park - Kelvin Estate	619629	7110497	South-east
9	African Dream Family Church	618211	7108681	South-south-west
10	Allen Grove	623191	7114644	North-east
11	Bushwillow Park	616329	7111329	West-north-west
12	Citraville AH	621998	7115664	North-east
13	Cresecondarylawn Primary	620900	7110962	East
14	Eastleigh	615623	7109504	West-south-west
15	Eden Glen	616901	7109334	North-west
16	Edenglen High School	617593	7108688	South-south-west
17	Edenvale	615270	7108153	South-west
18	Emerald Estate	615477	7111357	West-north-west
19	Founders Hill	617420	7112050	North-north-west
20	Greenstone Hill	615589	7110697	West
21	Greenstone Park	614515	7110985	West
22	Hoerskool Jeugland	621454	7115271	North-east
23	Hurlyvale	616579	7107204	South-west

No.	Sensitive Receptor	UTM mE	UTM mS	Direction from Site
24	Illiondale	616775	7111102	West-north-west
25	Intokozo AH	618482	7114701	North
26	Isando	620829	7108336	South-east
27	Jet Park	621872	7106885	South-east
28	Kempton Park West	618686	7114256	North
29	Laerskool Edleen	620585	7113447	North-north-east
30	Laerskool Kreft	623639	7112702	East-north-east
31	Lakeside	614889	7112744	North-west
32	Meadowdale	618072	7107093	South-South-west
33	Restonvale AH	620429	7115854	North-north-east
34	Rhodesfield	623117	7110531	East
35	Sir Pierre Van Reyneveld High School	622642	7112812	East-north-east
36	Terenure	619575	7114716	North-east-north
37	Terenure AH	620184	7114849	North-east-north
38	Thornhill Estate	615194	7112246	North-west
39	Van Riebeeck Park	621766	7115054	North-east

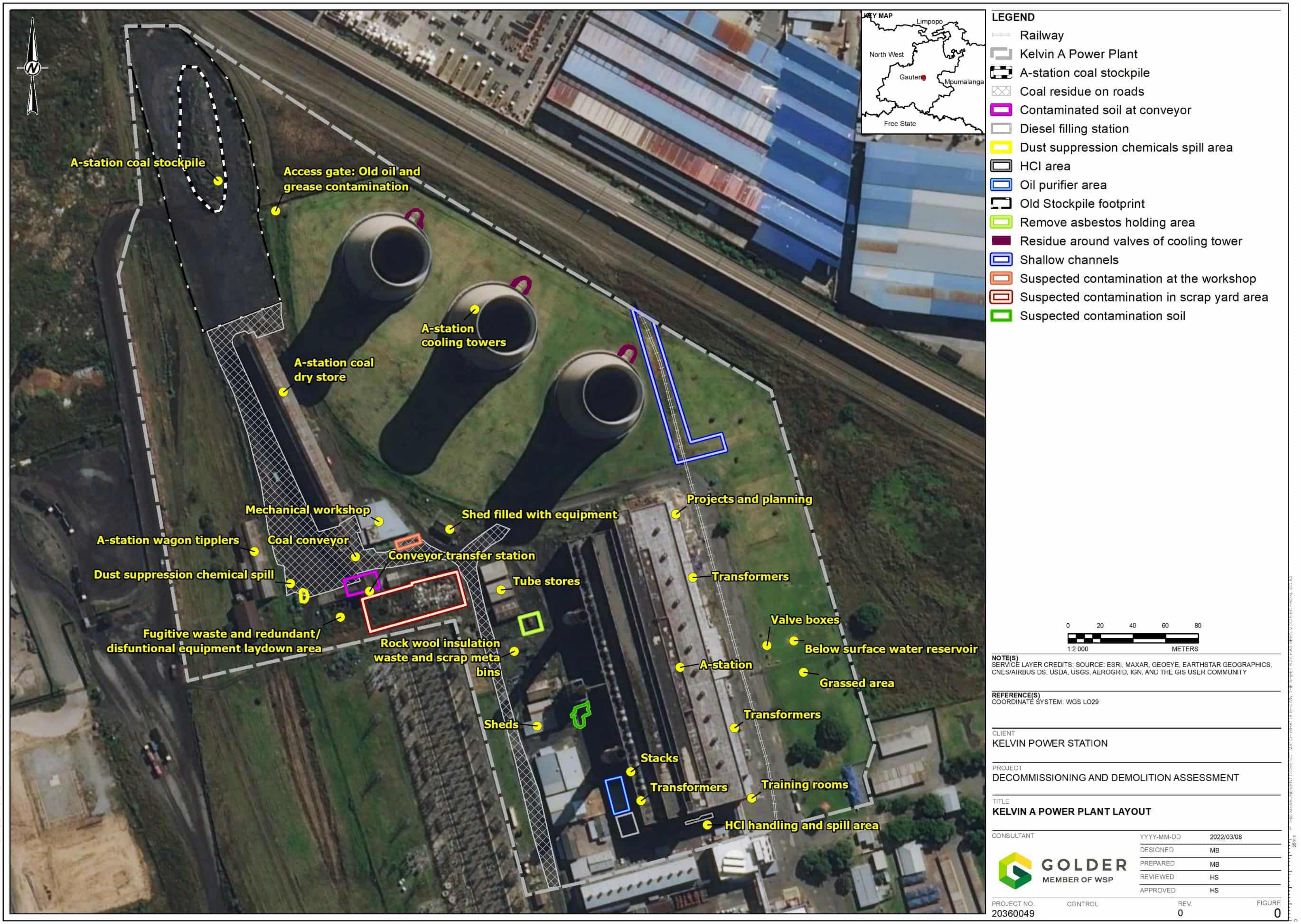

Figure 1: A-Station plant layout

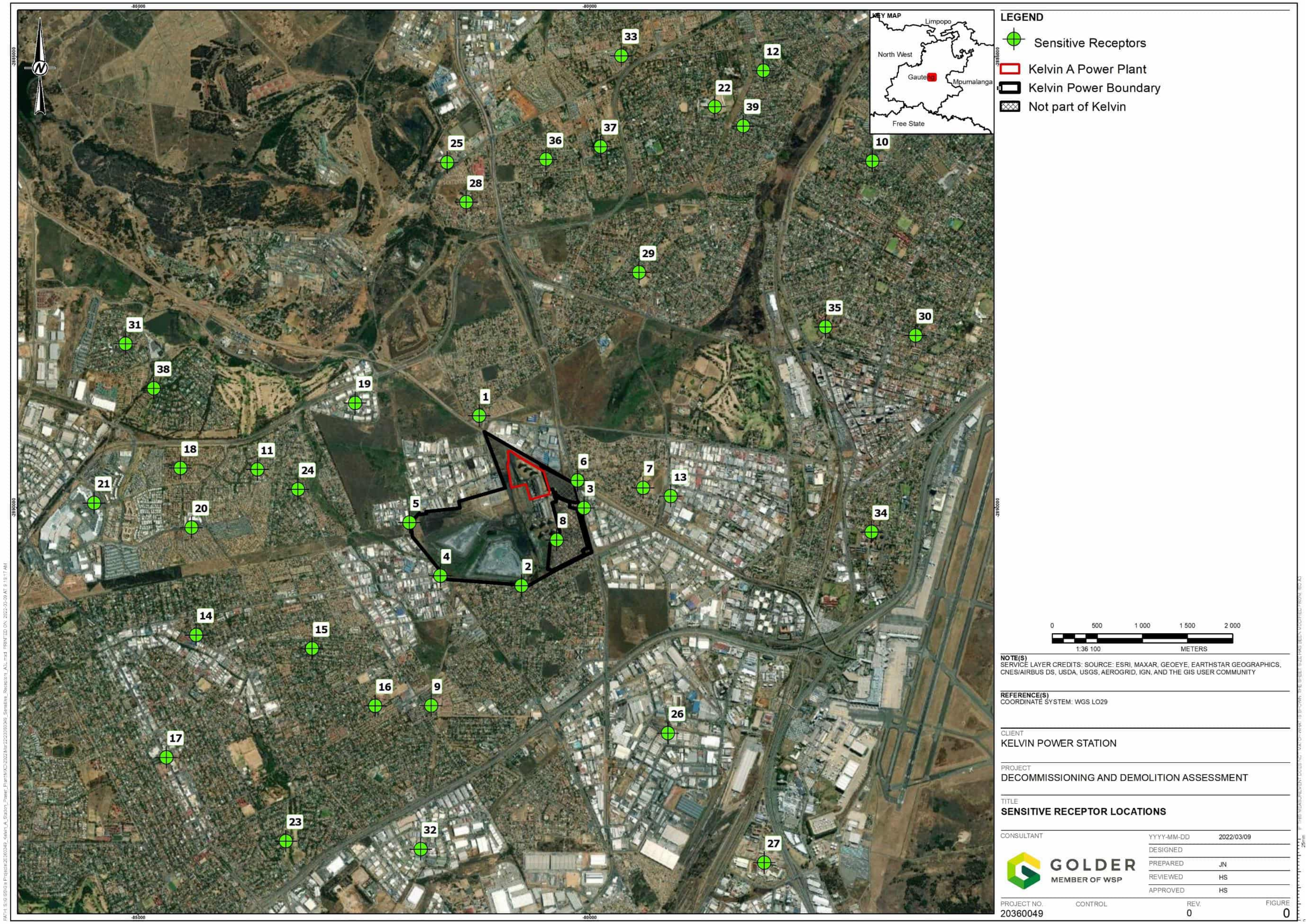

Figure 2: Sensitive receptor locations

3.0 NOISE TERMINOLOGY AND EFFECTS

3.1 Noise Terminology

Noise is typically defined as is unwanted sound deemed as unpleasant, loud and/or disruptive to hearing and thus poses a nuisance (Golder, 2019). The accepted range of sound audible to humans is typically from 0 dB to 140 dB and the frequency response of the ear is generally accepted as covering a range of 20 Hz to 20 000 Hz. The ear does not respond equal across all frequencies and is more sensitive in the mid-frequency range than in the low and high frequencies. In order to account for this variation in sensitivity, a weighting filter is applied during noise monitoring. The filter commonly applied is the ‘A weighting’ filter as this filter is an internationally accepted standard for noise measurements to represent the human subjective response to sound.

For noise levels, an increase or decrease of 1 dB(A) is not normally perceptible to most people, although this may be perceptible under laboratory conditions. An increase of 3 dB(A) is normally perceptible. The ‘loudness’ of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10 dB(A) corresponds to a doubling or halving in the perceived loudness.

Noise levels are rarely steady but fluctuate according to the surrounding activities. The relevant noise parameter to this assessment is the L_{Aeq} level. The L_{Aeq} level is the equivalent continuous A-weighted sound pressure level, expressed in decibels. The L_{Aeq} level is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of many other forms of environmental noise.

3.2 Effects of Noise

Noise generated as a result of Project activities can result in an increase in ambient noise levels across the study area. The effects of this increase in noise will depend on the level of increase.

Typical sound levels (dB(A)) are shown in Figure 3 for reference.

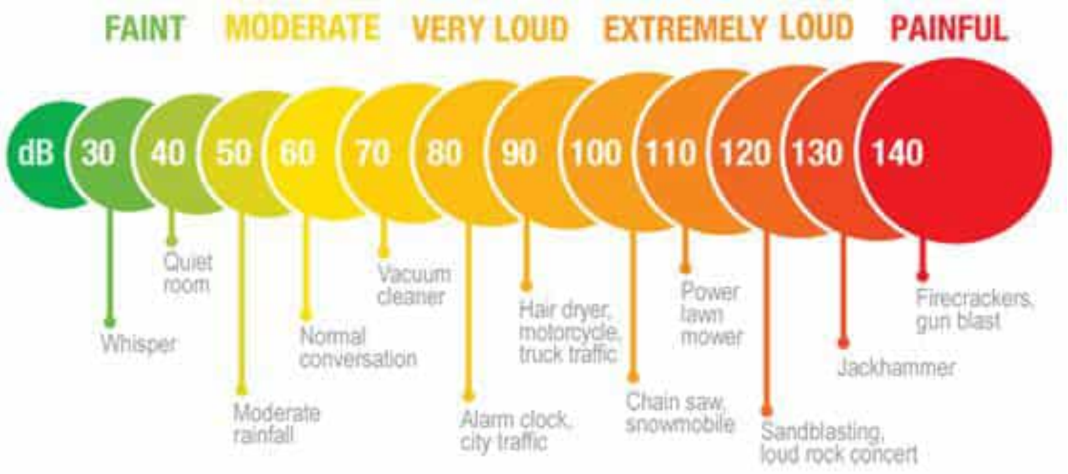

Figure 3: Typical sound levels (source: https://sites.google.com/site/laurenmcnanyspln/sound?mobile=true, July 2016)

4.0 LEGISLATION, STANDARDS AND GUIDELINES

4.1 South African National Standard

The SANS Method for noise assessments (SANS 10328:2008) provide a method for evaluating the noise impact of a proposed development. It is an umbrella document and makes many references to SANS 10103:2008 The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS 10103:2008).

The SANS 10103 Code of Practice provides typical ambient noise rating levels ($L_{Req,T}$) in various districts. The outdoor ambient noise levels recommended for the districts are shown in Table 2 below.

Further, under the National Environmental Management: Air Quality Act (NEM:AQA), the Noise Control Regulations indicate that "Disturbing Noise" is defined as a noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dB(A) or more.

Table 2: Typical rating levels for ambient noise

Type of district	Equivalent continuous rating level ($L_{Req,T}$) for noise (dB(A))					
	Outdoors			Indoors, with open windows		
	Day night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$	Day night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Note: For industrial districts, the LRdn concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24-hour day/night cycle LReqd = LReqn = 70.0dBA can be considered as typical and normal.

SANS 10103 provides criteria, for evaluating the community or group response to a noise source, these are presented in Table 3.

Table 3: SANS 10103 categories of community or group response

Excess, $\Delta L_{Req,T}$ dB(A)	Category	Description
0 to 10	Little	Sporadic complaints
5 to 15	Medium	Widespread complaints
10 to 20	Strong	Threats of community or group action

Excess, $\Delta L_{Req,T}$ dB(A)	Category	Description
>15	Very Strong	Vigorous community or group action

SANS 10103 provides three methods for determining the excess level ($\Delta L_{Req,T}$) of a proposed development:

- $\Delta L_{Req,T} = L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the Residual noise (determined in the absence of the Rated noise, i.e. the specific noise under investigation);
- $\Delta L_{Req,T} = L_{Req,T}$ of ambient noise under investigation MINUS the typical Rating level for the applicable district as determined from Table 3 of SANS 10103:2008; or
- $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation.

4.2 Standards Applicable to this Assessment

Kelvin Power is located in a district where the ambient noise is influenced by industrialisation. It is thus appropriate to assess the noise impacts of the Project against the industrial guidelines (SANS 10103) taking not that for industries legitimately operating in an industrial district during the entire 24-hour day/night cycle $L_{Reqd} = L_{Reqn}$ can be considered as typical and normal. As such, typical ambient levels in the area are rated as 70 dB(A) (day-time) and 70 dB(A) night-time, respectively.

5.0 METHODOLOGY

5.1 Plant Noise

The most current noise monitoring data was provided by the Client for the period January to March 2021. Noise monitoring was undertaken at fifteen locations (representative of the prevailing ambient noise levels on the boundaries of the property), with MPs 14, 15 and 16 consolidated in one measuring point, 340m direct south of MP16. These locations are presented in Figure 4.

Measurement procedures were undertaken according to the SANS 10103:2008 standards with a Larsen Davis Integrated Sound Level Meter Type 1 and environmental monitoring kit. Measurements were conducted at each monitoring location for daytime (06:00 to 22:00) and night-time (22:00 to 06:00) periods.

During the day, noise levels were below the 70 dB(A) day-time guideline rating level, with the exception of location 8 (above the day-time guideline rating level during January, February and March 2021) and location 9 (above the day-time guideline rating level during March 2021). These exceedances were only slightly above the guideline rating level with a maximum of 1.3 dB(A) in January 2021.

During the night-time, noise levels were below the 70 dB(A) night-time guideline rating level, with the exception of location 8, which was above the night-time guideline rating level during January, February and March 2021. Although above the night-time level, these exceedances were only slightly above the guideline rating level with a maximum of 1.1 dB(A) in March 2021.

Elevated levels of noise at monitoring point 8 and 9 can be attributed to the boilers and cooling towers at the power station, operating under normal circumstances.

Further, noise impacts from the local noise sources are increased at night as the cooler temperatures allow noise to more efficiently reach the monitoring points. Wind speed and direction also play a role in determining baseline noise levels. Noise monitoring is usually discouraged when wind speeds exceed 5 m/s (>18 km/h) as wind noise distorts the baseline noise levels by masking other noise sources. However, no wind speeds exceeded 5 m/s during the monitoring period.

It must be noted that the background noise such as traffic noise, aircraft noise in the vicinity of the power station, Gautrain noise, and industrial activities in the vicinity of the power station was excluded from the noise results to assess the noise impact from the power station only.

Importantly, no monitoring was conducted at the receptors to obtain an understanding of background noise levels at these receptors. However, as a worst-case scenario, monitoring location 10 was utilised to obtain ambient noise levels for this study, given its proximity to the residential area nearby.

Figure 4: Noise monitoring locations

Table 4: Noise ambient monitoring results

SR No.	Dates	Measured Sound Pressure Level (dBA)					
		Day-time Period			Night-time Period		
		L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
1. Northern boundary of the property	January 2021	43.8	47.7	41.9	46.4	47.7	45.7
	February 2021	47.7	50.6	46.0	44.8	50.6	38.5
	March 2021	48.5	51.4	46.1	47.8	55.2	45.2
2. Northern boundary of the property	January 2021	45.2	65.9	42.8	46.1	49.8	45.5
	February 2021	48.5	50.6	46.4	47.9	55.2	42.4
	March 2021	45.8	48.3	42.5	47.7	50.3	45.2
3. Northern boundary of the property	January 2021	49.6	57.2	46.3	49.2	59.5	47.7
	February 2021	54.6	60.6	52.1	54.6	57.6	52.3
	March 2021	52.5	57.4	49.5	49.5	54.3	47.1
4. Eastern boundary opposite station A	January 2021	51.0	56.3	49.4	52.6	64.0	50.9
	February 2021	56.4	64.0	53.7	54.6	64.3	51.6
	March 2021	53.9	59.7	50.8	51.5	55.1	50.0
5. Eastern boundary at car park	January 2021	53.0	63.0	51.2	54.0	62.1	52.2
	February 2021	57.1	65.0	54.0	56.1	61.6	53.6
	March 2021	57.5	63.0	53.6	53.3	59.4	50.9
	January 2021	58.9	66.2	56.3	57.7	65.3	56.2

SR No.	Dates	Measured Sound Pressure Level (dBA)					
		Day-time Period			Night-time Period		
		L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
6. Eastern boundary at the entrance to power station	February 2021	58.6	62.9	56.7	58.5	60.7	57.1
	March 2021	59.0	67.2	56.0	57.2	59.7	55.6
7. Eastern boundary opposite station B	January 2021	64.1	72.8	62.3	64.1	67.3	63.1
	February 2021	64.9	71.1	64.0	64.0	65.7	62.8
	March 2021	64.5	74.5	63.0	65.0	67.2	64.1
8. Eastern boundary opposite cooling towers and station B	January 2021	**71.3**	71.8	68.5	**70.9**	71.5	70.5
	February 2021	**70.3**	71.8	68.6	**70.9**	71.7	69.6
	March 2021	**71.0**	71.9	69.9	**71.1**	71.8	69.9
9. South-eastern boundary opposite the cooling towers; Grassed area	January 2021	69.5	69.9	68.5	69.6	69.8	69.4
	February 2021	68.8	72.5	67.5	69.5	70.1	68.8
	March 2021	**70.2**	70.9	69.7	69.2	69.7	68.6
10. Southern boundary at the residential area	January 2021	44.8	64.5	39.9	49.2	60.7	38.3
	February 2021	49.3	59.3	45.5	50.1	59.3	46.7
	March 2021	48.5	51.4	46.7	50.1	61.4	47.2
11. Southern boundary at Ash dam	January 2021	42.7	55.8	37.9	46.6	60.7	40.5
	February 2021	46.6	53.3	43.4	47.2	60.8	44.2

SR No.	Dates	Measured Sound Pressure Level (dBA)					
		Day-time Period			Night-time Period		
		L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
	March 2021	43.3	52.6	40.3	46.4	62.1	40.6
12. South-western corner behind Ash dump	January 2021	49.8	55.3	44.8	48.9	55.6	47.2
	February 2021	49.0	57.5	46.5	57.7	59.8	56.9
	March 2021	46.2	50.2	43.8	46.3	51.0	43.8
13. Western boundary	January 2021	40.7	51.2	37.5	43.0	54.9	39.9
	February 2021	43.1	50.7	41.0	48.7	62.7	42.7
	March 2021	41.9	51.3	38.9	43.7	60.8	39.8
14,15,16. Western side	January 2021	43.5	54.3	41.1	44.3	53.6	41.0
	February 2021	46.4	61.6	43.1	49.6	61.1	44.4
	March 2021	45.0	54.1	41.1	46.3	51.0	43.8
17. Western boundary at hauling vehicles gate	January 2021	50.7	59.0	47.3	51.6	61.5	47.3
	February 2021	54.7	63.9	49.9	63.7	85.2	49.5
	March 2021	46.9	60.0	44.3	49.6	65.8	44.8

5.2 Screening Assessment – Noise Calculations

The equation below calculates the sound power level (PWL), of the Project from the sound pressure level (SPL). The ‘r’ value represents the distance (m) from the source.

$$PWL = SPL - \ 10\, log\frac{2}{4\pi r^2}$$

This logarithmic total noise level was applied to the source of the decommissioning and demolition activities in relation to each receptor and resultant noise levels at specified distances from the site were calculated using attenuation-over-distance noise calculations.

5.2.1 Decommission and Demolition Phase Assessment

In order to represent a worst-case scenario, the PWL from all equipment operating simultaneously, was logarithmically summed together to obtain a cumulative PWL for the operational phase. Table 5 presents a list of potential equipment that will be utilised during the decommissioning and demolition phase of the Project as well as the PWL specifications of the equipment.

During the decommissioning and demolition phase there will be no set locations for certain equipment at a given time. As such, it is assumed that one piece of each equipment will be used simultaneously at a location in the A-station area in closest proximity to the sensitive receptors. Such a worst-case scenario is unlikely to occur in reality. The decommissioning and demolition phase is assumed to be operational during the day-time only (07:30–16:00 from Mondays to Fridays and 07:30-14:00 on Saturdays), as per Client data.

Table 5: Decommissioning and demolition phase equipment and sound power level ratings from the Project

Equipment	Total No. in Operation	No. in Operation (simultaneously)	Sound Power Level (dB(A))
50ton Excavator with shear attachment	1	1	113
33ton Excavator with shear attachment	1	1	113
30ton Excavator with a hydraulic montabert hammer / bucket attachment	2	1	119
20ton Excavator with a bucket attachment	2	1	113
JCB TLB	2	1	108
Payloader	2	1	108
Bobcats	2	1	108
Crusher and screen	1	1	112
Tipper trucks	13	1	108
Pneumatic breakers	12	1	123
Compressor	3	1	103
Gas cutting torches	6	1	107
Super boom cherry picker	1	1	106
Electric chippers	1	1	106

Equipment	Total No. in Operation	No. in Operation (simultaneously)	Sound Power Level (dB(A))
Hand tools	1	1	112
Logarithmic Total			**126**

6.0 ASSUMPTIONS AND LIMITATIONS

In this assessment, various assumptions were made that may impact the results obtained. These assumptions include:

- Decommissioning and demolition phase noise source estimates are based on estimated quantities using sound level data from the British Standards Code of Practice for Noise and Vibration Control on Construction and Open Sites (BS5228-1:2009) database;
- As a worst-case scenario the sum of all the equipment used simultaneously was used in the noise propagation calculation with the noise emanating from the source to each respective sensitive receptor;
- All activities are assumed to be operational during the day-time only (07:30–16:00 from Mondays to Fridays and 07:30-14:00 on Saturdays), as per Client data.

7.0 RESULTS

Resultant noise levels and predicted impacts for day-time at the receptor locations are presented Table 6.

During the day-time (Table 6), increases in noise levels, from the decommissioning activities at the receptor locations will range from 1.5 to 17.6 dB(A). Such increases will result in "little" to "very strong" community response when the activities are occurring in closest proximity to each of the locations. It is likely that complaints will arise from receptors 1, 2, 4, 6, 7 and 8 given their proximity in location to the decommissioning and demolition activities. Further, such increases are well above the 7 dB(A) threshold for annoyance as per the SANS 10328:2008 guidelines for noise. It must however be noted that this is a worst-case scenario, which is unlikely to occur in reality.

Table 6: Predicted changes of the Project operations during the day-time

Receptor		Distance from Nearest Source (m)	Noise Level dB(A)				Estimated Community Response
ID	Description		Predicted	Baseline	Cumulative	Change	
1	Esther Park	550	63.3	47.9	63.5	15.5	Strong to very strong
2	Croydon	890	59.1	47.9	59.5	11.5	Medium to strong
3	Spartan	1360	55.5	47.9	56.2	8.2	Little to medium
4	Sebenza Area 1	930	58.8	47.9	59.1	11.2	Medium to strong
5	Sebenza Area 2	1250	56.2	47.9	56.8	8.9	Little to medium

Receptor		Distance from Nearest Source (m)	Noise Level dB(A)				Estimated Community Response
ID	Description		Predicted	Baseline	Cumulative	Change	
6	Cresslawn Residential Area	430	65.5	47.9	65.5	17.6	Strong to very strong
7	Cresslawn Primary School	760	60.5	47.9	60.8	12.8	Medium to strong
8	Kempton Park - Kelvin Estate	500	64.2	47.9	64.3	16.3	Strong to very strong
9	African Dream Family Church	1440	55.0	47.9	55.8	7.8	Little to medium
10	Allen Grove	4970	44.2	47.9	49.5	1.5	Little
11	Bushwillow Park	1840	52.8	47.9	54.1	6.1	Little to medium
12	Citraville AH	4990	44.2	47.9	49.5	1.5	Little
13	Cresecondarylawn Primary	1290	55.9	47.9	56.6	8.6	Little to medium
14	Eastleigh	2840	49.1	47.9	51.5	3.6	Little
15	Eden Glen	1570	54.2	47.9	55.1	7.2	Little to medium
16	Edenglen High School	1590	54.1	47.9	55.0	7.1	Little to medium
17	Edenvale	3530	47.2	47.9	50.6	2.7	Little
18	Emerald Estate	2700	49.5	47.9	51.8	3.9	Little
19	Founders Hill	1430	55.0	47.9	55.8	7.9	Little to medium
20	Greenstone Hill	2490	50.2	47.9	52.2	4.3	Little
21	Greenstone Park	3590	47.0	47.9	50.5	2.6	Little
22	Hoerskool Jeugland	4420	45.2	47.9	49.8	1.9	Little
23	Hurlyvale	3420	47.5	47.9	50.7	2.8	Little
24	Illiondale	1310	55.8	47.9	56.4	8.5	Little to medium
25	Intokozo AH	3140	48.2	47.9	51.1	3.1	Little
26	Isando	2290	50.9	47.9	52.7	4.8	Little
27	Jet Park	4080	45.9	47.9	50.1	2.1	Little
28	Kempton Park West	2580	49.9	47.9	52.0	4.1	Little
29	Laerskool Edleen	2430	50.4	47.9	52.4	4.4	Little
30	Laerskool Kreft	4360	45.3	47.9	49.8	1.9	Little

Receptor		Distance from Nearest Source (m)	Noise Level dB(A)				Estimated Community Response
ID	**Description**		**Predicted**	**Baseline**	**Cumulative**	**Change**	
31	Lakeside	3770	46.6	47.9	50.3	2.4	Little
32	Meadowdale	3040	48.5	47.9	51.2	3.3	Little
33	Restonvale AH	4630	44.8	47.9	49.7	1.7	Little
34	Rhodesfield	3440	47.4	47.9	50.7	2.8	Little
35	Sir Pierre Van Reyneveld High School	3430	47.4	47.9	50.7	2.8	Little
36	Terenure	3180	48.1	47.9	51.0	3.1	Little
37	Terenure AH	3450	47.4	47.9	50.7	2.7	Little
38	Thornhill Estate	3250	47.9	47.9	50.9	3.0	Little
39	Van Riebeeck Park	4500	45.1	47.9	49.7	1.8	Little

8.0 MITIGATION MEASURES

The methods of mitigating and managing noise for the decommissioning and demolition operations are provided below.

8.1 Decommissioning Phase

To minimise potential noise impacts arising from the decommissioning and demolition operations, the following noise controls are recommended:

- Planning decommissioning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance. Information regarding construction activities should be provided to all local communities. Such information includes:
  - Proposed working times;
  - Anticipated duration of activities;
  - Explanations on activities to take place and reasons for activities; and
  - Contact details of a responsible person on site should complaints arise.
- When working near (within 100 m) a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible;
- Avoiding or minimising Project transportation through community areas;
- Using noise control devices, such as temporary noise barriers and deflectors for high impact activities;
- Strict enforcement of speed limits such as a limit of 20 km/hr, will aid in limiting any additional noise along internal and public roads;
- Selecting equipment with the lowest possible sound power levels;

- All equipment used on the site should be equipped with effective mufflers that are maintained in good condition;
- Direct principal noise sources (e.g. exhausts) away from noise-sensitive places as far as possible;
- Fitting of equipment with effective and properly maintained noise suppression equipment consistent with the requirements of the activity, where possible;
- Ensure equipment utilised is maintained and operated as per manufacturers' specifications;
- The noise level of audible warning devices should be kept to the minimum necessary for the health and safety of employees; and
- Establishing noise deflection walls such as berms.

9.0 IMPACT ASSESSMENT

All impacts of the Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the magnitude, duration, scale , probability and significance of the impacts. A full description of the risk rating methodology is presented in Appendix A. Outcomes of the Environmental Noise Screening Assessment are contained within Table 7. A description of the impacts is provided below.

9.1 Decommissioning and Demolition Phase

During the decommissioning and demolition phase, the impact is predicted to be “moderate” at receptors 1, 2, 4, 6, 7 and 8, given their proximity in location to the decommissioning and demolition activities, whilst the impact is predicted to be “low” at the remaining receptors.

Table 7: Impact assessment summary

Phase	Activity	Impact	Without Mitigation						With Mitigation					
			Magnitude	Duration	Scale	Probability	Significance		Magnitude	Duration	Scale	Probability	Significance	
Decommissioning and Demolition Phase	Decommissioning and demolition phase on receptors 1, 2, 4, 6, 7 and 8	Increased noise levels on sensitive receptors	8	2	2	4	48	Moderate	6	2	2	3	30	Moderate
Decommissioning and Demolition Phase	Decommissioning and demolition phase on all remaining receptors	Increased noise levels on sensitive receptors	4	2	2	3	24	Low	2	2	2	2	12	Low

Note: This assessment considers the impact of noise sources associated with the decommissioning and demolition operations only

10.0 CONCLUSIONS

This report presents the potential noise impacts on the surrounding environment for the Project.

The Environmental Noise Screening Assessment, indicated that:

- During the day-time, increases in noise levels, from the decommissioning activities at the receptor locations will range from 1.5 to 17.6 dB(A). Such increases will result in “little” to “very strong” community response when the activities are occurring in closest proximity to each of the locations. It is likely that complaints will arise from receptors 1, 2, 4, 6, 7 and 8 given their proximity in location to the decommissioning and demolition activities. It must be noted that this is a worst-case scenario, which is unlikely to occur in reality.

All impacts of the proposed project were also evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology.

- During the decommissioning and demolition phase, the impact is predicted to be “moderate” at receptors 1, 2, 4, 6, 7 and 8, given their proximity in location to the decommissioning and demolition activities, whilst the impact is predicted to be “low” at the remaining receptors.

Based on the findings of the assessment, Golder’s professional opinion is that this project can be authorised with the recommended mitigation measures implemented and adhered to, especially when working in close proximity to receptors 1, 2, 4, 6, 7 and 8. It is further suggested that a noise survey be conducted monthly over the decommissioning and demolition phase at receptors 1, 2, 4, 6, 7 and 8 to establish the noise levels during this period and to ensure that noise is kept within acceptable limits. Should noise levels exceed the limits additional noise mitigation measures may need to be implemented and adhered to.

11.0 REFERENCES

1) SANS 10103:2008: South African Standard - Code of practice, SANS 10103:2008, the measurement and rating of environmental noise with respect to annoyance and to speech communication.

2) SABS 10328:2008: South African Standard - Code of practice, SABS 10328:2008, Methods for environmental nose impact assessments.

3) SANS 656: Sound level meters.

4) SANS 658: Integrating-averaging sound level meters.

5) SANS 61672-1 Electroacoustics – Sound level meters – Part 1: Specifications.

6) British Standards Code of Practice for Noise and Vibration Control on Construction and Open Sites (BS5228-1:2009) database.

Signature Page

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APPENDIX A

Impact Assessment Criteria

The significance of each identified impact was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on Environmental Impact Assessment (EIA) Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows.

Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used.

Impact assessment scoring methodology

Probability	Duration
5 - Definite/don’t know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 – Improbable	1 – Immediate
0 – None	
Scale	**Magnitude**
5 – International	10 - Very high/don’t know
4 – National	8 - High
3 – Regional	6 - Moderate
2 – Local	4 - Low
1 - Site only	2 - Minor
0 – None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows.

Significance of impact based on point allocation

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions,

For the methodology outlined above, the following definitions were used:

- ***Magnitude*** is a measure of the degree of change in a measurement or analysis (e.g. the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely recognised standards are to be used as a measure of the level of impact;
- ***Scale/Geographic extent*** refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- ***Duration*** refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- ***Probability*** of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

APPENDIX B

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Appendix G3: Contaminated Land Assessment

REPORT

Contaminated Land Assessment for A-Station

Kelvin Power Station

Submitted to:

Kelvin Power Station
1 x Client
1 x Shareholder

Submitted by:

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Distribution List

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1.0 INTRODUCTION

Kelvin Power (Pty) Ltd (Kelvin) appointed Golder Associates Africa (Pty) Ltd (Golder) to conduct the environmental regulatory process for the decommissioning and demolition of the A-Station Power Plant at the Kelvin Power Station situated in Ekurhuleni Metropolitan Municipality in Gauteng. This includes conducting or updating a number of specialist studies to inform the Basic Assessment Report (BAR).

This report focuses on the contaminated land assessment (CLA). Golder conducted a CLA (Golder report number 1534189-298895-1) for both power plants at Kelvin Power Station in 2015/16. A-Station Power Plant has been under care and maintenance since 2012. As there was minimal process activity since the contaminated land assessment was done, additional sampling was not recommended to inform the BAR.

2.0 OBJECTIVES

The objectives of the CLA are to:

- Formulate a specialist opinion on contaminated land of the A-Station Power Plant informed by:
  - The contaminated land assessment conducted in 2015/16.
  - Visual assessment of the areas of potential concern (AOPC) to confirm the validity of the CLA conducted in 2015/16 for the exposed areas of the plant and identify additional AOPC (if any).
- Develop the scope of work for the assessment of contaminated land and infrastructure to be undertaken during the demolition phase as footprints becomes available which will be recommended as conditions for the authorisation.
- Provide guidance on corrective actions and/or remedial actions that could be undertaken during the demolition phase based on the risk profile of the next land use, assumed to be industrial (power generation site).
- Provide a technical opinion on the nature and extent of the contaminated land and whether a Part 8 of Chapter 4 of National Environmental Management: Waste Act (Act 59 of 2008) (Part 8 of NEM:WA) is likely to be triggered.

3.0 CONTAMINATED LAND ASSESSMENT

3.1 Summary of 2015/16 CLA

In 2015/16, Golder conducted a Phase 1 CLA (Golder report number 1534189-298895-1; Golder, 2016; APPENDIX A) at A-Station and B-Station of Kelvin Power Station in line with provisions in Part 8 of NEM:WA. The section summarises the findings of the CLA related to the A-Station Power Plant.

The dominant soil forms classified for the site is:

- Bainsvlei - deep well drained, dark reddish brown, silt loam, with Mn concretions in the subsoils;
- Mispah - shallow dark reddish brown silt loam soil on hard rock; and
- Katspruit - grey to black clayey soil located in the toeslope to valley bottom position.

The Bainsvlei soil form dominates in the study area (A-Station).

3.1.1 Coal and ash veneer

The CLA (Golder, 2016) concluded that the main source of contamination relates to coal and ash prominent on site. Large areas are covered with a veneer of varying thickness of coal and ash material, even in grassed areas around the A-Station cooling towers where the entire sample profile (1100 mm) consisted of black fine and coarse ash. A major focus should therefore be on assessing whether or not this material needs to be removed based on the CLA (Golder, 2016) and the groundwater assessment (Golder, 2021; Report number 20360049-3408661-1).

Based on the initial soil screening level assessment (targeted samples at each suspected area) the concentration of Fe, Mn, Ni, Cr, Co, Sb, and Cu exceed the Soil Screening Value 1 (SSV1 of the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (GN R.331 of 02 May 2014)[1]) and/or EPA screening values. One sample collected close to the A-Station cooling towers exceeded SSV 1 threshold for As and Pb.

The findings of the assessment indicate that the high levels of Ni and Cr detected in majority of topsoil and subsoil samples are related to site geology, as these constituents are also high in the reference soil samples. This is also the case for the high levels of Fe, Mn, Co, Sb and As.

Water soluble soil screening was also done. Water soluble soil screening values (SSSVs) were derived from South African water quality guidelines for aquatic ecosystem protection and domestic water use and is therefore used as a conservative indication of the potential for migration to the groundwater. A dilution factor (DF) of 20 is included to adjust the screening as in the SA guidelines. Only the water-soluble Fe in the B1 horizon of the soil at A-Station cooling towers, is slightly above the SSSV. All other constituents analysed are below the SSSV.

Given the above and the findings of the groundwater assessment (Golder, 2021; Report number 20360049-3408661-1), the coal and ash veneer does not seem to have a significant impact on the groundwater. The removal of this material, especially from grassed areas is therefore not recommended provided that the next land use remain industrial.

3.1.2 Organic pollutants

The polyaromatic hydrocarbons (PAH) benzo(bk)fluoranthene and dibenzo(ah)anthracene were detected in two samples. These PAHs typically have very low solubilities and remain localised and relatively unchanged as they are recalcitrant. Provided that the next land use remains industrial, no further action is required.

Trichloroethene (TCE) was detected in the surface sample of test pit 7 located close to the A-Station cooling towers. However, no TCE was detected in the deeper samples collected from the same test pit and is therefore likely to be isolated. However, given the partitioning characteristics of TCE, a once of measurement of TCE and daughter products is recommended in groundwater samples collected from groundwater monitoring boreholes in close proximity to the A-Station cooling towers.

Volatile organic compounds were detected in-field using a photoionization detector (MSA Sirius PID) from small 20 mm shallow (33 – 35 cm) drill holes around the diesel dispenser and underground storage area. Kelvin has, by means of the owner of the diesel dispensing infrastructure, initiated the removal of the diesel dispense infrastructure and underground storage tanks. Samples from the soils, removed during the removal of the infrastructure, were analysed to determine the suitability for reuse on site as backfill. The laboratory analytical results of constituents of potential concern (COPCs) indicated that the stockpiled soil is chemically suitable for reuse on site.

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[1] SSV1 of the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (GN R.331 of 02 May 2014): These SSVs are conservative concentrations that are the lowest of three potential source-pathway-receptor model calculations presented in the GN R.331

4.0 SITE OBSERVATIONS AND RECOMMENDED MEASURES

In preparation for the next **industrial** land use, the site observations and proposed measures were tabulated (Table 1). The position of the areas of potential concern (AOPC) are shown in Figure 1. The AOPC (Table 1) are also prioritized according to the perceived risk to the receiving environment with:

🟩	Impact is deemed insignificant for industrial land use
🟨	Impact is low/likely to be low. Corrective actions under duty of care
🟧	Impact is moderate/likely to be moderate. Corrective action including remove source required
🟫	Impact unknown and requires further investigation
🟥	Impact is significant and requires immediate intervention

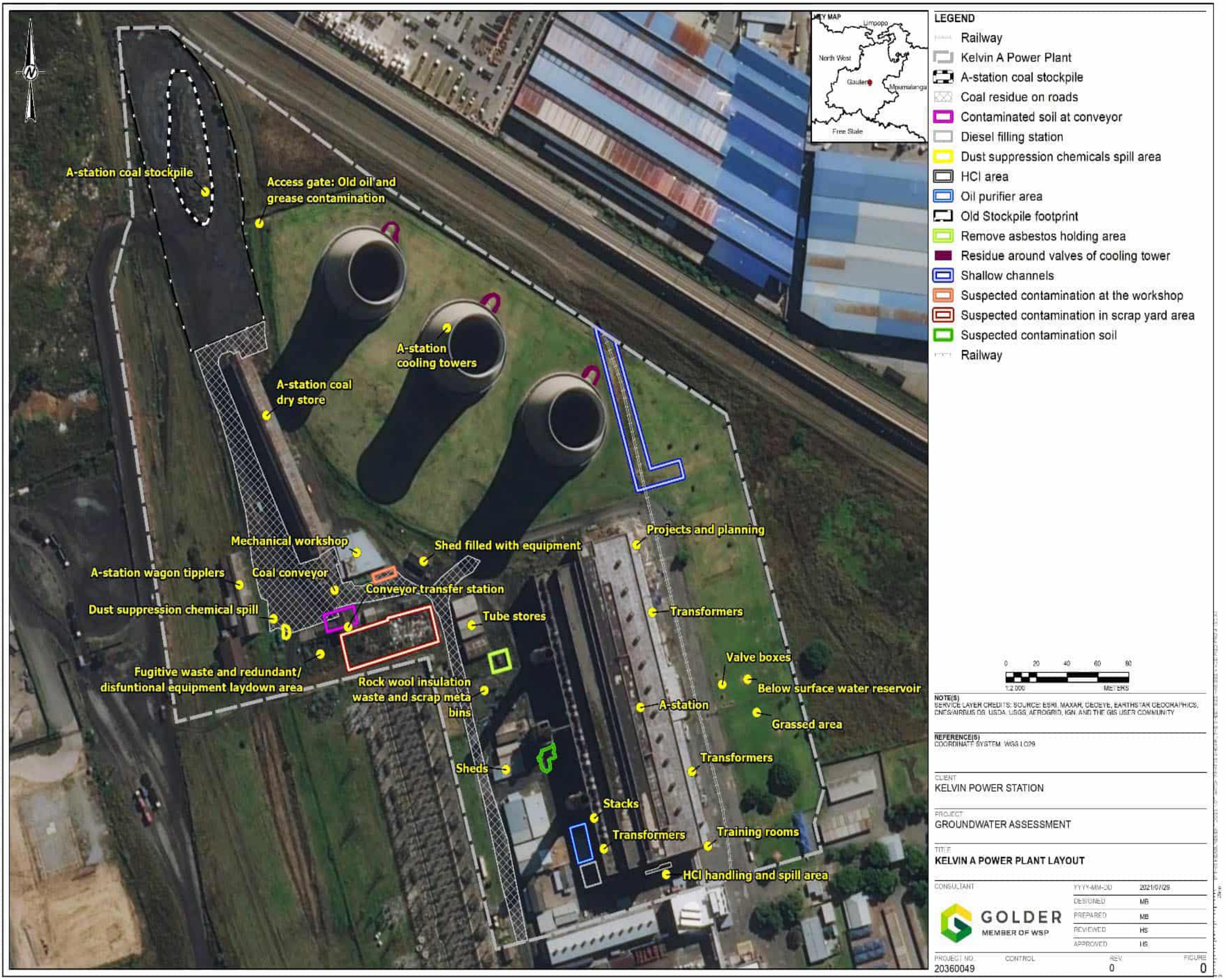


Figure 1: Kelvin A-Station site map

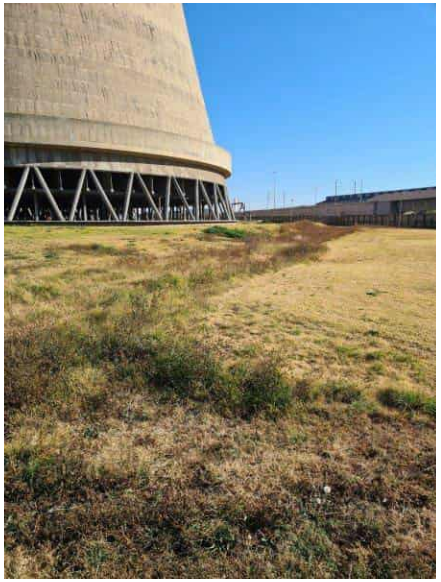
Table 1: Site observations

No	Area description	Findings/observations	Photos	Recommended measures
1	Grassed area east of A-Station	The area is covered with lawn. No stressed vegetation or visible contamination		None
2	Rail line running SSE to NNW along A-Station extending into the grass at the cooling towers	The surface between the railway line and the A-Station show weathering and cracking. Spillages both from the transformers and goods transported and/or offloaded via trains on the railway track could migrate through the cracks and penetrate the sub-soils. Given the age of the plant, poly-chlorinated biphenyl (PCBs) cannot be ruled out.		Assessment of contamination status before demolition: Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected along the area between the railway line and the A-Station. Samples should be analysed for PCBs, poly aromatic hydrocarbons (PAHs) and metals. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.

No	Area description	Findings/observations	Photos	Recommended measures
3	"Newer" transformers located along eastern side of A-Station	Transformer oil leaks. Obvious staining from historic and current transformer oil leaks were observed. Although the transformers seemed fairly new, PCBs cannot be ruled out.	 	This area should be included in the assessment proposed in "2" above
4	Substation with transformers located along eastern side of A-Station	These transformers seem to be part of the original infrastructure. Obvious staining from historic leaks were observed.	 	This area should be included in the assessment proposed in "2" above

No	Area description	Findings/observations	Photos	Recommended measures
5	Substation/ transformers located along eastern side of A-Station	Ballasts inside substation. Given the age of the substation, it is reasonable to assume that transformer oils leaked onto the ballasts and floor. These are therefore likely to be contaminated with transformer oils which could contain PCBs.	 	Due to the low volumes, it is recommended that the ballasts be removed and disposed at a hazardous disposal facility during the demolition preperation phase. The floor of the substation must also be cleaned before demolition commenses. Once the concrete is broken, a visual inspection of the subsurface is required to confirm that the sub-station floor was in tact. In the event that the oils leaked through the sub-station floor, dedicated concrete and sub-surface samples are to be collected and analysed for PCBs, PAHs and metals. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of this assessment will determine if additional excavation is required.

No	Area description	Findings/observations	Photos	Recommended measures
6	Projects and planning	The area outside the Projects and Planning office is fenced. The area is filled with fugitive waste, materials, equipment as well as phosphate and caustic containers. The area is paved.	 	The fugitive waste, materials, equipment and chemical containers must be removed and properly disposed, salvaged and/or donated before demolition activities commense.

No	Area description	Findings/observations	Photos	Recommended measures
7	Shallow channel and area around the at cooling towers	The CLA (Golder, 2016) concluded that the main source of contamination relates to coal and ash prominent on site. Large areas are covered with a veneer of varying thickness of coal and ash material, even in grassed areas around the A-Station cooling towers where the entire sample profile (1100 mm) consisted of black fine and coarse ash. No samples were collected in the trench close to the A-Station cooling towers in the 2015/16 contaminated land assessment. However, a similar channel at B-Station was assessed (Golder, 2016). Assuming that the same activities and hence impact is expected when comparing the cooling towers of A-Station with those of B-Station. Although the ash layer could be considered a source, removing this layer from such a large area could have a greater environmental impact (ito, transport, greenhouse gas	  Photo (Golder, 2016) showing the material that was augered in proximity of the Station A cooling towers. The entire profile (1100 mm) consisted of black fine and coarse ash	None

No	Area description	Findings/observations	Photos	Recommended measures
🟩		emissions, landfill airspace required) than leaving it in-situ, especially if the next land use remains industrial. A high-level assessment of the risk associated with leaving the waste layer in-situ was discussed in Section 3.1.1. Based on the outcome of this assessment, it is recommended that the channel and grassed area around the cooling towers not be disturbed apart from “10” below.	 Photo (Golder, 2016) showing the surface layer of ash in the trench of the cooling Towers of Station B.	
🟨 9	Dried sludge at base of cooling towers	-		The dried sludge at the base of the cooling towers should be removed and disposed at an appropriate landfill site before any demolition activities commenses.

No	Area description	Findings/observations	Photos	Recommended measures
10	Residue present around the valves of the cooling towers	There is a thick layer of residue around the valve boxes of the cooling towers. Its characteristics is unknown.	 	Conduct a waste assessment on the residue. Shallow excavation of the residue, followed by disposal at waste disposal facility authorised to accept such waste before commensing with demolition.
11	Old oil and grease at access gate	A relatively small area where old oil/grease residue is visible at the access gate east of the A-Station coal stockpile		Typically, once demolition is completed, the contractors conduct a final inspection and clearance of the site to remove any superficial contimination. It is recommended that the old oil/grease residue observed in this area is removed during this final cleanup.

No	Area description	Findings/observations	Photos	Recommended measures
12	A-Station coal stockpile	The surface of the entire area around the removed coal stockpile is covered with fine to coarse coal. Golder (2016) reported that the surface layer consists of a compacted coal layer on a dark reddish brown silt loam soil with 40-45% rounded stones also mixed with coal and ash throughout the top 700 mm depth. At varying depths throughout the top 700 mm, more clayey material with stones (±5 mm diameter) also occurs. Below the mixture of soil and coal is a dark reddish brown silt loam soil at least 400mm thick, followed by a brown silt loam 200 mm thick.	 	The residual coal and at least the top 300 to 500 mm of the coal/ash veneer will need to be removed. Due to the volumes, landfill disposal is not recommended due to the consequential environmental impact (in terms of transport, greenhouse gas emissions, landfill airspace required). This aspect talks to the waste management plan specialist report which will be developed in partnership with the appointed EPC. *Note to appointed EPC:* *The management of this waste needs dedicated specialist consideration in the waste management plan in which alternatives are considered for all the waste streams (including the demolition waste). This waste, could for example be co-disposed on a dedicated demolition waste on-site facility.* Once the footprint becomes available, a contaminated land assessment and rehabilitation

No	Area description	Findings/observations	Photos	Recommended measures
				study needs to be conducted by a registered soil scientist or contaminated land specialist depending on the future plan for the use of that parcel of land. The depth of the study will depend on the observations made during demolition. It is currently indicated that the future land use will remain industrial and therefore a high level assessment will be sufficient to confirm that the demolision and clean up was completed to an acceptable level. Similarly, a more in depth study and risk assessment will be required if the exposed footprint shows high levels of contamination.

No	Area description	Findings/observations	Photos	Recommended measures
13	A-Station coal dry store	Fine coal has accumulated between the supporting pillars of the coal dry store. These compartments also became storage areas for redundant equipment, empty drums etc.	 	The fine coal will need to be removed and managed in the same manner as described in “12” before demolition commenses.
14	Coal veneer covering haul roads to the west of the A-Station coal dry store	The surface of the entire area around the Dry Coal Store and the roads are covered with a residue of coal and ash. Golder (2016) describes the results of a test pit excavated in this area. The depth of overlying ash and coal is approximately 700 mm. This ash and coal mixed is strongly compacted. Below the ash and coal mixture, a 300 mm thick dark brown silty loam soil with approximately 20% coarse fragments, on a dark reddish brown silty loam soil	 	The residual coal and at least the top 300 to 500 mm of the coal/ash veneer will need to be removed and managed as described in “12”.

No	Area description	Findings/observations	Photos	Recommended measures
		with 10% coarse fragments. Both soil horizons have Mn concretions.	Photo on the right shows the profile of the test pit excavated in this area (Golder, 2016)	
15	A-Station wagon tipplers	There is a coal veneer covering the surface along the tippler railway and around the A-Station wagon tipplers. Based on the findings of the contaminated land assessment (Golder, 2016) the impact does not seem to have a significant impact on the groundwater. The removal of this material, especially from grassed areas is therefore not recommended provided that the next land use remain industrial.	 	None

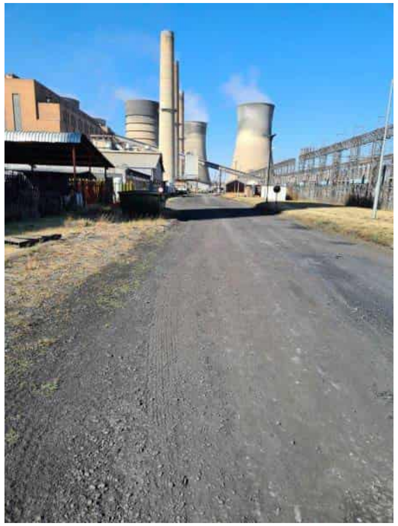
No	Area description	Findings/observations	Photos	Recommended measures
16	Dust suppression chemical storage and pump area (between tipplers and dry coal store)	Dust suppression chemical spillages. The active ingredient is Sodium Lignosulphonate sold under the trade name Hydrotac (M) Liquid by Dust-a-Side. Safety data sheet (SDS) in APPENDIX B.	 	Kelvin power should follow the instructions on handling of spillages as presented in the SDS (APPENDIX B). This should be addressed as soon as practically possible and not be delayed until demolition commences.
17	Coal conveyor	Potentially contaminated soil around conveyor. Redundant equipment laying around in this area. It is not clear what the contaminant of potential concern (PoPC). Apart from the coal, dust suppression liquid and/or oils were spilt in this area.	 	A contaminated land assessment is required in this area once the coal veneer is removed. Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected in this area. Samples should be analysed for the full suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.

No	Area description	Findings/observations	Photos	Recommended measures
				
18	Mechanical workshop	There is visual evidence of oils and grease outside workshop. The inside of the workshop is a concrete floor that is in a good condition. The impacted area is therefore limited.	 	The hydrocarbon contaminated gravel/soils should not be mixed with the demolition waste and therefore requires attention before demolition activities commences. Option 1: Excavate the impacted gravel and soil using a Photo Ionization Detector (PID) to guide the extent of the excavation required. Dispose of the highly contaminated material at a landfill authorised to accept hazardous hydrocarbon contaminated soils.

No	Area description	Findings/observations	Photos	Recommended measures
				Option 2: Assessment of contamination status before demolition commences: Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected along the outside of the mechanical workshop. Samples should be analysed for the full suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.

No	Area description	Findings/observations	Photos	Recommended measures
19	Shed next to mechanical store filled with equipment	The shed has a concrete floor that is in a good condition. No contamination on soils observed.		The redundent equipment needs to be removed and handled as described in 29 below as part of the preperation for demolition.
20	Scrap yard and old equipment laydown/storage area	The area is partly covered in concrete which is in a poor condition. Parts of the area is not covered.	 	The redundent equipment and waste needs to be removed and handled as described in 29 below and followed by a contaminated land assessment. Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected. Samples should be analysed for the full suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use.

No	Area description	Findings/observations	Photos	Recommended measures
				The findings of the assessment will determine if additional measures are required.
21	Removed asbestos holding area	Asbestos removed from the site was held in this area before disposal at a landfill site authorised to accept asbestos containing material (ACM).		All ACM and containers containing ACM were removed from the holding area. Shallow (0 – 30 cm) soil samples should be collected in the asbestos holding area and analysed for asbestos and free fibres. The findings of the assessment will determine if additional measures are required.
22	Western side of A-Station. Cooling equipment.	The equipment (assumed to be cooling equipment) resulted in a residue on ground.		A contaminated land assessment is required in this area. Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected. Samples should be analysed for the inorganic suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.

No	Area description	Findings/observations	Photos	Recommended measures
23	Road covered with coal veneer, west of A-Station	Haul road is covered with a residue of coal and ash.		The residual coal and at least the top 300 to 500 mm of the coal/ash veneer will need to be removed and managed as described in “12”.
24	West side of A-Station. Ash hopper.	The surface below the infrastructure where ash was handled (assumed to be an ash hopper) is covered with a white residue.		A contaminated land assessment is required in this area. Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected. Samples should be analysed for the inorganic suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.

No	Area description	Findings/observations	Photos	Recommended measures
25	Transformers on the western side of A-Station	Spillages from the transformers are possible. Given the age of the plant, poly-chlorinated biphenyl (PCBs) cannot be ruled out.		Assessment of contamination status following demolition: Shallow (0-30 cm) and deeper (50 – 100 cm) soil samples should be collected. Samples should be analysed for PCBs, poly aromatic hydrocarbons (PAHs) and metals. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use. The findings of the assessment will determine if additional measures are required.
26	Oil purifier	The cleaning of used oil for re-use often results in spillages.	 	It is understood that this facility is excluded from the demolition battery limits. However, due to the proximity to other infrastructure earmarked for demolition, an investigation into the potential impact of this area is recommended.

No	Area description	Findings/observations	Photos	Recommended measures
28	Hydrochloric acid spill area	Historic and ongoing hydrochloric acid (HCl) spillages and the eroded surface could have resulted in contamination of the subsurface soils and groundwater. HCl could also result in secondary metal contamination as the acid mobilises metals at low pH.		The area needs to be cleaned with a calcitic lime solution before demolition commenses. Rip impacted soils as the footprints become available and incorporate agricultural lime (crushed limestone; preferably particle size <1 mm). An initial dose of 0.75 kg/m^2 (7.5 ton/ha) is recommended. Measure the soil pH one month after the lime application and repeat the application of lime if required. Collect shallow (0-30 cm) and deeper (50 – 100 cm) soil samples after lime treatment. Samples should be analysed for the inorganic suite listed in GN R331 of 2 May 2014. The analytical data must be interpreted by a competent person considering the residual risk in the context of the next land use.

No	Area description	Findings/observations	Photos	Recommended measures
29	Various: Redundant equipment, fugitive waste	Old drums, flow bins, waste A-Station coal dry store - compartment on the eastern side Fugitive waste and redundant equipment around the A-Station wagon tippler		Redundent equipment, drums and other fugitive waste needs to be sorted at a dedicated temporary lay-down area for: ■ Decontamination ■ Salvaging ■ Re-use ■ Recycling ■ Alianation or donation ■ Disposal
30	A-Station footprint after demolition	Potential: Depending on the integrity of the foundations and hard stands, contamination could have impacted subsurface soils and groundwater beneath A-Station.		A visual inspection of the areas as footprints become available during demolition. Collect samples from potentially impacted soils for analyses to determine if additional measures are required.

5.0 CONCLUSION

This CLA is based on the results of a CLA assessment conducted in 2015/16 (Golder, 2016), the groundwater assessment report (Golder, 2021) and a visual assessment of the areas of potential concern (AOPC) to confirm the validity of the CLA conducted in 2015/16 for the exposed areas of the plant and identify additional AOPC. Thirty AOPC were identified and discussed separately.

Practical measures to be included in the pre-demolition (site preparation) and demolition phase was recommended where sufficient information was available to do so.

Golder (2016) concluded that the main source of contamination relates to coal and ash prominent on site. Large areas are covered with a veneer of varying thickness of coal and ash material, even in grassed areas around the A-Station cooling towers where the entire sample profile (1100 mm) consisted of black fine and coarse ash. A major focus was therefore assessing whether or not this material needs to be removed based on the CLA (Golder, 2016) and the groundwater assessment (Golder, 2021). These studies show that the coal and ash veneer does not seem to have a significant impact on the groundwater. The removal of all this material, especially from grassed areas is therefore not recommended provided that the next land use remain industrial.

However, areas covered in thick layers of residual coal will require the removal of at least the top 300 to 500 mm of the coal/ash veneer. Due to the high volumes, landfill disposal is not recommended due to the consequential environmental impact (in terms of, transport, greenhouse gas emissions, landfill airspace required).

The management of this waste needs dedicated specialist consideration in the waste management plan in which alternatives are considered for all the waste streams (including the demolition waste). This waste, could for example be co-disposed on a dedicated demolition waste on-site facility.

Once the project footprint, post demolition and rehabiltation, becomes available, a contaminated land assessment and rehabilitation study needs to be conducted by a registered soil scientist or contaminated land specialist dependent on the future plan for the use of that parcel of land. The depth of the study will depend on the observations made during demolition. It is currently indicated that the future land use will remain industrial and therefore a high level assessment will be sufficient to confirm that the demolision and clean up was completed to an acceptable level. Similarly, a more in depth study and risk assessment will be required if the exposed footprint shows high levels of contamination.

There are several AOPC where there is insuficient information to pronounce on the impact. These areas will need to be further investigated. This report details the scope of work for the CLA required for areas that need to be assessed before demolition commences and once footprints become available. Given the number of AOPC where the impact is unknown, it is not clear whether a Part 8 of Chapter 4 of National Environmental Management: Waste Act (Act 59 of 2008) (Part 8 of NEM:WA) is triggered or not.

It is recommended that this be clarified with the authorities in order to avoid running several legislative processes.

6.0 REFERENCES

Golder, 2016. Kelvin Power Station Contaminated Land Assessment, Kelvin Power Station (Pty) Ltd. Report number 1534189-298895-1

Golder 2021. Groundwater Impact Assessment of Decommissioning and Demolition of Kelvin Power A Station, Kelvin Power Station (Pty) Ltd. Report number 20360049-3408661-1

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https://golderassociates.sharepoint.com/sites/133264/project files/6 deliverables/final/specialist studies/contaminated land assessment/20360049-347277-3_kelvinstationa_cla2_final_24082022_final.docx

APPENDIX A

Phase 1 Contaminated land assessment completed in 2016 (1534189-298895-1)

April 2016

KELVIN POWER STATION (PTY) LTD

Kelvin Power Station Contaminated Land Assessment

Submitted to:
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REPORT

Report Number: 1534189-298895-1

Distribution:

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Kelvin Power Station (Pty) Ltd	Mr Simphiwe Khuluse	Final	28/04/2016	Email

Executive Summary

Introduction

Kelvin Power Pty Ltd is an independent power producer operating the Kelvin Power Station (Kelvin), a coal fired power station which is located approximately 5 km from the Kempton Park central business district and approximately 20 km from Johannesburg. Kelvin supplies electricity to City Power (Johannesburg Electricity utility).

Golder Associates (Golder) was appointed to conduct an initial land contamination assessment (phase 1), in line with provisions in Part 8 of Chapter 4 of National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA). The assessment is for Station A and B of Kelvin for the plant and all associated facilities.

Approach

On 02 May 2014, the Minister enacted Part 8 of the National Environmental Management Waste Act, 2008 (Act 59 of 2008) (as amended) (NEMWA) and gazetted National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (GN R.331 of 02 May 2014). The GN R.331 provides norms and standards for screening for the identification and registration of contaminated sites, to provide a risk-based decision support protocol for assessing Sites, and to offer a set of guidelines for the preparation and submission of site assessment reports.

Contaminated land legislation in South Africa strongly relates to the polluter pays principle and the tiered (phased) risk assessment approach. In order to discern if a soil is a contaminated soil, contaminant levels are compared with tabulated soil screening levels (SSL). If soil screening levels are exceeded, then a Site-specific risk assessment must be performed. If the outcome of this Site-specific risk assessment indicates that there are unacceptable risks, then the Regulator needs to be informed to decide whether the Site must be remediated (immediately or within a specified period) or does not present an immediate risk, but must be monitored and managed or is not contaminated.

Findings

The site naturally has high Ni and Cr which is attributed to the ultramafic and mafic geology. Of concern are the significantly high Pb and Cu around the Station A Cooling Towers and Baghouse and warrants further assessment to confirm the finding and determine the distribution of these contaminants.

The coal and ash residue on surfaces and roads is a prominent feature on site. The majority of organic constituents detected above the SSL are related to the activities (coal burning) on site. The source of Benzene, Trichloroethene (TCE) and Tetrachloroethene (PCE) is most probably related to detergents used for cleaning oils and grease but needs to be confirmed.

At the Diesel Storage area, the VOC’s were detected close to a manhole of the cemented area covering the tank. The adjusted benzene concentration calculated from the PID reading exceeds the US EPA Vapour Intrusion Screening Level as well as the SSL.

The areas most affected the above constituents of concern are as follows:

- Around Station A cooling towers;
- Sections of Baghouse where concrete has disintegrated;
- Sections of the Workshop where soil is exposed;
- South west of Ash dam B;
- South of Ash dam B;
- Astro Bricks; and
- Diesel Storage area.

Recommendation and conclusion

Based on the above findings and understanding of the site conditions, the significance of the exceedances found does not indicate a risk requiring immediate remediation. Site-specific risk assessment must nevertheless be performed to confirm whether the Regulator needs to be informed about the exceedances. The following aspects should be addressed in the site specific assessment:

- Before conducting additional soil sampling, the data collected for the recent groundwater study should be re-evaluated alongside the analytical results obtained the contaminated land assessment to check whether any of the exceeding constituents (Cu, Pb, benzene, TCE and PCE) in the soil was detected in the groundwater samples of boreholes near the suspected contaminated areas identified above;
- Confirm the extent and distribution of Cu and Pb with depth at the Baghouse and Station A Cooling Towers;
- Confirm the extent and distribution of VOC’s at the workshop; south west of Ash Dam B; south of Ash Dam B and along the outer west boundary of Astro Bricks; and
- Monitor the refuelling of the diesel tanks, checking for occurrence spillages. Also consider an assessment of the integrity of the tank;

Once the extent and distribution of the exceeding constituents are confirmed, notification may be required as per Part 8 of NEMWA Section 36 (5). Moreover, if the findings of the site-specific assessment indicate that a detailed Phase II investigation is required, notification should be considered by Kelvin management and their legal counsel.

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APPENDICES

1.0 INTRODUCTION

Kelvin Power Pty Ltd is an independent power producer operating the Kelvin Power Station (Kelvin), a coal fired power station which is located approximately 5 km from the Kempton Park central business district and approximately 20 km from Johannesburg. Kelvin supplies electricity to City Power (Johannesburg Electricity utility).

Golder Associates (Golder) was appointed to conduct an initial land contamination assessment (phase 1), in line with provisions in Part 8 of Chapter 4 of National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA). The assessment is for Station A and B of Kelvin for the plant and all associated facilities. This report details the approach, results and findings of the Phase 1 Contamination Land Assessment conducted.

2.0 PROJECT OBJECTIVES

The objective of the Phase 1 Contaminated Land assessment is to understand the extent of potential contamination (if any) of land at the two stations at Kelvin and the implications for Kelvin Power in terms of NEMWA Part 8 of Chapter 4.

3.0 APPROACH

On 02 May 2014, the Minister enacted Part 8 of the National Environmental Management Waste Act, 2008 (Act 59 of 2008) (as amended) (NEMWA) and gazetted National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (GN R.331 of 02 May 2014). The GN R.331 provides norms and standards for screening for the identification and registration of contaminated sites, to provide a risk-based decision support protocol for assessing Sites, and to offer a set of guidelines for the preparation and submission of site assessment reports.

Contaminated land legislation in South Africa strongly relates to the polluter pays principle and the tiered (phased) risk assessment approach. In order to discern if a soil is a contaminated soil, contaminant levels are compared with tabulated soil screening levels. If soil screening levels are exceeded, then a Site-specific risk assessment must be performed. If the outcome of this Site-specific risk assessment indicates that there are unacceptable risks, then the Regulator needs to be informed to decide whether the Site must be remediated (immediately or within a specified period) or does not present an immediate risk, but must be monitored and managed or is not contaminated.

GN R.331 of 2014 is supported by the Framework for the Management of Contaminated Land, 2010 (hereinafter called the Framework), and provides the basis for screening of a potentially contaminated site. However, these screening values can also be used to determine the requirement for notification.

The Framework follows a risk based approach in setting screening values for total contaminant concentrations in soil. This approach follows the commonly encountered practice of using three distinct investigation phases:

- Phase 1 – Preliminary site assessment (screening level assessment), using limited investigation and testing, to establish whether land is contaminated or not. If contamination is evident from this investigation, it leads to Phase 2;
- Phase 2 – Detailed investigation of impacted/contaminated areas (sampling and analyses) to determine and evaluate the risk to the receptors. If the risk to receptors are unacceptable, it leads to Phase 3; and
- Phase 3 – Remediation Plan including remediation objectives, targets, measures and options. Feasibility studies and a cost estimate for the different remediation options also form part of Phase 3, to select the best practicable option for implementation.

A schematic representation of this approach is presented in Figure 1. This contaminated land assessment covers a **Phase 1** contaminated land assessment.

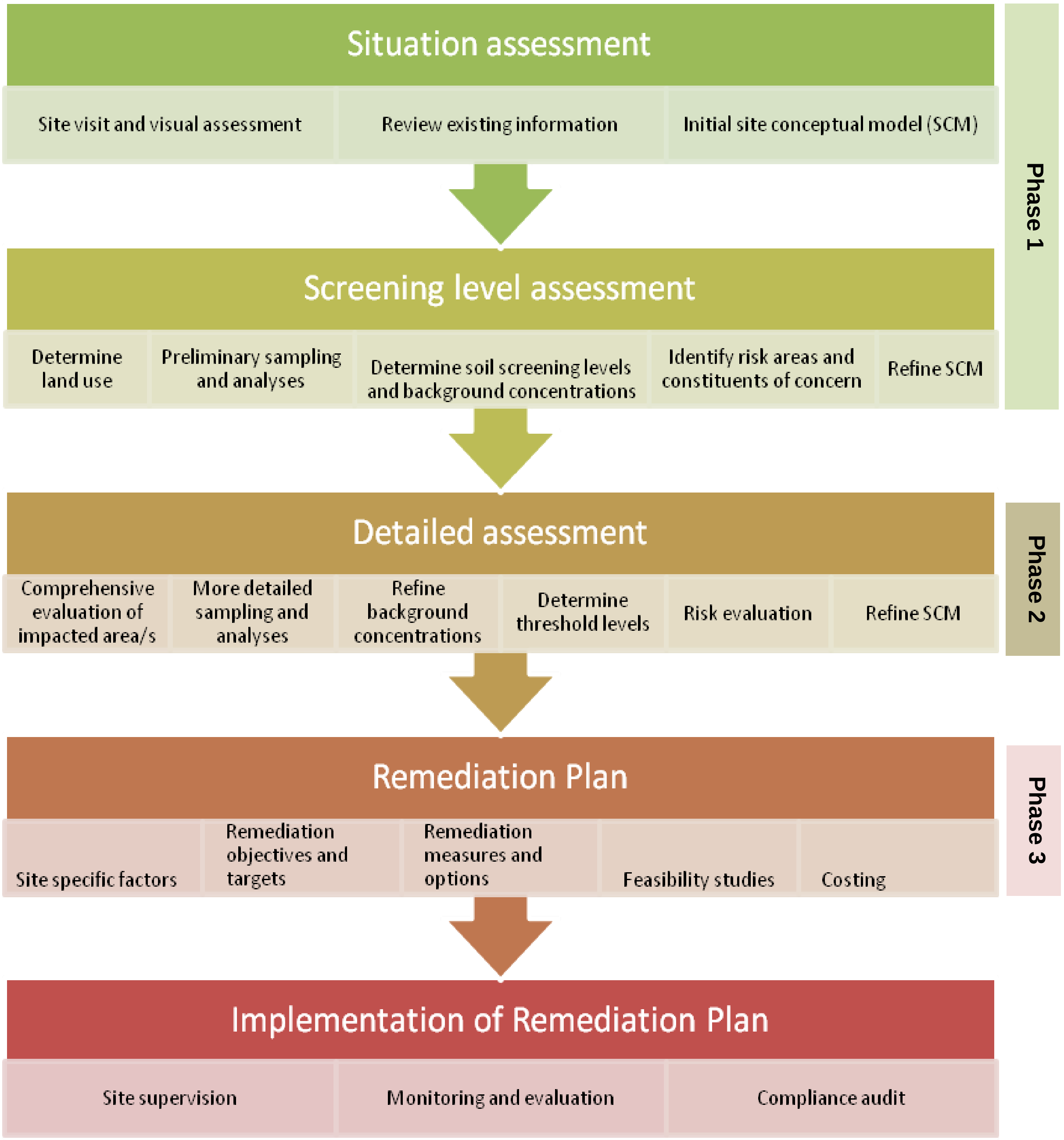

Figure 1: Overall approach to contaminated land assessment and remediation plan development

3.1 Soil screening

Screening was conducted according to the GN R.331. Soil screening values (SSVs) are used to assess whether constituents present in the soils require further in depth assessment:

- SSV1: These SSVs are conservative concentrations that are the lowest of three potential source-pathway-receptor model calculations:
  - Direct pathways for the protection of the child receptor taken as the most sensitive receptor in the context of potentially high exposures anticipated for informal residential settlements in South Africa;
  - Indirect pathway for the protection of water resources in terms of human health based on the ingestion of drinking water. The model for contaminant transfer from soil to water is based on simplified partitioning model with allowance for finite limited dispersion, dilution and attenuation

  within the groundwater-surface water medium, assuming a shallow water table within a typical porous sand aquifer;
  - Indirect pathway for the protection of aquatic ecosystems by applying aquatic eco-toxicology to the same assumptions used to define the soil to surface water pathway used in the calculation of the human health related water resource protection;
  - The SSV1 represent soil values required to achieve Department Water Affairs (DWA) Water Quality Guideline levels for aquatic ecosystem protection and domestic water use, and are consistent both in terms of method of derivation and acceptable risk level applied in development of the existing DWA Water Quality Guidelines;
- SSV2: If no risk to the water resource can be identified, then soil contaminant levels should be compared to SSV2:
  - SSV2 Residential (Informal or Standard): The most sensitive is the child receptor, taken as the sensitive receptor for informal settlements, since the exposure levels for the child on a standard residential development define a slightly higher level of contaminant concentration.
  - SSV2 Commercial/Industrial: Commercial and industrial land use is defined by exposure criteria for an adult maintenance worker based on outdoor exposure criteria.
  - If the values are less than the most appropriate of the three categories of Soil Screening Value 2, then the site is not a risk to human health and is not defined as being contaminated.

For this site SSV1s are used as the groundwater is considered the main water source that could potentially be impacted.

The US EPA Region 9 Soil Screening Levels (SSL), are also included for comparison (http://www.epa.gov/region9/superfund/prg/: updated June 2015) are used. These values are also risk based values and set using a comparable approach than the South African values. However, some differences in underlying assumptions result in differences in the screening values. For example a more stringent cancer risk is used for the establishment of the screening values. The DF (Dilution Factor) in the EPA screening is adjusted to 20 to be comparable to the South African approach and indicated in the Tables for screening purposes. Values for Fe, Cu and As in the EPA screening are set lower than practically occurring in soils and are not used in the interpretation of screening.

Water soluble soil screening indicates the potential for migration to the groundwater. Water soluble soil screening values (SSSVs) are derived from South African water quality guidelines for aquatic ecosystem protection and domestic water use. A DF of 20 is included to adjust the screening as in the SA guidelines.

3.2 Determining baseline concentrations

There is scientific evidence that the screening values published in GN R.331 of 2014 can both over- and underestimate the perceived risk. Assessment of baseline soil concentrations assessment of population distributions was conducted. A number of studies have been conducted estimating baseline concentrations for South African soils. The data from these studies was used to compare the site data with, especially with limited phase 1 data (Herselman, 2007; Herselman *et al,* 2005; Steyn *et al,* 2006 and Herselman *et al,* 2012).

Site specific baseline concentrations were determined for the site. When assessing potential contamination at a site, it is important to get an estimate of the background soil concentration. Background concentrations can be considers as the normal chemical composition of soil in the area prior to its contamination. Understanding the background soil concentration assist in data interpretation and can support in establishing clean-up thresholds. Some important soil background concentration concepts are:

- Baseline concentrations are range values;
- Baseline concentrations are specific to a particular soil type at a particular location; and
- The apparent upper limit of the range of baseline concentrations is referred to as the baseline threshold level.

Statistical analyses of the data are used to identify different populations of the soils in the area. The goal of this analysis tool is to identify which values form part the baseline population and which are anomalous populations with elevated concentrations, such as contaminated soil. The position of the background soil samples collected during the study in the population sets was used to assist with interpretation of the different population sets identified.

3.3 Sampling and analysis

A sampling strategy was prepared for the Kelvin Contaminated Land Assessment (CLA) and was based on a Site Walkover Assessment and review of a recent RSIP and IWWMP prepared for the site. Specific facilities highlighted as having potentially contaminated soils in these reports were included in the CLA sampling strategy. Excavation and assessment of 8 test pits distributed across the site were proposed for the CLA to cover the major facilities on site. The sampling strategy is provided in APPENDIX B. During the actual sampling conducted on 26 - 31 August 2015, only test pits 2, 3, 7 and 8 (9 not indicated on original sampling plan map) were excavated. The remaining test pits were not excavated due to the limited time available for use of the excavator. Hand auger observations and sampling was conducted in areas where tests pits were not excavated.

At each of the identified areas, the following was conducted:

- Inspection of the area to visually identify any traces and sources of contamination;
- Where traces of contamination were suspected, samples were collected of the potential source as well the underlying soil. Areas which were compacted were loosened using a pick, after which a spade or soil auger was then used to collect the sample of the soil underlying the potentially contaminated material. The samples were placed in sealable plastic bags and glass amber jars and stored in a cold storage container before being submitted to Jones Environmental Forensics laboratory for chemical analysis;
- At each sampling point, the point co-ordinates and overall site features were recorded and photographed.

Samples were analysed as follows:

- Total inorganic analysis;
- Total organic analysis on selected samples; and
- Soluble analysis using a 2:1 water to soil ratio.

A total of 35 samples at 19 locations were collected. The facility sampled, sample matrix, sampling depth and sample identification code is listed in Table 1. The location of the sampling points indicated in Figure 2.

In addition to the soil sampling, in-field detection of volatile organic compounds (VOC) was conducted around the concrete area at the Diesel Storage Tank, located behind Station A. VOC's were measured by drilling a total of 12, 30 cm deep boreholes around the concreted area, and measuring the levels of CO_2, H_2S and VOC's using a Sirius Multigas Detector.

Table 1: Samples collected at Kelvin

Facility	Sample ID	Sample Matrix	Depth (upper boundary) (mm)	Depth (lower boundary) (mm)
Station B Coal Stockpile	B-COAL STOCKPILE	Coal	0	850
Station B Cooling Towers	B-TOWERS-PIT-1	Coal	0	400
	B-TOWERS-PIT-2	Soil	400	600
	B-TOWERS-PIT-3	Soil	600	+
	B-TOWERS-AUGER	Ash	0	1000
Station B Dry Coal Store	DRY STORE B	Coal	0	170

Facility	Sample ID	Sample Matrix	Depth (upper boundary) (mm)	Depth (lower boundary) (mm)
Weighbridge &Haul roads	TP9/3	Ash	0	700
	TP9/1	Soil	700	1000
	TP9/2	Soil	1000	1300
Workshop	WORKSHOP-1	Ash + coal	0	200
	WORKSHOP-2	Soil	200	550
Baghouse - Station A	BAGHOUSE-1	Fine sediment	0	110
	BAGHOUSE-2	Fine sediment	110	280
Station A Coal Stockpile	TP8/3	Coal	0	700
	TP8/1	Soil	700	1100
	TP8/2	Soil	1100	1300
Station A Cooling Towers	TP7/1	Soil	0	170
	TP7/2	Soil	170	500
	TP7/3	Soil	500	900
	TP7/4	Soil	900	+
	A-TOWERS-AUGER	Ash	0	1100
Desiltation Reservoir	DESILT	Ash + soil	0	200
Ash Dam B	DAM B-MISPAH	Soil	0	300
	TP2/1	Ash +soil	0	1500
	TP2/2	Soil	1500	+
Ash Dam A	TP3/1	Ash	0	500
	TP3/2	Soil	500	950
Pumphouse	PUMPHOUSE-1	Ash	0	350
	PUMPHOUSE-2	Ash + soil	350	550
Astro Bricks	ASTRO VOC HEAP	Soil?	0	200
	ASTRO COMP	Ash+rock+waste		
Reference Katpruit	REF-WETLAND	Soil	0	700
Reference Mispah	REF-MISPAH	Soil	0	290
Reference Bainsvlei	REF-A	Soil	0	350
	REF-B1	Soil	350	650
	REF-B2	Soil	650	1000

Figure 2: Sample locations

4.0 RESULTS

The presence of coal and ash on site is widespread and in some instances form a prominent feature of the soil profiles. The soil profile descriptions for each observation point were recorded in-field. An illustration of the evaluated profiles is shown below.

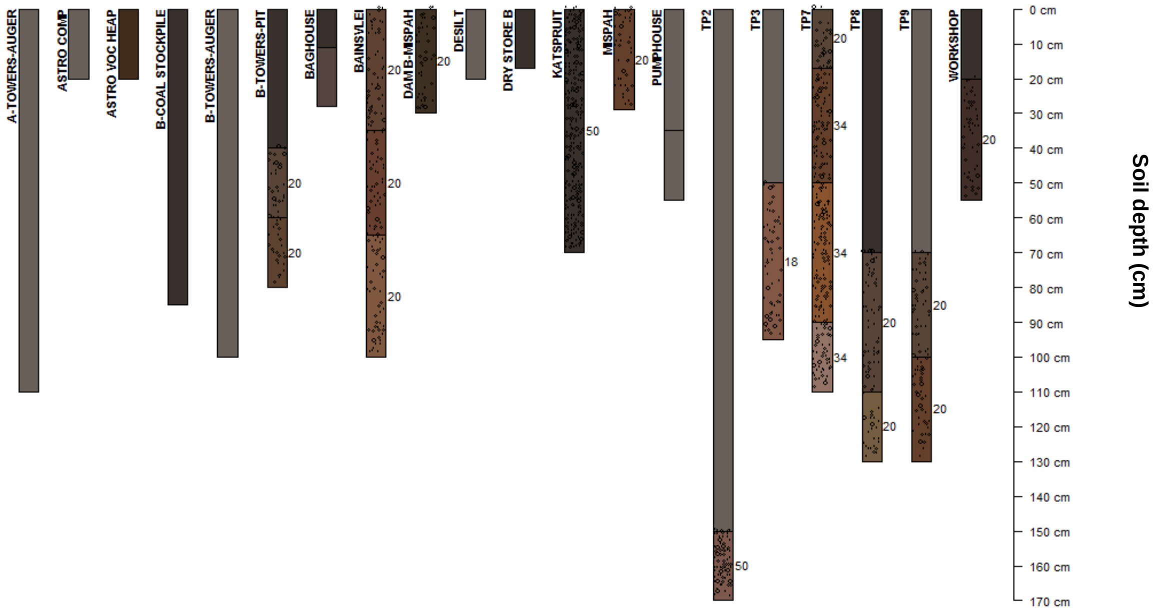

Figure 3: Soil profiles of observation points (test pits and auger samples) for Kelvin Power Station. Grey to black surface layer indicating ash and coal material, shades of brown indicating soil colours identified in-field. Clay percentage is indicated in brackets

The dominant soil forms classified for the site is:

- Bainsvlei - deep well drained, dark reddish brown, silt loam, with Mn concretions in the subsoils;
- Mispah - shallow dark reddish brown silt loam soil on hard rock; and
- Katspruit - grey to black clayey soil located in the toeslope to valley bottom position.

The soil map of the site was generated using the site geology, topography and features noted during the field investigation. The soil map is provided in Figure 4. The observations and descriptions are discussed in sections 4.1.1 to 4.1.18.

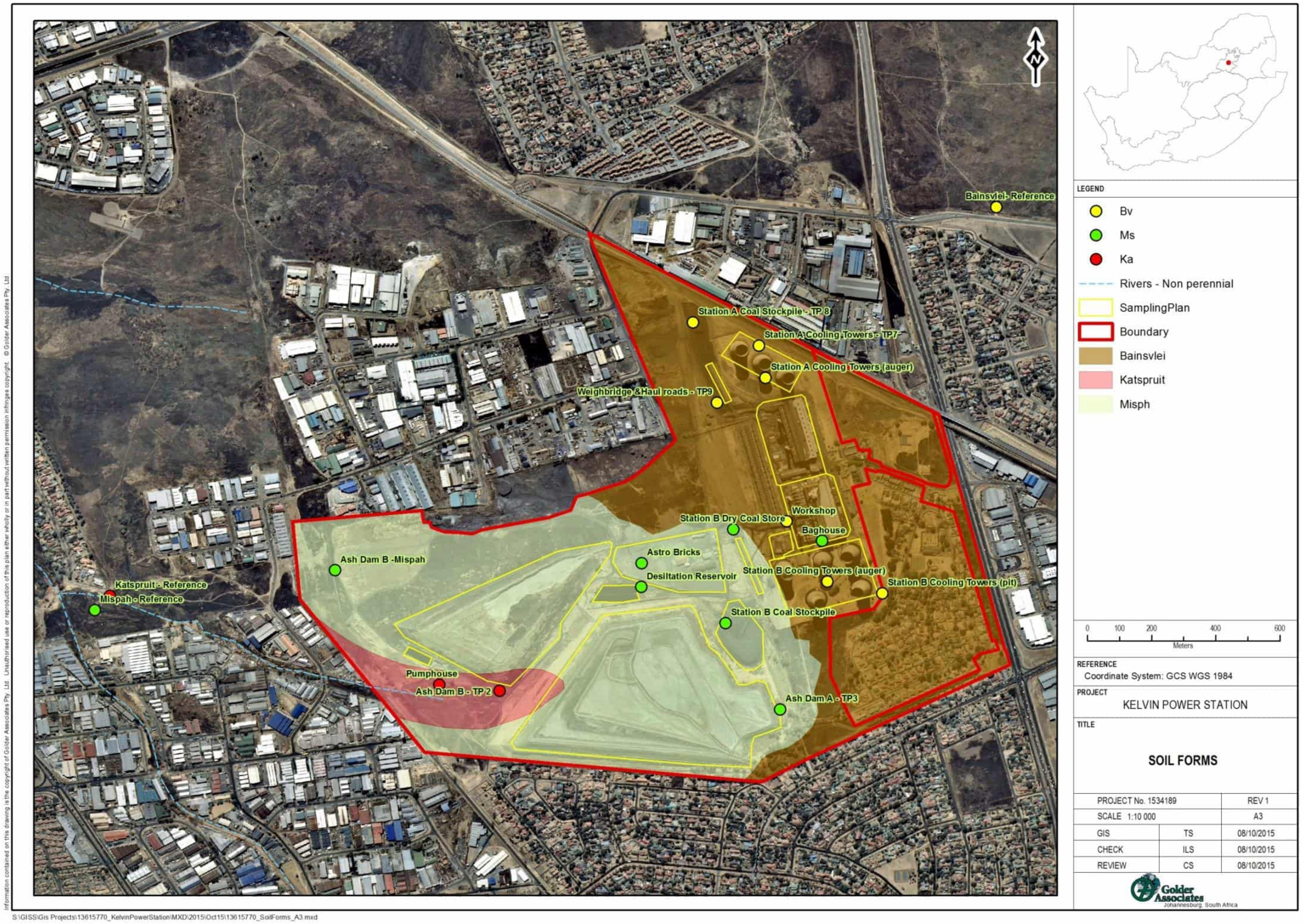

Figure 4: Predicted Soil forms on site

4.1 Site observations

4.1.1 Ash Dam B: Test Pit 2

Test pit 2 was located south of Ash Dam B and west of Ash Dam A, in the toeslope – valley position of the landscape. The surface is moderately compact, with the top 1500 mm consisting of ash mixed with black (GLEY1 2.5/N) clayey soil (Figure 5). Below this layer more distinctive features of gleying are visible, dark grey olive (5 Y 3/2) clayey soil (Figure 6). At approximately 900 mm depth, seepage was observed, increasing in frequency deeper in the soil profile. Samples were collected of the top 0 – 1500mm depth (TP 2/1), as this portion was strongly influenced by ash, and of the gleyed horizon (TP 2/2).

Predicted soil form underlying surface waste material: Katspruit

Figure 5: TP 2- Soil profile

Figure 6: G-horizon of Test Pit 2

4.1.2 Station B Coal Stockpile

The area is located south west of Station B Cooling towers and north of Ash Dam A. The surface consists of a compacted layer of black (GLEY1 2.5/N) fine to coarse coal, followed by more coarse coal throughout a depth of 850 mm, at which free standing water was encountered (Figure 7 and Figure 8). The stockpiles are adjacent to Ash Dam A which is irrigated for dust control. The shallow water table encountered at this position could be attributed to the irrigation of the Ash Dam. A sample was collected of the more coarse coal fraction (*Sample ID: Station B-Coal*).

Predicted soil form underlying surface waste material: Station B Coal Stockpile auger sample position is approximately 300 m, from Test Pit 3. The soil form underlying the coal stockpile is possibly similar to that identified at Test Pit 3, Mispah.

Figure 7: Station B, Coal stockpile

Figure 8: Position of auger sample (Coal stockpile and Ash Dam A in background)

4.1.3 Test Pit 3

Test pit 3 was excavated at the base of Ash Dam A, approximately 300 m from Station B Coal Stockpile, near the partially tarred access road a test pit was excavated. The surrounding wetland grasses/reeds vegetation, occur along the access road near the base of the Ash Dam. The top 500 mm of material consists of black (GLEY1 2.5/N) crumb, medium coarse coal and ash mixture, on a reddish brown (2.5 YR 4.4) loam soil between weathered rock (Figure 9 and Figure 10). (*Sample ID: TP 3/1, TP 3/2*)

Predicted soil form underlying surface waste material: Mispah

Figure 9: Soil profile at Test Pit 3

Figure 10: Prominent iron-staining between weathered rocks throughout profile

4.1.4 Station B Cooling Towers: Auger

On the vacant sections on land between the cooling towers (Figure 11), the site was inspected and the surface material augered to a depth of 900 mm at which impenetrable material was encountered. Throughout the 900 mm depth the material consisted of black (GLEY1 2.5/N) fine and coarse ash. (*Sample ID: B-Towers-Auger*)

Predicted soil form underlying surface waste material: Bainsvlei


31/08/2015

Figure 11: Position of Station B Cooling Towers auger sample

4.1.5 Station B Cooling Towers: Test Pit

Along the southern boundary of the site, an existing test pit was also evaluated and samples collected of the soil horizons underlying the surface layer of ash (Figure 12). The soil profile at this test pit is illustrated in Figure 13 consists of grey, coarse coal and ash mixture 400 mm thick, on 200 mm dark brown (7.5 YR 3/2) layer of soil mixed with ash, followed by a reddish brown (7.5YR 3/3) silty loam soil with little to no signs of coal or ash (Sample ID: B-Towers-Pit1, B-Towers-Pit2, B-Towers-Pit3)

Predicted soil form underlying surface waste material: Bainsvlei


31/08/2015

Figure 12: Trench along southern boundary of site

Figure 13: Station B Cooling Towers - soil profile

4.1.6 Workshop Area

At the workshop area south of Station B (Figure 14, Figure 15), samples was collected at a section where the soil was not covered with concrete (Figure 17) as is the case for most of the workshop area (The top 200 mm consists of black (GLEY1 2.5/N) ash and coal mixture commonly found on site, followed by 300 mm of coarse ash/coal mixed with very dusky red (2.5 YR 2.5/2) silty loam (*Sample ID: Workshop 1, Workshop 2*).

Predicted soil form underlying surface waste material: Bainsvlei

Figure 14: Workshop area

Figure 15: Surface of road along workshop area

Figure 16: Sample position at Workshop area

Figure 17: Ash coal mixture and underlying red soil

4.1.7 Station A Cooling Towers: Auger

The surface around the Cooling Towers is grassed, with few moles heaps occurring frequently (Figure 18). At a section between the Cooling Towers and the access road, the surface material was augered to a depth of 1100 mm. The entire profile consisted of black (GLEY1 3/N) fine and coarse ash (Figure 19). (*Sample ID: A-Towers-Auger*)

Predicted soil form underlying surface waste material: Bainsvlei soil form identified at Test Pit 7, located approximately 100 m north of auger sample position.

Figure 18: Grassed surface at Station A Cooling Towers, with moles heaps.

Figure 19: Material sampled at Station A Cooling Towers

4.1.8 Baghouse

At the Baghouse the concreted surface was inspected for cracks and sections where the concrete has disintegrated. A portion of the concrete at the Baghouse was found to be damaged, and at this section an auger sample was collected (Figure 20 and Figure 21). The profile at the Baghouse consisted of a coarse grey (GLEY 1 3/N) residue/dust, approximately 110mm thick, on very coarse, stony dark reddish grey (2.5 YR 3/1) soil 170 mm thick. Sampling was restricted to 280 mm after which a stony layer was encountered. Around the Baghouse area, Warning Signs indicating that Asbestos is used in the area was noted (*Samples ID: Baghouse 1, Baghouse 2*).

It is noted that during the laying down of concrete a layer of soil mixed with concrete is often used, referred to as "*topping*". It is important to note that the material sampled at the Baghouse could possibly be topping instead of the natural soil. Sampling deeper than the 280 mm was not possible due to the presence of stony, hard layer encountered.

Predicted soil form underlying surface waste material: Mispah


31/08/2015

Figure 20: Position of Baghouse sample


31/08/2015

Figure 21: Auger sample at damaged concrete at Baghouse

4.1.9 Station A Dry Coal Store/ Weighbridge - Test Pit 9

Along the access road to the weighing bridge, heaps of ash was observed. The weighing bridge is located behind Station A Dry Coal Store. The surface of the entire area around the weigh bridge, the Dry Coal Store and the roads are covered with a residue of coal and ash. Close to the entrance of the weigh bridge, near the ash heaps Test pit 9 was excavated. The depth of overlying ash and coal is approximately 700 mm (Figure 22). This ash and coal mixed is strongly compacted. Below the ash and coal mixture, a 300 mm thick dark brown (7.5 YR 3/2) silty loam soil with approximately 20% coarse fragments, on a dark reddish brown (5 YR 3/4) silty loam soil with 10% coarse fragments. Both soil horizons have Mn concretions (Figure 23). Samples were collected of the top 0-700mm depth fraction, 700 -1000 mm depth fraction and the 1000 – 1300 mm soil depth fraction (*Sample ID: TP 9/1, TP 9/2, TP 9/3*).

Predicted soil form underlying surface waste material: Bainsvlei

Figure 22: Profile at Test Pit 9


27/08/2015

Figure 23: Mn-concretions found in soil underlying coal-ash mixture at Test pit 9

4.1.10 Ash Dam B

South West of Ash Dam B, the soil surface was inspected and was found to have a thin layer of ash on the soil surface. The soil consists of a very dark brown (10 YR 2/2) silty loam soil, approximately 300 mm deep on hard rock (Figure 24). Along the north western section Ash Dam B rocky outcrops are common, with heaps of ash/coal also common (Figure 25). A sample was collected of the A horizon. (*Sample ID: Dam B-Mispah*)

Predicted soil form underlying surface waste material: Mispah


31/08/2015

Figure 24: Ash Dam B- auger sample position

Figure 25: Ash coal heaps common along rocky outcrop area of site new Ash Dam B

4.1.11 Station A Coal Stockpile: Test Pit 8

The Coal Stockpile is located north of the Dry Coal Store and the weighing bridge. The surface of the entire area around remaining Coal Stockpile is covered with fine to coarse coal. A test pit was excavated at the base of the remaining Coal Stockpile (Figure 26) to a depth of 1100 mm. At the base of the test pit, further soil auger samples were inspected to an additional depth of 200 mm at which hard rock was encountered. The surface layer consists of a compacted coal layer (Figure 27) on a dark reddish brown (5 YR 3/2) silt loam soil with 40-45% rounded stones also mixed with coal and ash throughout the top 700 mm depth. At varying depths throughout the top 700 mm, more clayey material with stones (±5 mm diameter) also occurs. Below the mixture of soil and coal is a dark reddish brown (5 YR 3/2) silt loam soil at least 400mm thick, followed by a brown (10 YR 4/3) silt loam 200 mm thick (Figure 28). (*Sample ID: TP 8/1, TP 8/2, TP 8/3*)

Predicted soil form underlying surface waste material: Bainsvlei

Figure 26: Location of Test Pit at Station A Coal Stockpile

Figure 27: Test pit profile consisting of coal mixed with soil

Figure 28: 1100-1300mm fraction collected by means of auger

4.1.12 Station A Cooling Towers: Test Pit 7

North of Station A Cooling Towers, Test pit 7 was excavated to a depth of 1000 mm, after which a soil auger was used to inspect the soil a further 300 mm. The soil profile consists of a thin loose dark brown (7.5 YR 3/2) silt loam Orthic A horizon with 20% stones, followed by a thin layer of a whitish crumb material occurring at small sections in the profile, on 330 mm thick, firm dark reddish brown (5 YR 3/4) silty clay loam B1-horizon (Figure 29). Below the B1-horizon is a 400 mm friable yellowish red (5 YR 4/6) silty clay loam, on a 400 mm thick friable reddish brown (2.5 YR 5/3) silty clay loam. All B horizons have approximately Mn-concretions (Figure 30), increasing in abundance deeper in the profile. (*Sample ID: TP7/1, TP7/2, TP7/3, TP7/4)*

Predicted soil form: Bainsvlei

Figure 29: Soil profile at Test Pit 7

Figure 30: Mn concretions in B horizon

4.1.13 Desilting Reservoir Area

The area around the desilting reservoir also has the residue of ash on the surface. Rock outcrops, within a thin layer of soil are also common around the desilting reservoir (Figure 31 and Figure 32). The stony very dark grey (GLEY 1 4/N) soil layer approximately 200 mm thick is mixed with the ash residue. (*Sample ID: DESILT*).

Predicted soil form underlying surface waste material: Mispah

Figure 31: Desilting reservoir

Figure 32: Rock outcrop at desilt reservoir

4.1.14 Pumphouse

The Pumphouse is located south west of Ash Dam B, in the toeslope-valley position of the landscape. The soil surface around the Pumphouse is covered with the ash residue. The sample was taken along the southern boundary of the Pumphouse (Figure 33) at the 0-350 mm and 350 -550 mm depth. The entire profile is mixed with fine ash (Figure 34) decreasing in intensity deeper down the profile (*Sample ID: Pumphouse 1, Pumphouse 2*).

Predicted soil form underlying surface waste material: Katspruit. This position is less than 200 m from Test pit 2, also located in the toeslope position and classified as the Katspruit soil form.

Figure 33: Pumphouse - Sample along southern fence

Figure 34: Ash and soil mixture at Pumphouse

4.1.15 ASTRO Bricks

Located almost in the centre of the entire site, is Astro Bricks. This area consists of a number of heaps of material (Figure 35). The area appears to have been raised. A composite sample of the various material heaps was collected as well as a separate sample of a heap which had dark brown greasy appearance (Figure 36). (*Sample ID: Astro Comp, Astro Oil*).

Predicted soil form underlying surface waste material: Mispah. The soil forms identified at sampling points surrounding Astro bricks is Mispah.

Figure 35: Various heaps of material at Astro Bricks

Figure 36: Dark brown heap with greasy/oily appearance

4.1.16 B Station Coal Dry Store

Located east of Station B, the area around the Coal Dry Store has a fine-medium coal residue on the surface (Figure 37). An auger was used for sampling. Sampling was restricted to a depth of 170 mm by an impenetrable layer. The sample was collected of the fine-medium coal within the top 170 mm depth fraction (*Sample ID: Dry Store B*). *Predicted soil form underlying surface waste material: Mispah*

Figure 37: Coal residue on surface at Dry Coal Store

4.1.17 Diesel storage area

Around the concrete surface at the diesel storage area (Figure 38), an initial set of eight 20 mm boreholes were drilled to a depth of 30 – 35 cm. At each borehole, a photoionization detector (MSA Sirius PID) was used to measure concentration of volatile organic compound (isobutylene), carbon monoxide, hydrogen sulphide and oxygen (Figure 39). The VOC reading was then converted to obtain an adjusted benzene value. The results are reported in Table 7.

Figure 38: Diesel refuelling area

Figure 39: Position of PID measurement (along concrete of diesel storage area)

4.1.18 Reference/Baseline

Soil samples were collected from areas off-site in order to obtain sufficient information of the uncontaminated soil conditions of similar soil types as those occurring on site. On site, three main soil forms were identified namely the Bainsvlei soils in the more well drained positions, Mispah on the rocky outcrop areas and Katspruit in the toeslope to valley (wetland) positions. Offsite representative Bainsvlei, Mispah and Katspruit soils were sampled. The baseline soil profiles have following features:

Bainsvlei **–** Located approximately 1 km north east of the site, the soil was inspected by means of a hand auger to a depth of 1000 mm.

Horizon	*Depth(mm)*	*Description*
A	0 – 350	dark reddish brown (5YR 3/3) silt loam, apeal; many fine roots
B1	350 – 650	dark reddish brown (2.5YR 3/4) silt loam, apeal; few fine roots; few Mn
B2	650 – 1000	reddish brown (5YR 4/4) silt loam, apeal; fewer fine roots; many Mn concretions

Mispah **–** Located approximately 1 km west of the site, the soil was inspected by means of a hand auger to a depth of 290 mm (Figure 40).

Horizon	*Depth(mm)*	*Description*
A	0 – 290	dark reddish brown (5YR 3/3) silt loam, apeal; many fine roots
R	290 +	Hard Rock

Figure 40: Mispah soil form identified along western portion of site

Katspruit – Located approximately 1 km west of the site, the soil was inspected by means of a hand auger to a depth of 700 mm (Figure 41).

Horizon	*Depth(mm)*	*Description*
G	0 – 700	grey to black (10YR 2/1) clay, with many thick roots

Figure 41: Grey to black soil at Reference Katspruit

5.0 ANALYSIS RESULTS

All analysis certificates are included in APPENDIX B.

5.1.1 Total metals

The analysis results for the total inorganic constituents are presented Table 2.The soil screening assessment of total metals also included the use of Data for South African baseline soils with clay percentages of between 10 - 20%, 20-35% and >35% (Herselman, 2007; Herselman *et al*, 2005; Steyn *et al*, 2006 and Herselman *et al*, 2012). In terms of soil quality the samples have the following features:

- Levels of Antimony exceed the SSV1 in the subsoil sample at Station B Cooling Towers (B-TOWERS-PIT-3), the soil at the weighbridge (TP9/1, TP9/2), the subsoil around Station A Cooling Towers (TP7/2, TP7/3), the topsoil at the Desiltation reservoir (DESILT), the topsoil west of Ash Dam B (DAM B-MISPAH), the subsoil west of Ash Dam A (TP2/2), and the top and subsoil of the Reference Bainsvlei soil profile (REF-A, REF-B1, REF-B2). Antimony occurs in air and water from waste incinerators, metal processing works, mines and industrial facilities burning coal. The source of Sb on site may be related to the burning of coal for electricity generation.
- The fine sediment at the Baghouse (BAGHOUSE-1, BAGHOUSE-2) and the ash and coal mixture around the Station A Cooling Towers (A-TOWERS-AUGER) have As levels which exceed the SSV1; The material type at both locations are not soil, but rather a waste material deposited on the soil surface.
- Zn levels in the surface material sampled at the Dry Coal Store and the composite sample of waste heaps at Astro Bricks exceed the SSV1. Though these materials are not soil, it remains useful to screen these materials to the SSV1, to evaluate the risk the waste body may pose to the underlying soil. At the Dry Coal Store, the underlying the surface material was an impenetrable layer, presumable hard rock. The soils possibly underlying the Astro Bricks waste heaps, is possibly a shallow soil on hard rock (Mispah Soil Form).
- A number of samples were collected of the material overlying the soil, predominantly a mixture of ash and coal. The results of these analyses can rather be used in classifying the material waste type.
- The total Cr, Co, Fe, Cu, Mn, Ni and Pb exceed the SSV1 in a number of samples and have therefore been further inspected. The findings of the evaluation are covered in the subsequent section.

5.1.2 Water soluble metals and anions

The analysis results for the 2:1 Water to Soil extract expressed on a dry mass basis is presented in Table 3 and Table 4. Only the water soluble Fe in B1 horizon of the soil at Station A Cooling Towers, is slightly above the SSSV. All other constituents analysed are below the SSSV.

5.1.3 Organic constituents

The organic constituents were screened to the SSV1 and where no SSV is available, the EPA screening levels were used. No VOC or SVOC's were detected in any of the Reference samples (REF-WETLAND, REF-MISPAH, REF-A, REF-B1 and REF-B2).The results of the screening assessment of the organic constituents detected are provided in Table 5 and Table 6. The results of the in-field VOC measurements are provided in Table 7 and illustrated in Figure 42. Only constituents detected are indicated in the tables. Full set of results are included in APPENDIX B. The majority of the organic constituents were detected are not above the SSV but it is worth noting the following findings:

- The coal sample at the **Station B stockpile** (B-COAL STOCKPILE), had elevated levels of 2-Methylnaphthalene, Naphthalene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysen, Benzo(bk)fluoranthene, Benzo(a)pyrene, Indeno(123cd)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole, Dibenzofuran
- In surface ash and coal mixture at the **Weighbridge** (TP 9/3) Dichloromethane (DCM), 2-Methylnaphthalene, Naphthalene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene,

Benzo(a)anthracene, Chrysen, Benzo(bk)fluoranthene, Benzo(a)pyrene, Indeno(123cd)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole and Dibenzofuran was detected, with Benzo(bk)fluoranthene exceeding the EPA soil screening level. Only Styrene was detected in the soil layer directly underlying the ash coal mixture (TP9/1) at this location. No analysed organic constituents were detected in the soil sample taken of the deepest soil horizon (TP 9/2) of the profile evaluated.

- In the topsoil west of **Ash Dam B** (DAM B-MISPAH) the level of Dibenzo(ah)anthracene exceeds to the EPA SSL. Elevated levels of Naphthalene, Phenanthrene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(bk)fluoranthene, Benzo(a)pyrene, Indeno(123cd)pyrene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Dibenzo(ah)anthracene were also detected in this sample. Volatile organic compounds such as Dichloromethane (DCM), Benzene, Trichloroethene,Toluene, Tetrachloroethene, Ethylbenzene, p/m-Xylene, o-Xylene and Styrene were also detected in the topsoil sample at Ash Dam B, with Benzene and Trichloroethene exceeding the soil screening values.
- At the **Workshop**, the surface ash and coal mixture (WORKSHOP-1) and the underlying soil (WORKSHOP) Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(a)pyrene, Indeno(123cd)pyrene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole and Dibenzofuran were detected. Levels of 2-Methylnaphthalene, Naphthalene, Acenaphthylene are only detected in the ash and coal mixture, not the underlying soil. Benzo(bk)fluoranthene and Dibenzo(ah)anthracene where these levels exceed the SSV in both the surface ash and coal layer and the underlying soil. Trichloroethene (TCE) and Tetrachloroethene (PCE) were also detected in the surface ash and coal mixture and the underlying soil with Dichloromethane (DCM) only occurring in the surface ash layer and Styrene only occurring in the soil.
- The fine sediment at the **Baghouse** (BAGHOUSE-1, BAGHOUSE-2) Indeno(123cd)pyrene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(bk)fluoranthene, Benzo(a)pyrene, Benzo(ghi)perylene were detected. Only in the top layer of the fine sediment Benzo(b)fluoranthene and Benzo(k)fluoranthene was detected, and only in the second layer of fine sediment was Phenanthrene and Anthracene detected. Tetrachloroethene (PCE) and Trichloroethene (TCE) were also detected in the second layer, with the TCE level exceeding the SSV.
- Test Pit 7 near the **Station A Cooling Towers**, only in the topsoil sample (TP7/1) 2-Methylnaphthalene, Naphthalene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(bk)fluoranthene, Benzo(a)pyrene, Indeno(123cd)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole and Dibenzofuranwas detected. Tetrachloroethene (PCE), Trichloroethene (TCE) and Styrene were also detected in the topsoil (TP7/1), with the TCE level exceeding the SSV. Only Styrene was detected in the subsoil B1 horizon (TP7/2). No other organic constituents were detected in the B2 and B3 horizon samples (TP7/2, TP7/3, TP7/4).
- None of the semi-volatile organic constituents analysed were detected in the surface ash and coal mixture and the subsoil samples at Test Pit 2 west of **Ash Dam A** (TP2/1,TP2/2). Tetrachloroethene (PCE), Trichloroethene (TCE) and Styrene were also detected in the topsoil (TP2/1), with the TCE level exceeding the SSV.
- 2-Methylnaphthalene, Naphthalene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(bk)fluoranthene, Benzo(a)pyrene, Indeno(123cd)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole and Dibenzofuranwas and Fluorene were all detected in the dark heap sampled at **Astro Bricks**, with levels of Benzo(bk)fluoranthene, Benzo(a)anthracen, Benzo(a)pyrene, Indeno(123cd)pyrene and Dibenzo(ah)anthracene exceeding the screening level. Additionally Dichloromethane (DCM), Benzene, Trichloroethene (TCE), Toluene and Tetrachloroethene (PCE) were detected with the TCE and PCE exceeding the SSV;

- VOC's were detected in the soil vapour in the area between the **Diesel Storage tank** and Station A, with higher concentrations recorded closest to the cemented area where the tank is located (Figure 42). The calculated benzene concentrations (Table 7) were compared to the Vapour Intrusion Screening Level (VISL) for benzene (US EPA, 2015). The results indicate that the levels of benzene detected are above the VISL. In comparing the benzene levels in the soil vapour to the SSV (assuming 1:1 soil to air ratio), the benzene levels also far exceed the SSV indicated in the Framework.

Table 2: Total metals concentration

Sample ID	Top	Bottom	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Mo	Ni	P	K	Se	Na	Sr	Te	Tl	Ti	V	B	Z	Zr
	mm		mg/kg																												
SSV1					5.8			7.5		46000	300	16		20			740		91									150		240	
EPA			77000	7	0.03*		160	14		120000	5*	560	7000*	14			560	40	520	3800000		10				0.28		390		7400	
SA Baseline for 10 -20% clay					11			2.7		175	31	58		49			2759		136									361		115	
B-COAL STOCKPILE	0	850	3443	<1	2.3	117	<0.5	<0.1	6103	12.7	3.4	7	3676	<5	8	1051	62	1.6	12.4	417	190	<1	239	170	<5	<1	203	15	7.74	7	7
B-TOWERS-PIT-1	0	400	15930	<1	<0.5	539	1.3	<0.1	22400	91.2	15.3	9	17760	<5	25	3502	328	1.6	77.7	2133	514	<1	288	659	6	<1	1004	28	11.87	6	15
B-TOWERS-PIT-2	400	600	18950	2	<0.5	272	1.2	<0.1	14650	284.1	31.9	17	28330	12	27	5697	498	1.4	310.6	1227	514	<1	262	434	8	<1	927	40	8.46	21	8
B-TOWERS-PIT-3	600	+	16160	9	<0.5	172	1.1	<0.1	6035	991.3	57.9	20	43650	17	16	7652	815	1.2	711	734	484	1	188	178	14	<1	653	62	4.14	34	<5
B-TOWERS-AUGER	0	1000	15730	<1	1.3	347	1.1	<0.1	18800	19.2	8.2	10	11270	<5	26	2507	103	1.4	20.2	1252	325	<1	362	510	5	<1	990	22	12.37	<5	17
DRY STORE B	0	170	2626	<1	2.4	159	0.7	<0.1	18470	12.2	4.4	13	9742	33	<5	623	130	0.9	14.4	675	115	<1	234	277	<5	<1	202	11	6.12	214	<5
TP9/3	0	700	11500	<1	1.5	325	1.1	<0.1	14990	25.7	6.5	10	7422	<5	17	1739	147	1.3	19.1	1147	333	<1	475	404	<5	<1	652	18	8.72	13	10
TP9/1	700	1000	16450	12	<0.5	24	1.2	<0.1	1468	1543	32.4	17	67370	<5	6	939	332	1.2	567.5	285	438	1	99	16	16	<1	306	74	3.39	18	<5
TP9/2	1000	1300	18960	16	<0.5	63	1.6	<0.1	663	1972	71.2	26	103900	<5	8	477	950	1.3	756	441	425	2	140	8	27	<1	278	90	1.61	18	<5
WORKSHOP-1	0	200	15740	<1	3.1	358	1.3	<0.1	16680	72.4	10.5	22	17150	24	25	2278	189	2.7	36.6	1431	420	1	405	492	6	<1	969	29	21.75	100	15
WORKSHOP-2	200	550	22770	12	<0.5	764	1.7	<0.1	9953	1462	166.2	49	65360	14	22	2095	4306	2	1048	651	530	4	235	295	20	6	815	101	9.51	33	10
BAGHOUSE-1	0	110	21220	<1	8.8	332	1.2	<0.1	14310	163.3	18.2	78	19380	<5	36	5018	213	2.2	117.5	1054	545	<1	322	522	7	<1	1054	33	7.94	21	14
BAGHOUSE-2	110	280	9091	3	11.9	122	0.7	<0.1	9345	356.1	30.1	14	23800	117	13	4833	444	3.1	289.1	337	319	<1	201	117	6	<1	413	28	2.94	26	8
TP8/3	0	700	33290	<1	2	675	2.1	<0.1	34750	43.2	9.5	13	11060	<5	44	5274	152	1.8	16.9	1251	1695	1	884	1115	7	<1	2000	34	25.71	<5	21
TP8/1	700	1100	16770	7	<0.5	163	0.9	<0.1	7079	943.8	74.4	17	44330	7	13	13890	979	1.1	659.9	417	750	2	342	205	12	<1	644	48	5.92	15	9
TP8/2	1100	1300	18240	4	<0.5	40	<0.5	<0.1	681	499.1	68.2	3	41830	<5	<5	61200	751	<0.1	988.5	57	510	1	145	19	11	<1	896	43	0.88	11	<5
TP7/1	0	170	18390	6	<0.5	74	0.8	0.5	4644	345.7	33	97	35550	19	15	2495	448	1.1	268.6	1409	1073	2	148	48	8	<1	334	44	3.56	107	<5
TP7/2	170	500	19650	12	<0.5	55	1.1	<0.1	1117	1228	71.9	23	49410	<5	11	917	990	1.6	420.6	241	684	1	213	<5	15	<1	383	78	0.89	18	<5
TP7/3	500	900	21560	11	<0.5	196	1.3	<0.1	1058	1401	188.5	31	67020	12	17	1886	3512	1.4	941.6	237	637	3	283	<5	16	4	385	89	0.55	19	<5
TP7/4	900	+	13050	6	<0.5	19	<0.5	<0.1	771	566.2	40.3	15	47560	<5	<5	21690	324	<0.1	411.2	18	59	<1	218	<5	11	<1	203	34	<0.25	17	<5
A-TOWERS-AUGER	0	1100	10710	<1	16.5	337	1.1	0.1	16320	26.9	8	50	10210	26	18	2113	188	2.3	19.5	2356	554	3	419	496	<5	<1	757	22	32.62	51	13
DESILT	0	200	13560	11	<0.5	157	1.1	<0.1	5127	1523	61.1	9	51610	<5	10	8879	919	1.3	739.5	475	310	1	245	145	14	<1	563	51	4.44	17	6
DAM B-MISPAH	0	300	10480	8	<0.5	51	<0.5	<0.1	1871	1046	49.3	16	32030	9	8	5554	832	0.7	278.4	239	210	1	134	27	8	<1	323	42	0.88	48	<5
TP2/1	0	1500	19180	5	<0.5	79	0.6	<0.1	3794	722.7	26.1	13	30920	<5	24	10460	609	2.8	274.2	97	778	1	325	78	7	<1	246	40	3.39	22	<5
TP2/2	1500	+	22080	7	<0.5	156	0.7	<0.1	1222	707.2	46.8	13	36560	<5	18	8370	1398	0.2	292.2	26	507	2	381	9	8	<1	312	60	1.66	23	<5
TP3/1	0	500	18990	<1	0.7	451	1.4	<0.1	16380	138.4	11.7	14	13210	23	27	3606	179	1.2	57.2	1644	631	<1	510	617	6	<1	1142	31	11.08	7	14
TP3/2	500	950	11380	<1	<0.5	58	<0.5	<0.1	1726	61.8	17.5	44	19600	<5	8	4625	250	<0.1	78.9	106	827	<1	220	16	11	<1	2045	34	<0.25	14	14
PUMPHOUSE-1	0	350	5478	<1	<0.5	90	0.6	<0.1	7847	19.5	3.7	9	7669	<5	6	1868	87	1.4	9.5	189	236	<1	156	95	<5	<1	364	9	1.07	11	7
PUMPHOUSE-2	350	550	10430	2	<0.5	149	0.6	<0.1	9163	385.8	24.4	8	19460	<5	14	4832	456	1.7	180.8	449	246	<1	176	171	7	<1	618	24	4.27	40	8
ASTRO VOC HEAP	0	200	1529	<1	1.2	81	0.5	<0.1	2499	54.6	5.1	7	6088	7	<5	457	235	0.8	22.4	198	113	<1	147	61	<5	<1	64	9	3.08	7	<5
ASTRO COMP			12930	<1	2	332	1.3	<0.1	19630	23.3	5.8	23	16250	29	22	2753	156	2	14.4	1097	441	1	434	442	6	<1	841	24	44.29	130	20
REF-WETLAND	0	700	15660	5	<0.5	46	<0.5	<0.1	3522	494.8	18.6	11	24810	<5	7	8879	214	0.3	220.1	193	260	<1	113	35	6	<1	230	36	1.06	24	<5
REF-MISPAH	0	290	14050	6	<0.5	18	<0.5	<0.1	653	628.6	84.7	20	24890	<5	<5	13550	885	0.4	352.1	57	52	1	105	5	6	<1	274	47	0.63	13	<5
REF-A	0	350	12510	8	<0.5	64	0.7	<0.1	<500	902.3	40.1	14	38190	6	9	384	867	1.4	261.4	208	230	2	78	6	10	<1	265	52	<0.25	12	<5
REF-B1	350	650	20740	17	<0.5	167	1.5	<0.1	<500	1987	170.7	38	74020	13	20	111	2924	2.8	770.9	391	301	3	104	<5	21	3	377	110	<0.25	15	<5
REF-B2	650	1000	14330	15	<0.5	193	1.3	<0.1	<500	1743	83.2	26	75150	9	7	214	1835	1.9	638.5	274	227	2	103	<5	20	<1	350	103	<0.25	13	<5

Red: Above SSV and Baseline where available

Purple: above baseline but below SSV

Orange: above SSV but below baseline* SSV SA = EPA Risk based SSL *20

Table 3: Water soluble metals concentration

Sample ID	Top	Bottom	Al	Sb	As	Ba	B	Cr	Cu	Ca	Mg	K	Na	Fe	Li	Mn	Mo	Ni	P	Se	Sr	Ti	V	Z
	mm		mg/kg																					
SSSSV			3	0.12*	0.2	40*	80*	1	1.6	640	600	1000	2000	2	0.8	1	2*	1.4	10	0.4	240		2	4
B-COAL STOCKPILE	0	850	0.56	0.004	0.009	0.074	1.346	<0.003	<0.014	65.4	17.6	18.4	55.8	0.1	0.41	0.02	0.07	<0.004	0.21	0.058	0.92	<0.01	0.294	0.012
TP9/1	700	1000	0.06	<0.004	<0.005	0.012	1.866	0.004	<0.014	536.6	77.6	4.4	21.4	0.08	<0.01	<0.004	<0.004	0.016	0.17	<0.006	-	<0.01	0.004	0.012
TP9/2	1000	1300	<0.04	<0.004	<0.005	0.014	1.72	<0.003	<0.014	199.8	72.8	2.2	15	<0.04	<0.01	0.004	<0.004	0.032	0.12	<0.006	1.94	<0.01	<0.003	0.018
WORKSHOP-2	200	550	0.06	<0.004	<0.005	0.046	1.252	0.015	<0.014	200.6	23.8	11.4	38.8	0.06	<0.01	<0.004	<0.004	<0.004	0.03	<0.006	-	<0.01	0.004	0.01
BAGHOUSE-1	0	110	0.52	0.01	0.114	0.06	1.346	0.063	<0.014	55	12.4	29.8	85.8	0.24	0.66	<0.004	0.2	0.012	1.14	0.026	1.08	<0.01	0.073	0.012
BAGHOUSE-2	110	280	0.86	<0.004	0.019	0.05	0.606	0.047	<0.014	59.8	5.6	19.8	55	0.54	0.21	<0.004	0.246	0.018	0.37	<0.006	0.96	<0.01	0.012	0.018
TP7/2	170	500	2.8	<0.004	<0.005	0.01	0.24	0.034	0.024	35	5.2	16	63	2.32	<0.01	0.032	0.008	0.082	0.32	<0.006	0.02	<0.01	0.01	0.018
TP7/3	500	900	1.4	<0.004	<0.005	<0.006	0.224	0.016	<0.014	21	2.4	11.2	100.6	1.3	<0.01	0.004	<0.004	0.042	0.07	<0.006	0.02	<0.01	0.007	0.012
TP7/4	900	+	0.42	0.004	<0.005	<0.006	0.088	0.013	<0.014	6	13	1.4	92.4	0.52	<0.01	<0.004	<0.004	0.022	0.05	<0.006	0.02	<0.01	0.003	0.034
TP2/2	1500	+	0.04	<0.004	<0.005	0.01	0.594	0.008	<0.014	29.6	73.2	2	157.8	<0.04	0.34	<0.004	0.222	0.01	0.06	<0.006	0.25	<0.01	0.006	0.01
REF-WETLAND	0	700	0.34	<0.004	<0.005	0.032	0.096	0.012	<0.014	16.2	7.8	1.4	12.2	0.3	<0.01	<0.004	0.006	0.054	0.36	<0.006	0.3	0.01	0.012	0.02
REF-MISPAH	0	290	0.38	<0.004	<0.005	0.022	0.076	0.019	<0.014	12.6	11.8	2.4	5.6	0.84	<0.01	0.076	<0.004	0.056	0.13	<0.006	0.11	0.01	0.005	0.018
REF-A	0	350	2	0.006	<0.005	0.056	0.134	0.02	<0.014	11.4	4.6	1.2	3.8	1.56	<0.01	0.16	<0.004	0.056	0.34	<0.006	0.13	0.04	0.008	0.03
REF-B2	650	1000	<0.40	<0.040	<0.050	<0.060	<0.240	<0.030	<0.140	3.4	13.4	1.4	3.6	<0.40	<0.10	<0.040	<0.040	<0.040	<0.10	<0.060	0.15	<0.10	<0.030	0.164

Red: Above SSV and Baseline where available

Purple: above baseline but below SSV

Orange: above SSV but below baseline* SSV SA = EPA Risk based SSL *20

Table 4: Water soluble anions concentration

Sample ID	Top	Bottom	NH4	Cl	F	NO3	SO4	EC	pH$^{\#}$
	mm		mg/kg					µS/cm	pH units
SSSSV			ng	12000	30	120	4000		6-9
B-COAL STOCKPILE	0	850	<0.6	10	<0.3	<2.5	206	217	8.62
TP9/1	700	1000	2.5	44	<0.3	75	1276	533	7.85
TP9/2	1000	1300	<0.6	28	<0.3	45.1	688	389	7.6
TP9/3	0	700	<0.6	150	1.8	50.2	640	526	8.19
DAM B-MISPAH	0	300	4.6	4	1.4	<2.5	158	304	6.94
WORKSHOP-1	0	200	2.8	12	3.6	28.6	904	508	8.12
WORKSHOP-2	200	550	1.6	4	<0.3	14	515	524	8.29
BAGHOUSE-1	0	110	1.4	50	2.5	40.3	182	239	8.93
BAGHOUSE-2	110	280	<0.6	20	2.4	13.3	118	215	8.8
TP7/1	0	170	0.9	26	<0.3	63.6	117	309	7.53
TP7/2	170	500	<0.6	66	1.2	<2.5	<3	110	8.4
TP7/3	500	900	<0.6	<2	<0.3	<2.5	172	156	8.37
TP7/4	900	+	<0.6	52	<0.3	<2.5	92	125	8.29
TP2/1	0	1500	<0.6	120	1.4	<2.5	322	317	8.47
TP2/2	1500	+	<0.6	130	0.3	<2.5	352	397	8.74
ASTRO VOC HEAP	0	200	3	20	0.3	<2.5	1010	492	6.82
REF-WETLAND	0	700	<0.6	<2	<0.3	<2.5	47	104	7.65

Sample ID	Top	Bottom	NH4	Cl	F	NO3	SO4	EC	pH$^{\#}$
	mm		mg/kg					µS/cm	pH units
REF-MISPAH	0	290	<0.6	4	<0.3	<2.5	73	<100	6.37
REF-A	0	350	<0.6	12	<0.3	<2.5	108	<100	6.97
REF-B1	350	650	<0.6	<2	<0.3	<2.5	24	<100	7.23
REF-B2	650	1000	<0.6	<2	<0.3	<2.5	<3	<100	6.59

Table 5: SVOC constituent concentrations

Red: Above SSV or Above SSL

Sample ID	Top	Bottom	PAHs																			Other	
			2-Chloronaphthalene$^{\#}$	2-Methylnaphthalene$^{\#}$	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene$^{\#}$	Anthracene	Fluoranthene$^{\#}$	Pyrene$^{\#}$	Benzo(a)anthracene	Chrysene	Benzo(bk)fluoranthene	Benzo(a)pyrene	Indeno(123cd)pyrene	Dibenzo(ah)anthracene	Benzo(ghi)perylene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Carbazole	Dibenzofuran$^{\#}$
	mm		µg/kg																				
SSV1 (May 2014)					**28000**							**5300**				**340**							
EPA (June 2014)				**3800**			**11000**	**108000**		**1160000**	**1780000**		**150**	**15000**	**150**		**150**	**15**			**1500**		**3000**
B-COAL STOCKPILE	0	850	<10	297	149	<10	17	30	186	21	67	87	91	67	149	39	39	**24**	87	107	42	18	113
TP9/3	0	700	<10	418	239	<10	<10	30	311	43	141	118	95	110	**233**	50	53	**29**	124	168	65	12	201
TP9/1	700	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TP9/2	1000	1300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
DAM B-MISPAH	0	300	<10	<10	16	<10	<10	<10	60	<10	44	35	92	132	47	32	27	**15**	41	34	13	<10	<10
WORKSHOP-1	0	200	<10	117	86	12	<10	<10	173	31	260	229	144	179	**345**	156	106	**44**	137	248	97	21	65
WORKSHOP-2	200	550	<10	18	12	<10	<10	<10	136	26	251	202	109	114	**207**	96	56	**22**	65	149	58	15	12
BAGHOUSE-1	0	110	<10	<10	<10	<10	<10	<10	<10	<10	18	23	32	27	56	21	18	<10	28	40	16	<10	<10
BAGHOUSE-2	110	280	<10	<10	<10	<10	<10	<10	14	15	25	25	43	23	<10	18	13	<10	18	<10	<10	<10	<10
TP7/1	0	170	<10	25	15	<10	<10	<10	62	11	103	92	53	61	98	45	32	14	43	71	27	12	12
TP7/2	170	500	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TP7/3	500	900	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TP7/4	900	+	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TP2/1	0	1500	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TP2/2	1500	+	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
ASTRO VOC HEAP	0	200	<10	4484	2058	<10	<10	462	2658	498	909	1067	**659**	790	**1941**	**568**	**505**	**292**	1228	1398	543	148	1725

Table 6: VOC constituent concentrations

Sample ID	Top (mm)	Bottom (mm)	Dichloromethane (DCM) $^{\#}$	Benzene $^{\#}$	Trichloroethene (TCE) $^{\#}$	Toluene $^{\#}$	Tetrachloroethene (PCE) $^{\#}$	Ethylbenzene $^{\#}$	p/m-Xylene $^{\#}$	o-Xylene $^{\#}$	Styrene
	mm		µg/kg								
SSV1 (May 2014)				30		25000					
EPA (June 2014)					3.6		46	26000	3800	3800	2200
B-COAL STOCKPILE	0	850	<7	<3	<3	<3	<3	<3	<5	<3	<3
TP9/3	0	700	73	<3	<3	<3	<3	<3	<5	<3	<3
TP9/1	700	1000	<7	<3	<3	<3	<3	<3	<5	<3	9
TP9/2	1000	1300	<7	<3	<3	<3	<3	<3	<5	<3	<3
DAM B-MISPAH	0	300	65	52	40	58	18	15	21	12	13
WORKSHOP-1	0	200	55	<3	23	<3	14	<3	<5	<3	<3
WORKSHOP-2	200	550	<7	<3	15	<3	10	<3	<5	<3	15
BAGHOUSE-1	0	110	<7	<3	<3	<3	<3	<3	<5	<3	<3
BAGHOUSE-2	110	280	<7	<3	13	<3	8	<3	<5	<3	<3
TP7/1	0	170	<7	<3	12	<3	9	<3	<5	<3	8
TP7/2	170	500	<7	<3	<3	<3	<3	<3	<5	<3	5
TP7/3	500	900	<7	<3	<3	<3	<3	<3	<5	<3	<3
TP7/4	900	+	<7	<3	<3	<3	<3	<3	<5	<3	<3
TP2/1	0	1500	<7	<3	15	<3	8	<3	<5	<3	11
TP2/2	1500	+	<7	<3	<3	<3	<3	<3	<5	<3	<3
ASTRO VOC	0	200	171	15	45	27	59	<3	<5	<3	<3

Red: Above SSV or above SSL

Table 7: Results of VOC field measurements

Point	O2 (%)	H2S (ppm)	CO (ppm)	VOC (ppm)	Benzene (ppm)
1	20.8	0	0	0	0
2	20.8	0	0	0	0
3	20.8	0	0	0	0
4	20.8	0	0	0	0
5	20.8	0	0	0	0
6	20.8	0	0	0	0
7	20.8	0	0	5.4	2.538
8	20.8	0	0	0	0
9	20.8	0	0	2.2	1.034
10	20.8	0	0	2.2	1.034
11	20.8	0	0	2.1	0.987
12	20.8	0	0	1.6	0.752

Notes: Benzene calculated by multiplying isobutylene equivalent by benzene tabulated benzene correction factor (CF) of 0.47. (RAE Systems, Technical Note TN-106)

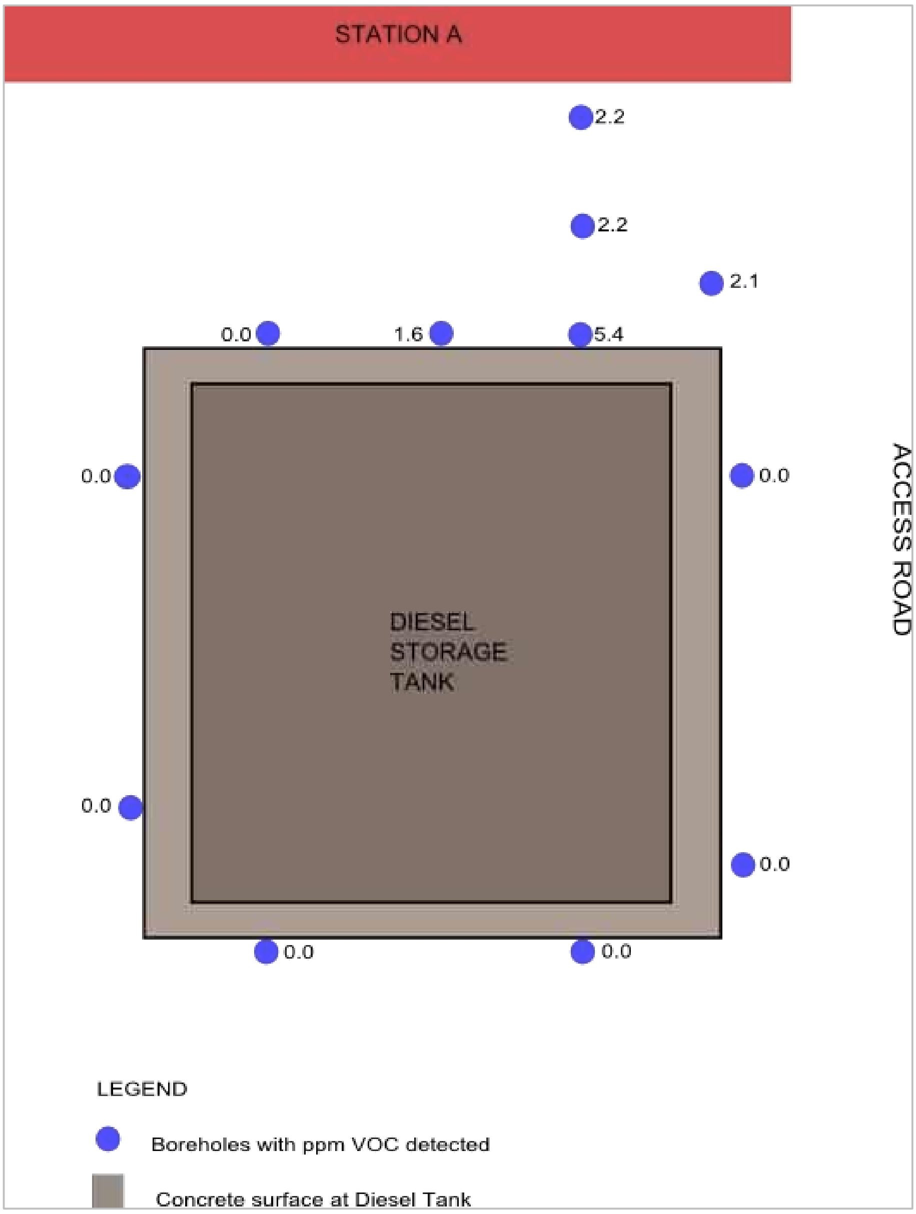

Figure 42: Borehole location and VOC measurement in ppm (drawing not to scale)

5.2 Evaluation of screened constituents

5.2.1 Total metals

As indicated earlier, for a number of the samples the concentrations of Fe, Mn, Ni, Cr, Co, Pb, As, Sb and Cu far exceed the SSV1. Further data analysis was conducted to evaluate whether these concentration levels reflect background concentration levels or are related to a source of contamination. Cumulative probability plots indicating the sample populations for each of the above mentioned metals are shown in Figure 43 and Figure 44. Site specific threshold values for the various metals were estimated based on the cumulative probability plots and are listed in Table 8. Furthermore, to establish whether the elevated Pb, Co, Ni and Cr levels were related to inherent soil mineralogical properties, correlation coefficients for Fe in relation to Cr, Ni, Mn and Pb were calculated. The correlations are depicted in Figure 45. Based on the evaluation of the metals the following is understood:

- High levels of Mn in all soil samples can be attributed to presence of Mn black concretions noted in the soils in the north eastern portion of the site. These soils are classified as Bainsvlei and include the area around the Station A Cooling Towers, Weighbridge and Station A Coal stockpile. Abundance and size of concretions increased with depth in these soils. The highest levels of Mn are reported in the subsoil samples. The positive correlation between Fe and Mn, also indicate that the high Mn concentration is more likely associated to inherent soil properties than potential external source of Mn contamination.

- The high concentration of Cr, Ni and Co in soil samples has also been compared to Fe. The strong correlation observed indicates that these high concentrations are associated with the inherent soil properties. High levels of Cr, Ni and Co are also typical of soils derived from mafic and ultramafic igneous rocks as found on site. The highest Ni level reported was for the subsoil sample collected within this geology (TP 8/3). The geology of the area consists of granodiorite with mafic and ultramafic rocks found along the west and east of the site. The pronounced signature of high Ni, Cr and Co within the granodiorite derived soils, indicate possible xenoliths of ultramafic and mafic rock within the granodiorite (*Xenolith is foreign rock inclusion, usually in an igneous rock*).

- On evaluation of the Pb cumulative probably plot, a distinct population shift/change is seen between the fine sediment and the other sample types. The estimated site specific threshold for Pb is 17 mg/kg. The Pb content of the fine sediment of the second layer at the Baghouse is reported as 117 mg/kg. The source of Pb in this area is mostly likely attributed to the fine greyish dust settling at the Baghouse. Investigation into the exact source of Pb should further analysis of the dust deposited at the Baghouse.

- The Cu concentration of the surface samples at Station A Cooling Towers and Baghouse is 97 mg/kg and 78 mg/kg respectively. These concentrations exceed the estimated site specific threshold value for Cu of 26 mg/kg, and appear to be attributed to an external source rather than inherent soil properties in the case of the topsoil at Station A Cooling Towers. The subsoil layers at Station A Cooling Towers have Cu levels comparable with the baseline soils which have clay contents of 10 -20%. It is worth noting that during the soil sampling, a whitish grey precipitate was observation in the topsoil at Station A Cooling Towers. At the Baghouse, the high Cu is likely to be associated with the dust deposited on the concrete. The chemical analysis of the dust deposited around the Baghouse should be considered to rule out this as the main source of Cu in the area. Further investigation into the source of Cu around Station A Cooling Towers and the Baghouse is recommended.

5.2.2 Organics above SSV

In comparing the samples which have screened above the SSV with those below the SSV, one notices that the samples which are above the SSV are mostly surface samples.

- The Benzo[b]fluoranthene, Benz[a]anthracene, Benzpyrene, Indeno[1,2,3-cd]pyrene and Dibenzo(ah)anthracene are produced by the incomplete burning of organic matter and are primarily found in gasoline exhaust, tobacco and cigarette smoke, coal tar and coal combustion emissions (NCBI, 2015). With the exception of the soil sample at the Workshop and the soil sample west of Ash Dam B, the sample type in which these constituents are above the SSV is coal. The soil sample at the Workshop, 200 -550 mm layer, is directly beneath a layer of ash mixed with coal, and had visible traces of coal in the soil matrix. Below 550 mm an impenetrable layer was encountered, restricting sampling at deeper in the profile. The soil at Ash Dam B consists of thin layer of soil on hard rock. The risk associated with mobility of these constituents to groundwater should be investigated further.

- **Benzene** is found in crude oils and as a by-product of coal distillation. Benzene is used as an industrial solvent in paints, varnishes, lacquer thinners and gasoline (NCBI, 2015) and is also found in emissions from burning coal and oil and vehicle exhaust (EPA, 2012). The level of Benzene in the soil sample west of Ash Dam B is nearly double the SSV. Benzene was also detected in the dark waste heap at Astro Bricks, though this is not above the SSV. The calculated benzene concentration in the soil vapour at the Diesel Storage area is also above the VISL and the SSV. The boreholes close to this area should be monitored for benzene.

- **Trichloroethene** and **Tetrachloroethylene** are mainly used in the vapour degreasing of metal parts. Trichloroethene is moderately water soluble and therefore in when in soil, it has the potential to migrate into groundwater (EPA, 2000). TCE was mainly detected in surface samples.

- The exact source of the above mentioned organic constituent requires further investigation. Including these organic compounds as part of future groundwater monitoring is also recommended.

5.3 Further evaluation and considerations

Golder Associates was also appointed by Kelvin Power Station to conduct the Waste Classification on representative samples from the Ash dams and the fugitive coal on site. The results of waste samples analysed were then compared to the results of the contaminated land assessment in order to determine whether the source of contamination observed in the soils is possibly related to the specific waste types present on site. The following is noted:

- Elevated levels of Cu and Pb in waste samples were found, particularly in the fugitive waste sample around Station A, as was found in the topsoil of the test pit at Station A Cooling Towers. This confirms that the source of the Cu and Pb in the soil is the fugitive coal which was commonly found in this area. The depth of the coal/ash veneer around this area varies, ranging from 200 - 1100 mm thick around the Cooling Towers. Remediating this area, will require removal of the coal/ash veneer. The exact depth the removal will need to be confirmed through further depth profiling, sampling and analysis. Important to note is that the soil conditions are mostly alkaline, which affects the solubility of metals such as Cu and Pb. This may be the main reason why the concentrations of water soluble Cu and Pb are low, and subsequently minimise the risk that these metals pose to the groundwater quality.
- The organic constituents detected in the soil samples were compared to the CoC's in the waste and were found to be very low, in comparison to levels in the soil samples. The source of PCE and TCE is most probably related to detergents used for cleaning oils and grease.

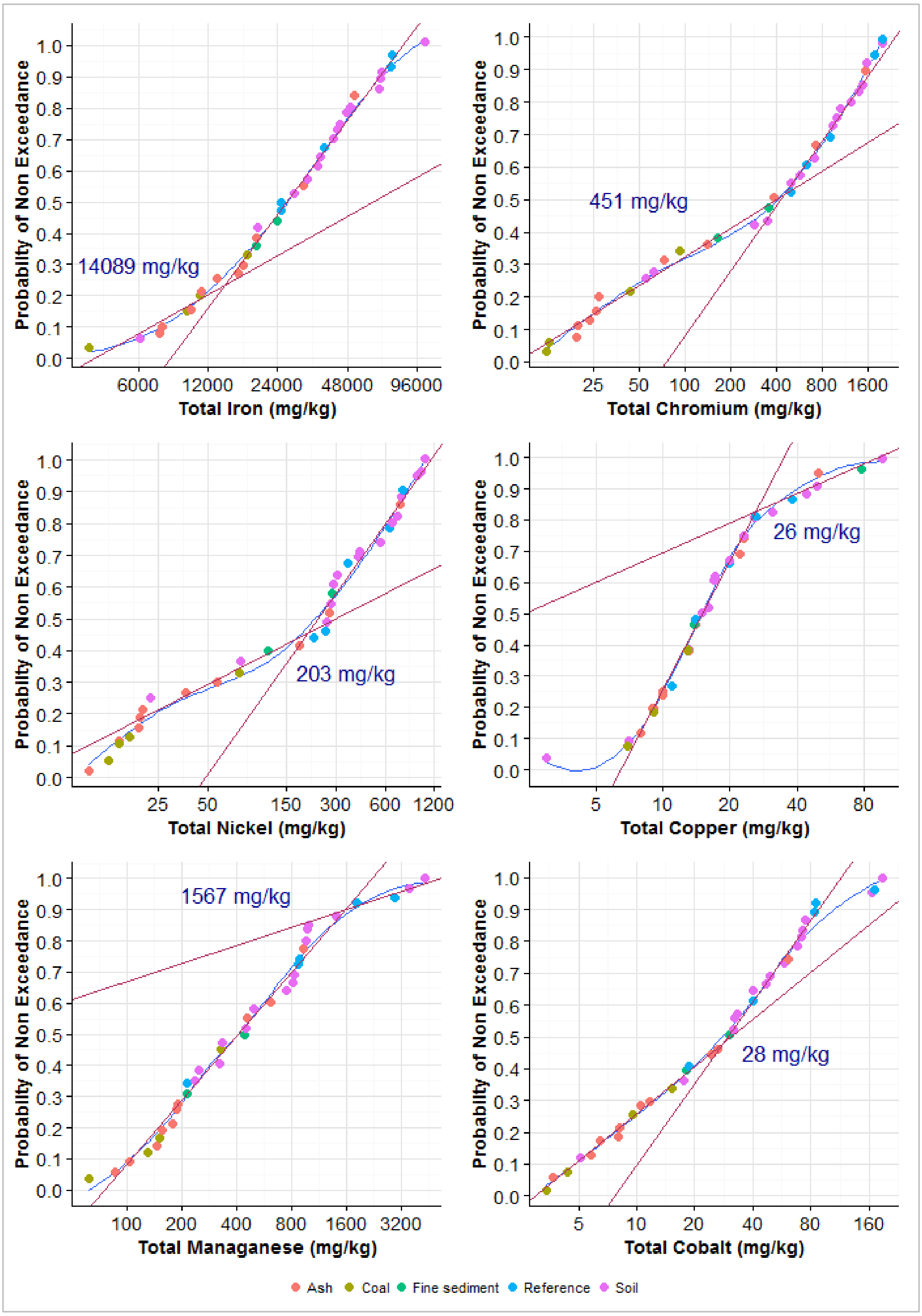

Figure 43: Cumulative distribution of total analysis data for Iron, Chromium, Nickel, Copper, Manganese and Cobalt

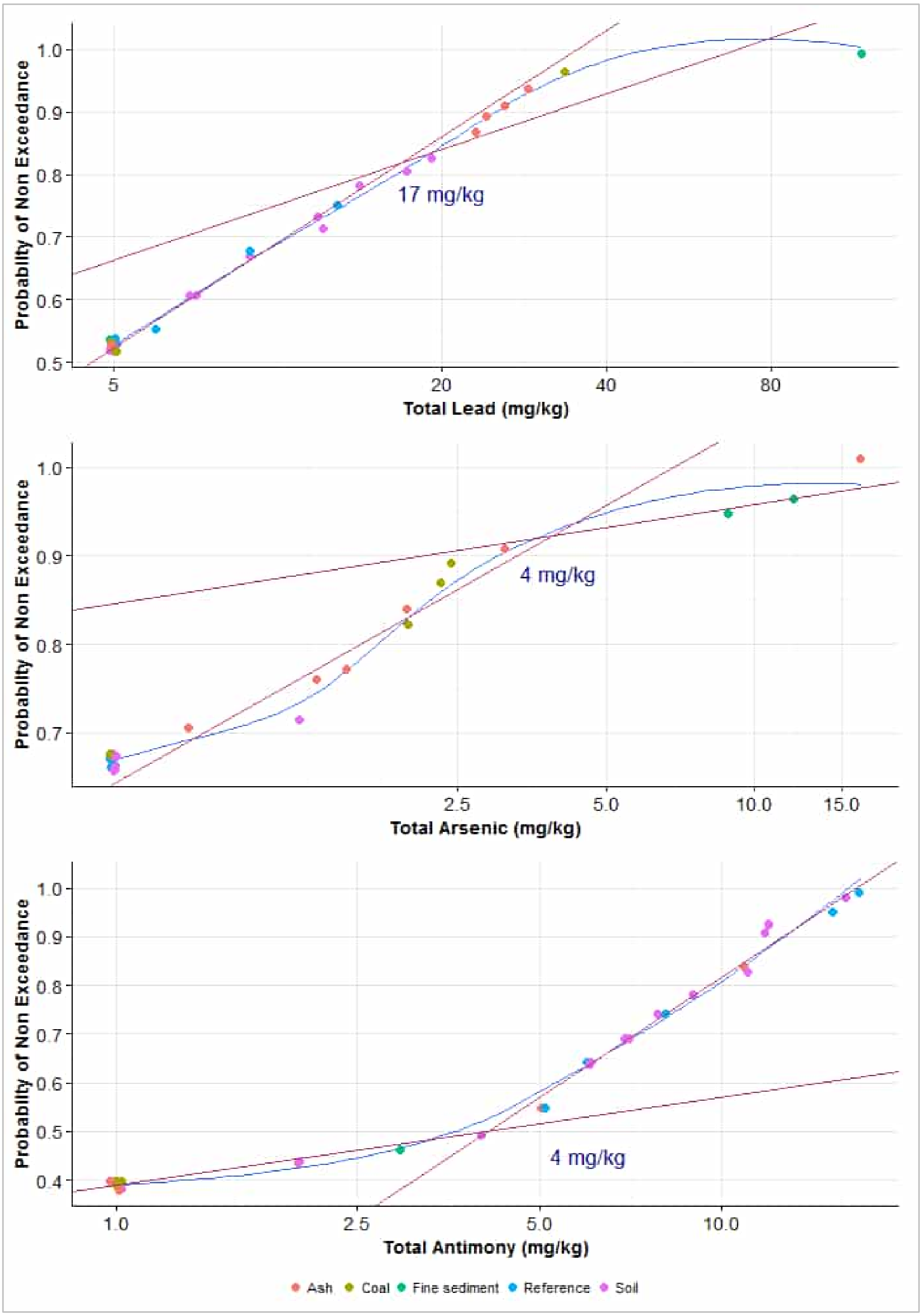

Figure 44: Cumulative distribution of total analysis data for Lead, Arsenic and Antimony

Table 8: Estimated site thresholds

Constituent	Site Threshold (mg/kg)
Chromium	451
Nickel	203
Copper	26
Cobalt	28
Manganese	1567
Iron	14089
Antimony	4
Arsenic	4
Lead	17

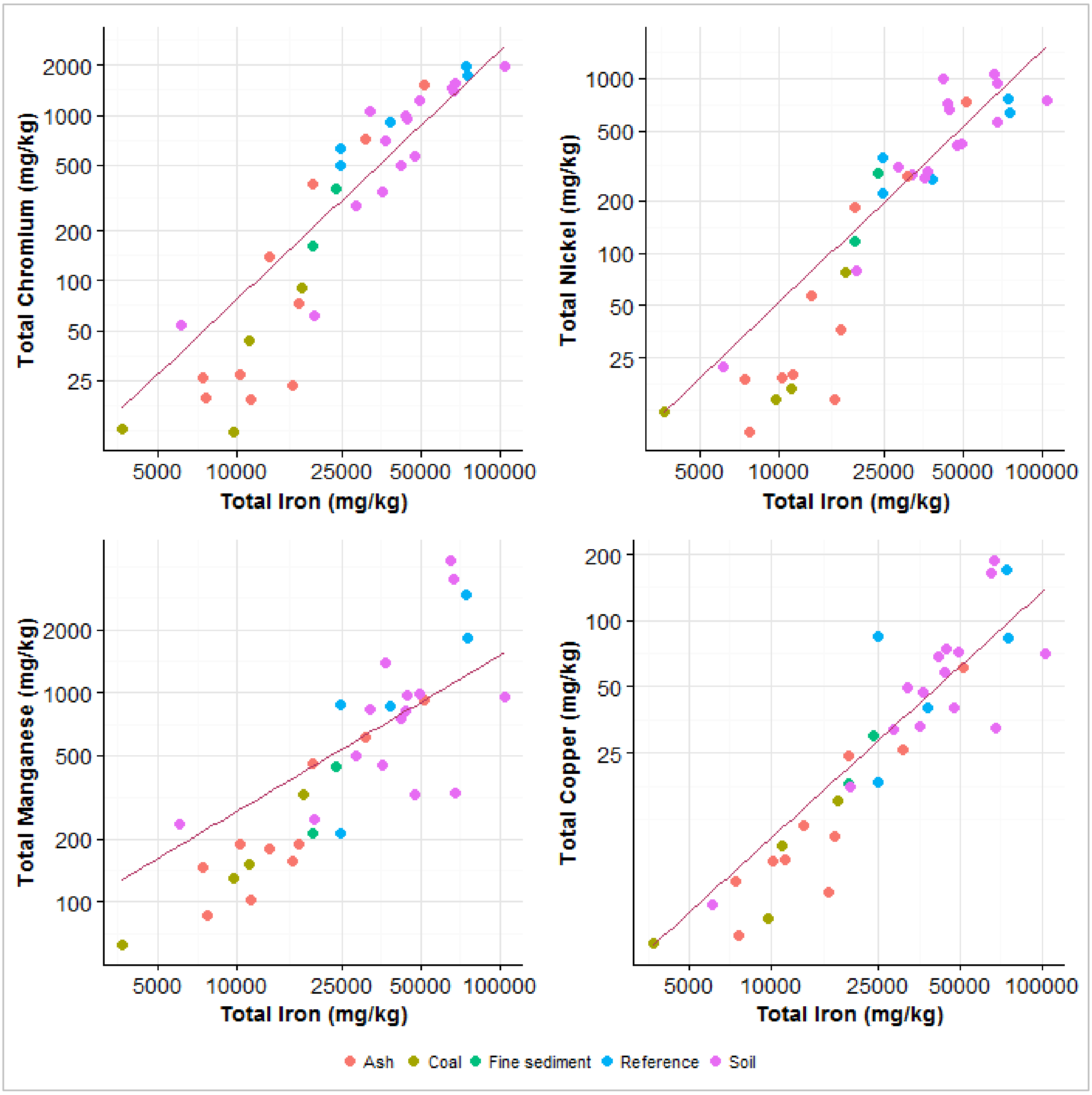

Figure 45: Association of Iron with Chromium, Nickel, Manganese and Copper

6.0 CONCEPTUAL UNDERSTANDING

6.1 Site biophysical environment

The underlying geology is predominately grey medium grained granodiorite with ultra-mafic and mafic rocks in western portion of the site. High concentrations of Ni and Cr also occur within the granodiorite, and are suspected to be related to possible ultra-mafic and mafic xenoliths. The site is at an elevation of between 1620 and 1680 mamsl with a gentle slope of approximately 0.03%. Three soil forms are dominant on site. Deep well drained, dark reddish brown, silt loam, with Mn concretions in the subsoils (Bainsvlei soil form), shallow dark reddish brown silt loam soil on hard rock (Mispah soil form) and grey to black clayey soil located in the toeslope to valley bottom position (Katspruit). Soil pH ranges between 6.4 -8.5.

6.2 Sources

Kelvin has two coal fired power stations, Station A and B of which only Station B is operational. Station B uses a pulverised fine-coal fraction for heat generation, which results in a fine ash by-product. Previously all the ash was pumped in slurry form to Ash Dam A. Presently, approximately 10% of the ash is being collected by a cement manufacturer as raw material, thereby facilitating waste minimisation (both in terms of ash and water use) at the power station. The remainder of the ash is still slurried and disposed of on Ash Dam A (Golder, 2015).

The final waste product from Kelvin is in the form of a wastewater effluent, consisting of cooling tower blow-down, effluent from miscellaneous cooling water uses, ash-quenching effluent and washings. These effluents are discharged to the Modderfontein Spruit after de-siltation (Golder, 2015).

Potential sources of contamination at Kelvin also previously identified in the IWWMP and RSIP reports are the following:

- Oil and grease waste - generated from the servicing of vehicles, empty oil drums;
- Fluorescent tubes/globes - used fluorescent tubes;
- Asbestos - waste generated from old insulation material;
- Ash Dams;
- Coal stockpiles;
- Plant workshop;
- Admin building;
- Return water dams;
- Desiltation reservoir;
- Roads;
- Hazardous waste materials used on site ranging from used solvents, used oil and grease, etc.;
- Vehicles entering the premises where drains are degraded resulting in coal spillages washing off the site during rain events;
- Storm water channels that are eroded;
- Transformer areas;
- Heavy Fuel Oil (HFO) tanks;
- Diesel and oil storage areas;
- Astro Bricks material heaps;
- Ash off-loading areas (Station A);

- Caustic soda and acid tanks; and
- Discharge of contaminated storm water and effluent to the Modderfonteinspruit.

The Ash Dams and Coal stockpiles are the most significant potential pollution sources at Kelvin. The coal and ash residue on most road surfaces and soil surfaces suggests that this is a significant source.

6.3 Pathways

This section provides a baseline description of the groundwater and surface water conditions at Kelvin, and has been extracted from the RSIP for Kelvin (Golder, 2015).

6.3.1 Surface Water Hydrology

Although the Kelvin site is situated on the boundary of two quaternary catchments, A21C and A21A, 97% of the site falls in catchment A21C (the Jukskei River catchment).

Catchment A21C drains in a North Westerly direction where the Jukskei River eventually confluences with the Crocodile River. Catchment A21C is 75 961 ha and the part of the Kelvin site contributing to this catchment is 154.7 ha (or 0.2%).

The 3% of the site that falls within catchment A21A is part of the “Remainder” facility and drains North East into Sesmylspruit. Catchment A21A is 48 189 ha and the part of the Kelvin site contributing to this catchment is 5.4 ha (or 0.01%).

6.3.2 Surface water Quality

Monitoring of surface water quality on site and in the vicinity of Kelvin is taking place on a regular basis. No baseline studies are available to determine the impact Kelvin has had on the surface water resource since commencement of the activities; however, trends are being assessed to determine current impacts.

The results of the survey conducted in May 2014 found that electrical conductivity (EC) levels were found to be very similar downstream and upstream of Kelvin. There were higher EC values measured at the site where effluent is discharged indicating a potential source of water quality degradation originating from the Effluent Stream. These higher values did not seem to have an effect on the EC values in the Modderfonteinspruit.

6.3.3 Groundwater quality

Groundwater monitoring wells were first installed at Kelvin in August 2003. As the ash dams were identified as potential pollution sources, the groundwater conditions associated with them were investigated in detail in 2003 by Arcus Gibb. Knights Piesold was appointed in 2006 to commence with a review and update of the groundwater management programme.

In 2003 the groundwater quality was found to be close to potable standards for most parameters and it was considered that the ash performed the role of a chemical filter by raising pH and precipitating most of the salts. Therefore the seepage water was thought to be well buffered by flow through this low permeability medium (Arcus Gibb, 2003).

The groundwater is currently being monitored on a quarterly basis by Aquatico Scientific. The current status of the groundwater is that the quality in the area varies from good to marginal with respect to drinking water standards.

In summary (Aquatico, 2014):

- Groundwater quality in the Kelvin Power Station monitoring boreholes vary from good to marginal with respect to potable water quality;
- Impacts of the operation are visible in the monitoring data, especially in down-gradient monitoring borehole KPS-BH01;
- The elevated groundwater salinity measured in monitoring borehole KPS-MON07 is unlikely to be the result of impacts from the site itself, as the monitoring borehole is located up-gradient from all possible

sources of groundwater contamination. The exception being if historical activities caused residual impacts in the area; and

- Magnesium concentrations in most of the boreholes are high, but natural ion exchange reactions in the aquifer host rock is likely to be the main contributing factor.

Review of recent RSIP and IWWMP reports does not indicate the monitoring of any hydrocarbons in surface or groundwater monitoring. Based on the finding of this report, it is recommended that the constituents of concern highlighted in this report, should be included in the suite of analysis for the groundwater monitoring.

6.4 Receptors

No surface water users in the vicinity of Kelvin have been identified (Golder, 2015). The station however situated on the boundary of a residential area.

In the south western portion of the site, wetland conditions were identified in the soils; though no known wetlands have previously been reported on site. The wetland area is upstream from the Modderfonteinspruit. The main receptors of concern is the groundwater, surface water and potentially also the residents along the southern boundary of the site.

6.5 Contamination status

The main source of contamination appears to relate to coal and ash prominent on site. Most of organic constituents detected in waste and soil samples are largely attributed to burning of coal.

Based on the initial soil screening level assessment (targeted samples at each suspected area) the concentration of Fe, Mn, Ni, Cr, Co, Pb, Sb, As and Cu exceed the SSV1 and/ EPA screening values.

The findings of the assessment indicate that the high levels of Ni and Cr detected in majority of topsoil and subsoil samples are related to site geology, as these constituents are also high in the reference soil samples. This is also the case for the high levels of Fe, Mn, Co, Sb and As. Only the water soluble Fe in the B1 horizon of the soil at Station A Cooling Towers, is slightly above the SSSV. All other constituents analysed are below the SSSV.

Benzene, TCE and PCE detected in the samples collected at workshop, south and south west of Ash dam B, the Baghouse, Astro Bricks and Station A Cooling Towers exceed the SSV 1, but are likely related to the use of organic solvents on site.

The soil vapour levels of benzene in the surface soils at Diesel Storage area also exceed the VISL and SSV and likely related to possible spillages during refuelling of the tank (the area where the VOC's were detected is close to a manhole of the cemented area covering the tank). The integrity of the tank was evaluated in May 2013, and was found to the meet the US EPA requirements for leak detection (MassTech, 2013).

Given the current site information and understanding, the significance of the exceedances found does not indicate a risk requiring immediate remediation. The extent and distribution of these constituents of concern however requires additional sampling to confirm significance of the constituents.

The areas most affected are as follows:

- Around Station A Cooling Towers;
- Sections of Baghouse where concrete has disintegrated;
- Sections of the Workshop where soil is exposed;
- South west of Ash dam B;
- South of Ash dam B;
- Astro Bricks; and
- Diesel Storage area.

7.0 RECOMMENDATIONS

Based on the above contamination statement, the following aspects should be addressed:

- Before conducting additional soil sampling, the data collected for the recent groundwater study should be re-evaluated alongside the analytical results obtained from the contaminated land assessment to check whether any of the exceeding constituents (Cu, Pb, benzene, TCE and PCE) in the soil was detected in the groundwater samples of boreholes near the suspected areas of concern identified above;
- Confirm the occurrence and distribution of Cu and Pb with depth at the Baghouse and Station A Cooling Towers. At Station A Cooling Towers, this will require the inspection and sampling of at least four test pits and soil sampling to be collected at three depth intervals. At the Baghouse, two core samples will need to be collected at sections of the concrete which has disintegrated as well as three core samples around the Baghouse area also at three depth intervals. All samples should be analysed for total and water soluble Cu and Pb, and topsoil samples for TCE and PCE;
- Confirm the distribution of VOC’s at the following areas:
  - Five auger points, and sampling of the top and subsoil around the workshop area where soil is exposed;
  - Five auger points, and sampling of topsoil around initial sampling point south west of Ash dam B;
  - Five auger points, and sampling of the top and subsoil around the initial sampling point south of Ash Dam B;
  - Three test pits on the outer west boundary of Astro Bricks, collecting samples of the topsoil and subsoil;
- Monitor the refuelling of the diesel tanks, checking for occurrence spillages. Also consider an assessment of the integrity of the tank. Also include organic compounds associated with diesel in suite of analysis for groundwater monitoring.

Once the extent and distribution of the exceeding constituents are confirmed, notification may be required as per Part 8 of NEMWA Section 36 (5). Moreover, if the findings of the additional sampling indicate that a detailed Phase II investigation is required, notification should be considered by Kelvin management and their legal counsel.

8.0 CONCLUSION

The site naturally has high Ni and Cr which is attributed to the ultramafic and mafic geology. Of concern are the significantly high Pb and Cu around the Station A Cooling Towers and Baghouse and warrants further assessment to confirm the finding and determine the distribution of these contaminants. Solubility of the Pb and Cu were low and do not indicated a significant current risk.

The coal and ash residue on surfaces and roads is a prominent feature on site. The organic constituents detected above the SSV namely Benzo[b]fluoranthene, Benz[a]anthracene, Benzpyrene, Indeno [1,2,3-cd]pyrene and Dibenzo(ah) anthracene are related to the activities (coal burning) on site. The source of Benzene, Trichloroethene and Tetrachloroethylene are potentially related to organic solvents, are of concern. The extent of the occurrence of Benzene, TCE and PCE should be investigated to better understand the potential risk to the groundwater.

The source of the detected VOC’s at the Diesel Storage area may be attributed to spillages possibly occurring during the refilling of the diesel tank. This requires further inspection when actual refilling of the tank is in process.

Based on the above findings and understanding of the site conditions, the significance of the exceedances found does not indicate a risk requiring immediate remediation, but rather further site-specific assessment at affected areas. The extent and distribution of the exceeding constituents however need to be assessed in order to confirm whether notification is required as per Part 8 of NEMWA Section 36 (5).

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APPENDIX A

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APPENDIX B

Sampling Strategy

DATE 21 August 2015 **PROJECT No.** 1534189_Mem_001

TO Simphiwe Khusule
Kelvin Power Station

CC Carl Steyn

FROM Ilse Snyman **EMAIL** ilsnyman@golder.co.za

KELVIN POWER STATION CONTAMINATED LAND ASSESSMENT – SAMPLING STATEGY

1.0 INTRODUCTION

On 20 August 2015 a Site Walkover was conducted to gain an understanding of current site conditions and to identify focus areas for the Contaminated Land Assessment. The entire area as inspected for signs of soil contamination. Based on the findings of the RSIP and IWWMP reports and observations from the site Walkover, sampling positions were selected. The sample focus area, type and number of samples are listed in the table below.

Table 1: Sampling locations for Kelvin CLA

Facility	Number of samples
Station A coal stockpile	2
External stockpile A	2
Coal store	2
Cooling towers (2 Northern and 2 Southern)	4
Baghouse area - B station;	2
Workshop and contractor facilities;	2
Astro bricks;	2
B station coal dry store;	2
B station coal stockpile;	2
De-silting reservoir area;	2
Ash dam A;	4
Ash dam B;	2
Return water dam (RWD) and pump house;	2
Diesel storage tank;	2
A weighbridge for trucks bringing in coal;	2
Haul roads and access roads;	2
Reference Soil sample - Hutton	2
Reference Soil sample - Mispah	2
TOTAL NUMBER OF SAMPLES	**40**

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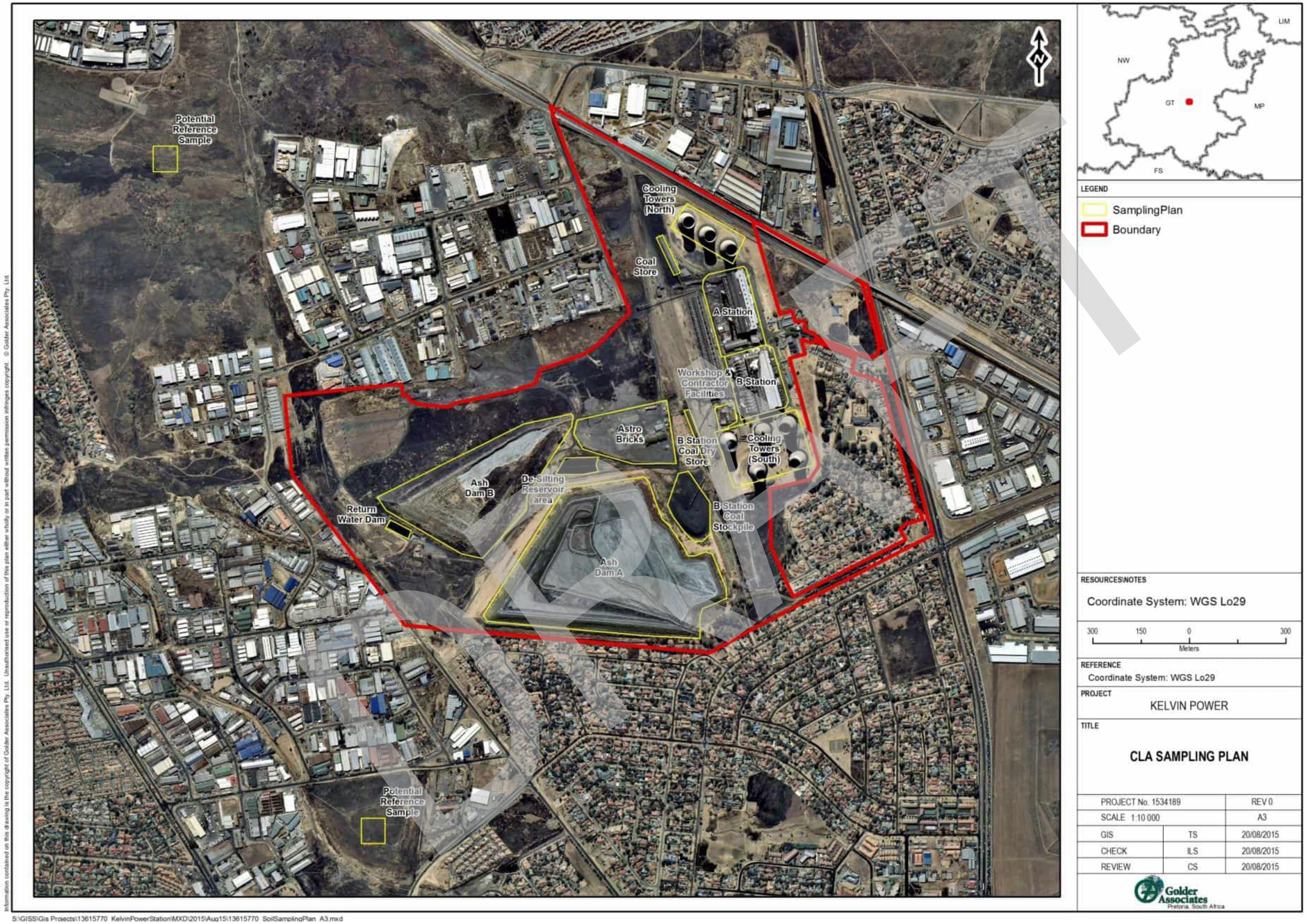

Figure 1: Proposed sampling locations

2.0 SAMPLING

Sampling will mainly be done on open areas. At each facility, soil samples will be collected per horizon identified in-field by means of a hand auger. Where practically possible, test pits will be excavated, soil will be properties assessed and samples collected. At each sampling point, the point co-ordinates and overall site features will be recorded and photographed. The soil samples will be placed in sealable plastic bags and glass amber jars and stored in a cold storage container. The samples will then be submitted to Jones Environmental Forensics laboratory for chemical analysis.

3.0 LABORATORY ANALYSIS

The samples will be analysed for total organic and inorganic compounds as required by the regulations. Selected samples will be analysed for pH, EC, and water soluble components - Ca, Mg, Na, K, Cl, SO_4, NO_3, NH_4, and metals (ICP scan).

4.0 CONCLUDING REMARKS

It is envisioned that the sampling will require two day's field work, to be conducted on 26-27 August 2015. Soil samples will then be submitted for laboratory analysis on Friday 28 August 2015. Laboratory results may be expected after about 2-3 weeks.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Ilse Snyman Soil Scientist	Carl Steyn Senior Soil Scientist

ILS/CS/ils

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APPENDIX C

Laboratory certificates

Jones Environmental Laboratory - South Africa

Unit 2/5
9 Quantum Road
Firgrove Business Park
Somerset West
7130
South Africa

Golder Associates Africa Ltd
Building 1, Golder House
Magwa Crescent West
Maxwell Office Park
Cnr Allandale Road and Maxwell Drive
Waterfall City, Midrand
South Africa

Attention :	Ilse Snyman
Date :	30th September, 2015
Your reference :	1534189
Our reference :	Test Report 15/12420 Batch 1
Location :	Kempton Park
Date samples received :	7th September, 2015
Status :	Final report
Issue :	1

Thirty one samples were received for analysis on 7th September, 2015 of which thirty one were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

All analysis was undertaken at Jones Environmental Laboratory in the UK, which is ISO 17025 accredited under UKAS (4225).

NOTE: Under International Laboratory Accreditation Cooperation (ILAC), ISO 17025 (UKAS) accreditation is recognised as equivalent to SANAS (South Africa) accreditation.

Compiled By:

Boden

Paul Lee-Boden BSc
Project Manager

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20			
Sample ID	B-COAL STOCKPILE	B-TOWERS-PIT-1	B-TOWERS-PIT-2	B-TOWERS-PIT-3	B-TOWERS-AUGER	TP9/1	TP9/2	TP9/3	DAM B-MISPAH	WORKSHOP-1			
Depth	0-850MM	0.400MM	400-600MM	600+MM	0-1000MM	700-1000MM	700-1000MM	0-300MM	0-300MM	0-200MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	27/08/2015	27/08/2015	31/08/2015	31/08/2015	31/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Aluminium	3443	15930	18950	16160	15730	16450	18960	11500	10480	15740	<50	mg/kg	TM30/PM15
Antimony	<1	<1	2	9	<1	12	16	<1	8	<1	<1	mg/kg	TM30/PM15
Arsenic$^{\#}$	2.3	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	1.5	<0.5	3.1	<0.5	mg/kg	TM30/PM15
Barium$^{\#}$	117	539	272	172	347	24	63	325	51	358	<1	mg/kg	TM30/PM15
Beryllium	<0.5	1.3	1.2	1.1	1.1	1.2	1.6	1.1	<0.5	1.3	<0.5	mg/kg	TM30/PM15
Bismuth	<5	<5	<5	<5	<5	<5	9	<5	<5	<5	<5	mg/kg	TM30/PM15
Cadmium$^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Calcium	6103	22400	14650	6035	18800	1468	663	14990	1871	16680	<500	mg/kg	TM30/PM15
Chromium$^{\#}$	12.7	91.2	284.1_{AB}	991.3_{AB}	19.2	1543.0_{AB}	1972.0_{AB}	25.7	1046.0_{AB}	72.4	<0.5	mg/kg	TM30/PM15
Cobalt$^{\#}$	3.4	15.3	31.9	57.9	8.2	32.4	71.2	6.5	49.3	10.5	<0.5	mg/kg	TM30/PM15
Copper$^{\#}$	7	9	17	20	10	17	26	10	16	22	<1	mg/kg	TM30/PM15
Iron	3676	17760	28330	43650_{AB}	11270	67370_{AB}	103900_{AB}	7422	32030	17150	<20	mg/kg	TM30/PM15
Lead$^{\#}$	<5	<5	12	17	<5	<5	<5	<5	9	24	<5	mg/kg	TM30/PM15
Lithium	8	25	27	16	26	6	8	17	8	25	<5	mg/kg	TM30/PM15
Magnesium	1051	3502	5697	7652	2507	939	477	1739	5554	2278	<25	mg/kg	TM30/PM15
Manganese$^{\#}$	62	328	498	815	103	332	950	147	832	189	<1	mg/kg	TM30/PM15
Mercury$^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum$^{\#}$	1.6	1.6	1.4	1.2	1.4	1.2	1.3	1.3	0.7	2.7	<0.1	mg/kg	TM30/PM15
Nickel$^{\#}$	12.4	77.7	310.6_{AB}	711.0_{AB}	20.2	567.5_{AB}	756.0_{AB}	19.1	278.4_{AB}	36.6	<0.7	mg/kg	TM30/PM15
Phosphorus	417	2133	1227	734	1252	285	441	1147	239	1431	<10	mg/kg	TM30/PM15
Potassium	190	514	514	484	325	438	425	333	210	420	<5	mg/kg	TM30/PM15
Selenium$^{\#}$	<1	<1	<1	1	<1	1	2	<1	1	1	<1	mg/kg	TM30/PM15
Silver	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Sodium	239	288	262	188	362	99	140	475	134	405	<5	mg/kg	TM30/PM15
Strontium	170	659	434	178	510	16	8	404	27	492	<5	mg/kg	TM30/PM15
Tellurium	<5	6	8	14	5	16	27	<5	8	6	<5	mg/kg	TM30/PM15
Thallium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Titanium	203	1004	927	653	990	306	278	652	323	969	<5	mg/kg	TM30/PM15
Vanadium	15	28	40	62	22	74	90	18	42	29	<1	mg/kg	TM30/PM15
Boron (Aqua Regia Soluble)	7.74	11.87	8.46	4.14	12.37	3.39	1.61	8.72	0.88	21.75	<0.25	mg/kg	TM30/PM15
Zinc$^{\#}$	7	6	21	34	<5	18	18	13	48	100	<5	mg/kg	TM30/PM15
Zirconium	7	15	8	<5	17	<5	<5	10	<5	15	<5	mg/kg	TM30/PM15
Calcium (2:1 Ext)	32.7	-	-	-	-	268.3_{AA}	99.9	112.1	19.4	153.7	<0.2	mg/l	TM30/PM20
Magnesium (2:1 Ext)	8.8	-	-	-	-	38.8	36.4	15.6	10.9	23.7	<0.1	mg/l	TM30/PM20
Potassium (2:1 Ext)	9.2	-	-	-	-	2.2	1.1	11.9	6.4	6.9	<0.1	mg/l	TM30/PM20
Sodium (2:1 Ext)	27.9	-	-	-	-	10.7	7.5	77.1	1.5	30.4	<0.1	mg/l	TM30/PM20
Calcium (Water Soluble)	65.4	-	-	-	-	536.6_{AA}	199.8	224.2	38.8	307.4	<0.4	mg/kg	TM30/PM20
Magnesium (Water Soluble)	17.6	-	-	-	-	77.6	72.8	31.2	21.8	47.4	<0.2	mg/kg	TM30/PM20
Potassium (Water Soluble)	18.4	-	-	-	-	4.4	2.2	23.8	12.8	13.8	<0.2	mg/kg	TM30/PM20
Sodium (Water Soluble)	55.8	-	-	-	-	21.4	15.0	154.2	3.0	60.8	<0.2	mg/kg	TM30/PM20
Natural Moisture Content	15.5	-	-	-	-	13.0	12.1	2.3	5.5	9.4	<0.1	%	PM4/PM0

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	LOD/LOR	Units	Method No.
Sample ID	B-COAL STOCKPILE	B-TOWERS-PIT-1	B-TOWERS-PIT-2	B-TOWERS-PIT-3	B-TOWERS-AUGER	TP9/1	TP9/2	TP9/3	DAM B-MISPAH	WORKSHOP-1			
Depth	0-850MM	0.400MM	400-600MM	600+MM	0-1000MM	700-1000MM	700-1000MM	0-300MM	0-300MM	0-200MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	27/08/2015	27/08/2015	31/08/2015	31/08/2015	31/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Ammoniacal Nitrogen as NH4 (2:1 Ext)	<0.3	-	-	-	-	1.1	<0.3	<0.3	2.2	1.3	<0.3	mg/l	TM38/PM20
Chloride (2:1 Ext) #	5	-	-	-	-	22	14	75	2	6	<1	mg/l	TM38/PM20
Fluoride (2:1 Ext)	<0.15	-	-	-	-	<0.15	<0.15	0.90	0.70	1.80	<0.15	mg/l	TM27/PM20
Nitrate as NO3 (2:1 Ext) #	<1.25	-	-	-	-	37.51	22.54	25.11	<1.25	14.31	<1.25	mg/l	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	103.2	-	-	-	-	637.8	344.1	319.8	78.9	452.1	<1.5	mg/l	TM38/PM20
Ammoniacal Nitrogen as NH4 (Water Soluble)	<0.6	-	-	-	-	2.5	<0.6	<0.6	4.6	2.8	<0.6	mg/kg	TM38/PM20
Chloride (Water Soluble) #	10	-	-	-	-	44	28	150	4	12	<2	mg/kg	TM38/PM20
Fluoride (Water Soluble)	<0.3	-	-	-	-	<0.3	<0.3	1.8	1.4	3.6	<0.3	mg/kg	TM27/PM20
Nitrate as NO3 (Water Soluble) #	<2.5	-	-	-	-	75.0	45.1	50.2	<2.5	28.6	<2.5	mg/kg	TM38/PM20
Sulphate as SO4 (Water Soluble) #	206	-	-	-	-	1276	688	640	158	904	<3	mg/kg	TM38/PM20
Electrical Conductivity @25C (5:1 ext)	217	214	1027	854	212	533	389	526	304	508	<100	uS/cm	TM76/PM58
pH #	8.62	8.58	8.14	7.50	8.57	7.85	7.60	8.19	6.94	8.12	<0.01	pH units	TM73/PM11

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40			
Sample ID	WORKSHOP-2	BAGHOUSE-1	BAGHOUSE-2	TP8/1	TP8/2	TP8/3	TP7/1	TP7/2	TP7/3	TP7/4			
Depth	200-550MM	0-110MM	110+MM	0-700MM	700-1100MM	700-1100MM	0-170MM	170-500MM	500-900MM	900+MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	31/08/2015	31/08/2015	27/08/2015	27/08/2015	31/08/2015	27/08/2015	27/08/2015	27/08/2015	27/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Aluminium	22770	21220	9091	16770	18240	33290	18390	19650	21560	13050	<50	mg/kg	TM30/PM15
Antimony	12	<1	3	7	4	<1	6	12	11	6	<1	mg/kg	TM30/PM15
Arsenic$^{\#}$	<0.5	8.8	11.9	<0.5	<0.5	2.0	<0.5	<0.5	<0.5	<0.5	<0.5	mg/kg	TM30/PM15
Barium$^{\#}$	764	332	122	163	40	675	74	55	196	19	<1	mg/kg	TM30/PM15
Beryllium	1.7	1.2	0.7	0.9	<0.5	2.1	0.8	1.1	1.3	<0.5	<0.5	mg/kg	TM30/PM15
Bismuth	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM30/PM15
Cadmium$^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Calcium	9953	14310	9345	7079	681	34750	4644	1117	1058	771	<500	mg/kg	TM30/PM15
Chromium$^{\#}$	1462.0$_{AB}$	163.3	356.1$_{AB}$	943.8$_{AB}$	499.1$_{AB}$	43.2	345.7$_{AB}$	1228.0$_{AB}$	1401.0$_{AB}$	566.2$_{AB}$	<0.5	mg/kg	TM30/PM15
Cobalt$^{\#}$	166.2	18.2	30.1	74.4	68.2	9.5	33.0	71.9	188.5	40.3	<0.5	mg/kg	TM30/PM15
Copper$^{\#}$	49	78	14	17	3	13	97	23	31	15	<1	mg/kg	TM30/PM15
Iron	65360$_{AB}$	19380	23800	44330	41830	11060	35550	49410$_{AB}$	67020$_{AB}$	47560	<20	mg/kg	TM30/PM15
Lead$^{\#}$	14	<5	117	7	<5	<5	19	<5	12	<5	<5	mg/kg	TM30/PM15
Lithium	22	36	13	13	<5	44	15	11	17	<5	<5	mg/kg	TM30/PM15
Magnesium	2095	5018	4833	13890	61200	5274	2495	917	1886	21690	<25	mg/kg	TM30/PM15
Manganese$^{\#}$	4306$_{AB}$	213	444	979	751	152	448	990	3512$_{AB}$	324	<1	mg/kg	TM30/PM15
Mercury$^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum$^{\#}$	2.0	2.2	3.1	1.1	<0.1	1.8	1.1	1.6	1.4	<0.1	<0.1	mg/kg	TM30/PM15
Nickel$^{\#}$	1048.0$_{AB}$	117.5	289.1$_{AB}$	659.9$_{AB}$	988.5$_{AB}$	16.9	268.6$_{AB}$	420.6$_{AB}$	941.6$_{AB}$	411.2$_{AB}$	<0.7	mg/kg	TM30/PM15
Phosphorus	651	1054	337	417	57	1251	1409	241	237	18	<10	mg/kg	TM30/PM15
Potassium	530	545	319	750	510	1695	1073	684	637	59	<5	mg/kg	TM30/PM15
Selenium$^{\#}$	4	<1	<1	2	1	1	2	1	3	<1	<1	mg/kg	TM30/PM15
Silver	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Sodium	235	322	201	342	145	884	148	213	283	218	<5	mg/kg	TM30/PM15
Strontium	295	522	117	205	19	1115	48	<5	<5	<5	<5	mg/kg	TM30/PM15
Tellurium	20	7	6	12	11	7	8	15	16	11	<5	mg/kg	TM30/PM15
Thallium	6	<1	<1	<1	<1	<1	<1	<1	4	<1	<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Titanium	815	1054	413	644	896	2000	334	383	385	203	<5	mg/kg	TM30/PM15
Vanadium	101	33	28	48	43	34	44	78	89	34	<1	mg/kg	TM30/PM15
Boron (Aqua Regia Soluble)	9.51	7.94	2.94	5.92	0.88	25.71	3.56	0.89	0.55	<0.25	<0.25	mg/kg	TM30/PM15
Zinc$^{\#}$	33	21	26	15	11	<5	107	18	19	17	<5	mg/kg	TM30/PM15
Zirconium	10	14	8	9	<5	21	<5	<5	<5	<5	<5	mg/kg	TM30/PM15
Calcium (2:1 Ext)	100.3	27.5	29.9	-	-	-	32.7	17.5	10.5	3.0	<0.2	mg/l	TM30/PM20
Magnesium (2:1 Ext)	11.9	6.2	2.8	-	-	-	11.1	2.6	1.2	6.5	<0.1	mg/l	TM30/PM20
Potassium (2:1 Ext)	5.7	14.9	9.9	-	-	-	34.3	8.0	5.6	0.7	<0.1	mg/l	TM30/PM20
Sodium (2:1 Ext)	19.4	42.9	27.5	-	-	-	10.2	31.5	50.3	46.2	<0.1	mg/l	TM30/PM20
Calcium (Water Soluble)	200.6	55.0	59.8	-	-	-	65.4	35.0	21.0	6.0	<0.4	mg/kg	TM30/PM20
Magnesium (Water Soluble)	23.8	12.4	5.6	-	-	-	22.2	5.2	2.4	13.0	<0.2	mg/kg	TM30/PM20
Potassium (Water Soluble)	11.4	29.8	19.8	-	-	-	68.6	16.0	11.2	1.4	<0.2	mg/kg	TM30/PM20
Sodium (Water Soluble)	38.8	85.8	55.0	-	-	-	20.4	63.0	100.6	92.4	<0.2	mg/kg	TM30/PM20
Natural Moisture Content	12.4	18.5	14.1	-	-	-	13.2	7.9	9.7	1.5	<0.1	%	PM4/PM0

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	LOD/LOR	Units	Method No.
Sample ID	WORKSHOP-2	BAGHOUSE-1	BAGHOUSE-2	TP8/1	TP8/2	TP8/3	TP7/1	TP7/2	TP7/3	TP7/4			
Depth	200-550MM	0-110MM	110+MM	0-700MM	700-1100MM	700-1100MM	0-170MM	170-500MM	500-900MM	900+MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	31/08/2015	31/08/2015	27/08/2015	27/08/2015	31/08/2015	27/08/2015	27/08/2015	27/08/2015	27/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Ammoniacal Nitrogen as NH4 (2:1 Ext)	0.7	0.6	<0.3	-	-	-	0.4	<0.3	<0.3	<0.3	<0.3	mg/l	TM38/PM20
Chloride (2:1 Ext) #	2	25	10	-	-	-	13	33	<1	26	<1	mg/l	TM38/PM20
Fluoride (2:1 Ext)	<0.15	1.25	1.20	-	-	-	<0.15	0.60	<0.15	<0.15	<0.15	mg/l	TM27/PM20
Nitrate as NO3 (2:1 Ext) #	7.00	20.15	6.64	-	-	-	31.80	<1.25	<1.25	<1.25	<1.25	mg/l	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	257.5	91.1	58.8	-	-	-	58.7	<1.5	86.2	46.0	<1.5	mg/l	TM38/PM20
Ammoniacal Nitrogen as NH4 (Water Soluble)	1.6	1.4	<0.6	-	-	-	0.9	<0.6	<0.6	<0.6	<0.6	mg/kg	TM38/PM20
Chloride (Water Soluble) #	4	50	20	-	-	-	26	66	<2	52	<2	mg/kg	TM38/PM20
Fluoride (Water Soluble)	<0.3	2.5	2.4	-	-	-	<0.3	1.2	<0.3	<0.3	<0.3	mg/kg	TM27/PM20
Nitrate as NO3 (Water Soluble) #	14.0	40.3	13.3	-	-	-	63.6	<2.5	<2.5	<2.5	<2.5	mg/kg	TM38/PM20
Sulphate as SO4 (Water Soluble) #	515	182	118	-	-	-	117	<3	172	92	<3	mg/kg	TM38/PM20
Electrical Conductivity @25C (5:1 ext)	524	239	215	478	171	677	309	110	156	125	<100	uS/cm	TM76/PM58
pH #	8.29	8.93	8.80	8.30	8.30	9.14	7.53	8.40	8.37	8.29	<0.01	pH units	TM73/PM11

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	41-42	43-44	45-46	47-48	49-50	51-52	53-54	55-56	57-58	59-60			
Sample ID	DESILT	TP2/1	TP2/2	TP3/1	TP3/2	PUMPHOUSE-1	PUMPHOUSE-2	A-TOWERS-AUGER	ASTRO VOC HEAP	ASTRO COMP			
Depth	0-200MM	0-1500MM	1500+MM	0-500MM	500-950MM	0-350MM	350-450MM	0-1100MM	0-200MM				
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	27/08/2015	27/08/2015	27/08/2015	26/08/2015	26/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Aluminium	13560	19180	22080	18990	11380	5478	10430	10710	1529	12930	<50	mg/kg	TM30/PM15
Antimony	11	5	7	<1	<1	<1	2	<1	<1	<1	<1	mg/kg	TM30/PM15
Arsenic #	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	16.5	1.2	2.0	<0.5	mg/kg	TM30/PM15
Barium #	157	79	156	451	58	90	149	337	81	332	<1	mg/kg	TM30/PM15
Beryllium	1.1	0.6	0.7	1.4	<0.5	0.6	0.6	1.1	0.5	1.3	<0.5	mg/kg	TM30/PM15
Bismuth	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM30/PM15
Cadmium #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Calcium	5127	3794	1222	16380	1726	7847	9163	16320	2499	19630	<500	mg/kg	TM30/PM15
Chromium #	1523.0$_{AB}$	722.7$_{AC}$	707.2$_{AB}$	138.4	61.8	19.5	385.8$_{AB}$	26.9	54.6	23.3	<0.5	mg/kg	TM30/PM15
Cobalt #	61.1	26.1	46.8	11.7	17.5	3.7	24.4	8.0	5.1	5.8	<0.5	mg/kg	TM30/PM15
Copper #	9	13	13	14	44	9	8	50	7	23	<1	mg/kg	TM30/PM15
Iron	51610$_{AB}$	30920	36560	13210	19600	7669	19460	10210	6088	16250	<20	mg/kg	TM30/PM15
Lead #	<5	<5	<5	23	<5	<5	<5	26	7	29	<5	mg/kg	TM30/PM15
Lithium	10	24	18	27	8	6	14	18	<5	22	<5	mg/kg	TM30/PM15
Magnesium	8879	10460	8370	3606	4625	1868	4832	2113	457	2753	<25	mg/kg	TM30/PM15
Manganese #	919	609	1398	179	250	87	456	188	235	156	<1	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	1.3	2.8	0.2	1.2	<0.1	1.4	1.7	2.3	0.8	2.0	<0.1	mg/kg	TM30/PM15
Nickel #	739.5$_{AB}$	274.2$_{AC}$	292.2$_{AB}$	57.2	78.9	9.5	180.8	19.5	22.4	14.4	<0.7	mg/kg	TM30/PM15
Phosphorus	475	97	26	1644	106	189	449	2356	198	1097	<10	mg/kg	TM30/PM15
Potassium	310	778	507	631	827	236	246	554	113	441	<5	mg/kg	TM30/PM15
Selenium #	1	1	2	<1	<1	<1	<1	3	<1	1	<1	mg/kg	TM30/PM15
Silver	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Sodium	245	325	381	510	220	156	176	419	147	434	<5	mg/kg	TM30/PM15
Strontium	145	78	9	617	16	95	171	496	61	442	<5	mg/kg	TM30/PM15
Tellurium	14	7	8	6	11	<5	7	<5	<5	6	<5	mg/kg	TM30/PM15
Thallium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Titanium	563	246	312	1142	2045	364	618	757	64	841	<5	mg/kg	TM30/PM15
Vanadium	51	40	60	31	34	9	24	22	9	24	<1	mg/kg	TM30/PM15
Boron (Aqua Regia Soluble)	4.44	3.39	1.66	11.08	<0.25	1.07	4.27	32.62	3.08	44.29	<0.25	mg/kg	TM30/PM15
Zinc #	17	22	23	7	14	11	40	51	7	130	<5	mg/kg	TM30/PM15
Zirconium	6	<5	<5	14	14	7	8	13	<5	20	<5	mg/kg	TM30/PM15
Calcium (2:1 Ext)	-	22.1	14.8	-	-	-	-	-	157.2	-	<0.2	mg/l	TM30/PM20
Magnesium (2:1 Ext)	-	24.3	36.6	-	-	-	-	-	34.8	-	<0.1	mg/l	TM30/PM20
Potassium (2:1 Ext)	-	3.9	1.0	-	-	-	-	-	19.9	-	<0.1	mg/l	TM30/PM20
Sodium (2:1 Ext)	-	73.0	78.9	-	-	-	-	-	18.6	-	<0.1	mg/l	TM30/PM20
Calcium (Water Soluble)	-	44.2	29.6	-	-	-	-	-	314.4	-	<0.4	mg/kg	TM30/PM20
Magnesium (Water Soluble)	-	48.6	73.2	-	-	-	-	-	69.6	-	<0.2	mg/kg	TM30/PM20
Potassium (Water Soluble)	-	7.8	2.0	-	-	-	-	-	39.8	-	<0.2	mg/kg	TM30/PM20
Sodium (Water Soluble)	-	146.0	157.8	-	-	-	-	-	37.2	-	<0.2	mg/kg	TM30/PM20
Natural Moisture Content	-	39.0	28.8	-	-	-	-	-	7.5	-	<0.1	%	PM4/PM0

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	41-42	43-44	45-46	47-48	49-50	51-52	53-54	55-56	57-58	59-60			
Sample ID	DESILT	TP2/1	TP2/2	TP3/1	TP3/2	PUMPHOUSE-1	PUMPHOUSE-2	A-TOWERS-AUGER	ASTRO VOC HEAP	ASTRO COMP			
Depth	0-200MM	0-1500MM	1500+MM	0-500MM	500-950MM	0-350MM	350-450MM	0-1100MM	0-200MM				
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	27/08/2015	27/08/2015	27/08/2015	26/08/2015	26/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
Ammoniacal Nitrogen as NH4 (2:1 Ext)	-	<0.3	<0.3	-	-	-	-	-	1.4	-	<0.3	mg/l	TM38/PM20
Chloride (2:1 Ext)#	-	60	65	-	-	-	-	-	10	-	<1	mg/l	TM38/PM20
Fluoride (2:1 Ext)	-	0.70	0.15	-	-	-	-	-	0.15	-	<0.15	mg/l	TM27/PM20
Nitrate as NO3 (2:1 Ext)#	-	<1.25	<1.25	-	-	-	-	-	<1.25	-	<1.25	mg/l	TM38/PM20
Sulphate as SO4 (2:1 Ext)#	-	160.9	176.2	-	-	-	-	-	505.0	-	<1.5	mg/l	TM38/PM20
Ammoniacal Nitrogen as NH4 (Water Soluble)	-	<0.6	<0.6	-	-	-	-	-	3.0	-	<0.6	mg/kg	TM38/PM20
Chloride (Water Soluble)#	-	120	130	-	-	-	-	-	20	-	<2	mg/kg	TM38/PM20
Fluoride (Water Soluble)	-	1.4	0.3	-	-	-	-	-	0.3	-	<0.3	mg/kg	TM27/PM20
Nitrate as NO3 (Water Soluble)#	-	<2.5	<2.5	-	-	-	-	-	<2.5	-	<2.5	mg/kg	TM38/PM20
Sulphate as SO4 (Water Soluble)#	-	322	352	-	-	-	-	-	1010	-	<3	mg/kg	TM38/PM20
Electrical Conductivity @25C (5:1 ext)	489	317	397	224	117	1036	221	787	492	1470	<100	uS/cm	TM76/PM58
pH#	8.18	8.47	8.74	7.74	7.86	7.91	8.23	7.37	6.82	7.80	<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	61-62												
Sample ID	DRY STORE B												
Depth	0-170MM												
COC No / misc													
Containers	V												
Sample Date	31/08/2015												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015												
Aluminium	2626										<50	mg/kg	TM30/PM15
Antimony	<1										<1	mg/kg	TM30/PM15
Arsenic #	2.4										<0.5	mg/kg	TM30/PM15
Barium #	159										<1	mg/kg	TM30/PM15
Beryllium	0.7										<0.5	mg/kg	TM30/PM15
Bismuth	<5										<5	mg/kg	TM30/PM15
Cadmium #	<0.1										<0.1	mg/kg	TM30/PM15
Calcium	18470										<500	mg/kg	TM30/PM15
Chromium #	12.2										<0.5	mg/kg	TM30/PM15
Cobalt #	4.4										<0.5	mg/kg	TM30/PM15
Copper #	13										<1	mg/kg	TM30/PM15
Iron	9742										<20	mg/kg	TM30/PM15
Lead #	33										<5	mg/kg	TM30/PM15
Lithium	<5										<5	mg/kg	TM30/PM15
Magnesium	623										<25	mg/kg	TM30/PM15
Manganese #	130										<1	mg/kg	TM30/PM15
Mercury #	0.1										<0.1	mg/kg	TM30/PM15
Molybdenum #	0.9										<0.1	mg/kg	TM30/PM15
Nickel #	14.4										<0.7	mg/kg	TM30/PM15
Phosphorus	675										<10	mg/kg	TM30/PM15
Potassium	115										<5	mg/kg	TM30/PM15
Selenium #	<1										<1	mg/kg	TM30/PM15
Silver	<1										<1	mg/kg	TM30/PM15
Sodium	234										<5	mg/kg	TM30/PM15
Strontium	277										<5	mg/kg	TM30/PM15
Tellurium	<5										<5	mg/kg	TM30/PM15
Thallium	<1										<1	mg/kg	TM30/PM15
Tin	<1										<1	mg/kg	TM30/PM15
Titanium	202										<5	mg/kg	TM30/PM15
Vanadium	11										<1	mg/kg	TM30/PM15
Boron (Aqua Regia Soluble)	6.12										<0.25	mg/kg	TM30/PM15
Zinc #	214										<5	mg/kg	TM30/PM15
Zirconium	<5										<5	mg/kg	TM30/PM15
Calcium (2:1 Ext)	-										<0.2	mg/l	TM30/PM20
Magnesium (2:1 Ext)	-										<0.1	mg/l	TM30/PM20
Potassium (2:1 Ext)	-										<0.1	mg/l	TM30/PM20
Sodium (2:1 Ext)	-										<0.1	mg/l	TM30/PM20
Calcium (Water Soluble)	-										<0.4	mg/kg	TM30/PM20
Magnesium (Water Soluble)	-										<0.2	mg/kg	TM30/PM20
Potassium (Water Soluble)	-										<0.2	mg/kg	TM30/PM20
Sodium (Water Soluble)	-										<0.2	mg/kg	TM30/PM20
Natural Moisture Content	-										<0.1	%	PM4/PM0

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	61-62											
Sample ID	DRY STORE B											
Depth	0-170MM											
COC No / misc												
Containers	V											
Sample Date	31/08/2015											
Sample Type	Soil											
Batch Number	1											
Date of Receipt	07/09/2015										LOD/LOR	Units	Method No.
Ammoniacal Nitrogen as NH4 (2:1 Ext)	-									<0.3	mg/l	TM38/PM20
Chloride (2:1 Ext) #	-									<1	mg/l	TM38/PM20
Fluoride (2:1 Ext)	-									<0.15	mg/l	TM27/PM20
Nitrate as NO3 (2:1 Ext) #	-									<1.25	mg/l	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-									<1.5	mg/l	TM38/PM20
Ammoniacal Nitrogen as NH4 (Water Soluble)	-									<0.6	mg/kg	TM38/PM20
Chloride (Water Soluble) #	-									<2	mg/kg	TM38/PM20
Fluoride (Water Soluble)	-									<0.3	mg/kg	TM27/PM20
Nitrate as NO3 (Water Soluble) #	-									<2.5	mg/kg	TM38/PM20
Sulphate as SO4 (Water Soluble) #	-									<3	mg/kg	TM38/PM20
Electrical Conductivity @25C (5:1 ext)	432									<100	uS/cm	TM76/PM58
pH #	7.41									<0.01	pH units	TM73/PM11

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Golder Associates Africa Ltd	**SVOC Report :**	**Solid**
Reference:	1534189		
Location:	Kempton Park		
Contact:	Ilse Snyman		
JE Job No.:	15/12420		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-2	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	33-34	LOD/LOR	Units	Method No.
Sample ID	B-COAL STOCKPILE	TP9/1	TP9/2	TP9/3	DAM B-MISPAH	WORKSHOP-1	WORKSHOP-2	BAGHOUSE-1	BAGHOUSE-2	TP7/1			
Depth	0-850MM	700-1000MM	700-1000MM	0-300MM	0-300MM	0-200MM	200-550MM	0-110MM	110+MM	0-170MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	27/08/2015	27/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	27/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
SVOC MS													
Phenols													
2-Chlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dichlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylnaphthalene #	297	<10	<10	418	<10	117	18	<10	<10	25	<10	ug/kg	TM16/PM8
Naphthalene	149	<10	<10	239	16	86	12	<10	<10	15	<10	ug/kg	TM16/PM8
Acenaphthylene	<10	<10	<10	<10	<10	12	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Acenaphthene	17	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Fluorene	30	<10	<10	30	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenanthrene #	186	<10	<10	311	60	173	136	<10	14	62	<10	ug/kg	TM16/PM8
Anthracene	21	<10	<10	43	<10	31	26	<10	15	11	<10	ug/kg	TM16/PM8
Fluoranthene #	67	<10	<10	141	44	260	251	18	25	103	<10	ug/kg	TM16/PM8
Pyrene #	87	<10	<10	118	35	229	202	23	25	92	<10	ug/kg	TM16/PM8
Benzo(a)anthracene	91	<10	<10	95	92	144	109	32	43	53	<10	ug/kg	TM16/PM8
Chrysene	67	<10	<10	110	132	179	114	27	23	61	<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	149	<10	<10	233	47	345	207	56	<10	98	<10	ug/kg	TM16/PM8
Benzo(a)pyrene	39	<10	<10	50	32	156	96	21	18	45	<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	39	<10	<10	53	27	106	56	18	13	32	<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	24	<10	<10	29	15	44	22	<10	<10	14	<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	87	<10	<10	124	41	137	65	28	18	43	<10	ug/kg	TM16/PM8
Benzo(b)fluoranthene	107	<10	<10	168	34	248	149	40	<10	71	<10	ug/kg	TM16/PM8
Benzo(k)fluoranthene	42	<10	<10	65	13	97	58	16	<10	27	<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Diethyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Dimethyl phthalate #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8

Client Name:	Golder Associates Africa Ltd	**SVOC Report :**	**Solid**
Reference:	1534189		
Location:	Kempton Park		
Contact:	Ilse Snyman		
JE Job No.:	15/12420		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-2	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	33-34			
Sample ID	B-COAL STOCKPILE	TP9/1	TP9/2	TP9/3	DAM B-MISPAH	WORKSHOP-1	WORKSHOP-2	BAGHOUSE-1	BAGHOUSE-2	TP7/1			
Depth	0-850MM	700-1000MM	700-1000MM	0-300MM	0-300MM	0-200MM	200-550MM	0-110MM	110+MM	0-170MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	27/08/2015	27/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	27/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Bromophenylphenylether #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Carbazole	18	<10	<10	12	<10	21	15	<10	<10	12	<10	ug/kg	TM16/PM8
Dibenzofuran #	113	<10	<10	201	<10	65	12	<10	<10	12	<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorobutadiene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Isophorone #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Nitrobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

SVOC Report : **Solid**

J E Sample No.	35-36	37-38	39-40	43-44	45-46	57-58					LOD/LOR	Units	Method No.
Sample ID	TP7/2	TP7/3	TP7/4	TP2/1	TP2/2	ASTRO VOC HEAP							
Depth	170-500MM	500-900MM	900+MM	0-1500MM	1500+MM	0-200MM							
COC No / misc													
Containers	V	V	V	V	V	V							
Sample Date	27/08/2015	27/08/2015	27/08/2015	27/08/2015	27/08/2015	31/08/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015							
SVOC MS													
Phenols													
2-Chlorophenol#	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dichlorophenol#	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Phenol#	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene#	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Methylnaphthalene#	<10	<10	<10	<10	<10	4484					<10	ug/kg	TM16/PM8
Naphthalene	<10	<10	<10	<10	<10	2058					<10	ug/kg	TM16/PM8
Acenaphthylene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Acenaphthene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Fluorene	<10	<10	<10	<10	<10	462					<10	ug/kg	TM16/PM8
Phenanthrene#	<10	<10	<10	<10	<10	2658					<10	ug/kg	TM16/PM8
Anthracene	<10	<10	<10	<10	<10	498					<10	ug/kg	TM16/PM8
Fluoranthene#	<10	<10	<10	<10	<10	909					<10	ug/kg	TM16/PM8
Pyrene#	<10	<10	<10	<10	<10	1067					<10	ug/kg	TM16/PM8
Benzo(a)anthracene	<10	<10	<10	<10	<10	659					<10	ug/kg	TM16/PM8
Chrysene	<10	<10	<10	<10	<10	790					<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	<10	<10	<10	<10	<10	1941					<10	ug/kg	TM16/PM8
Benzo(a)pyrene	<10	<10	<10	<10	<10	568					<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	<10	<10	<10	<10	<10	505					<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	<10	<10	<10	<10	<10	292					<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	<10	<10	<10	<10	<10	1228					<10	ug/kg	TM16/PM8
Benzo(b)fluoranthene	<10	<10	<10	<10	<10	1398					<10	ug/kg	TM16/PM8
Benzo(k)fluoranthene	<10	<10	<10	<10	<10	543					<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Diethyl phthalate	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Dimethyl phthalate#	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: Golder Associates Africa Ltd **SVOC Report :** **Solid**
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Please see attached notes for all abbreviations and acronyms

J E Sample No.	35-36	37-38	39-40	43-44	45-46	57-58							
Sample ID	TP7/2	TP7/3	TP7/4	TP2/1	TP2/2	ASTRO VOC HEAP							
Depth	170-500MM	500-900MM	900+MM	0-1500MM	1500+MM	0-200MM							
COC No / misc													
Containers	V	V	V	V	V	V							
Sample Date	27/08/2015	27/08/2015	27/08/2015	27/08/2015	27/08/2015	31/08/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015							
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Bromophenylphenylether #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Carbazole	<10	<10	<10	<10	<10	148					<10	ug/kg	TM16/PM8
Dibenzofuran #	<10	<10	<10	<10	<10	1725					<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorobutadiene #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Isophorone #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Nitrobenzene #	<10	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

VOC Report : **Solid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-2	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	33-34			
Sample ID	B-COAL STOCKPILE	TP9/1	TP9/2	TP9/3	DAM B-MISPAH	WORKSHOP-1	WORKSHOP-2	BAGHOUSE-1	BAGHOUSE-2	TP7/1			
Depth	0-850MM	700-1000MM	700-1000MM	0-300MM	0-300MM	0-200MM	200-550MM	0-110MM	110+MM	0-170MM			
COC No / misc													
Containers	V	V	V	V	V	V	V	V	V	V			
Sample Date	31/08/2015	27/08/2015	27/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015	27/08/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015			
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7	<7	73	65	55	<7	<7	<7	<7	<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	52	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	40	23	15	<3	13	12	<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	58	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	18	14	10	<3	8	9	<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	15	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	21	<5	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	12	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Styrene	<3	9	<3	<3	13	<3	15	<3	<3	8	<3	ug/kg	TM15/PM10
Bromoform	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27	<27	<27	<27	<27	<27	<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	80	110	110	99	97	112	109	111	108	102	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	73	116	125	63	65	66	85	76	83	94	<0	%	TM15/PM10

Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Golder Associates Africa Ltd	**VOC Report :**	**Solid**
Reference:	1534189		
Location:	Kempton Park		
Contact:	Ilse Snyman		
JE Job No.:	15/12420		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	35-36	37-38	39-40	43-44	45-46	57-58							
Sample ID	TP7/2	TP7/3	TP7/4	TP2/1	TP2/2	ASTRO VOC HEAP							
Depth	170-500MM	500-900MM	900+MM	0-1500MM	1500+MM	0-200MM							
COC No / misc													
Containers	V	V	V	V	V	V							
Sample Date	27/08/2015	27/08/2015	27/08/2015	27/08/2015	27/08/2015	31/08/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015	07/09/2015					LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1					<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7	<7	<7	<7	171					<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3	15					<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	15	<3	45					<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	<3	27					<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	8	<3	59					<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	<5	<5					<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Styrene	5	<3	<3	11	<3	<3					<3	ug/kg	TM15/PM10
Bromoform	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2	<2					<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3	<3					<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5	<5					<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6	<6					<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7	<7					<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4	<4					<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27	<27					<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7	<7					<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	77	109	107	104	112	61					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	82	124	118	86	124	78					<0	%	TM15/PM10

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 15/12420

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 (UKAS) accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution
AB	x10 Dilution
AC	x20 Dilution

JE Job No: 15/12420

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM27	Modified US EPA method 9056.Determination of water soluble anions using Dionex (Ion-Chromatography).	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AD	Yes

JE Job No: 15/12420

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AR	No
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM58	Dried and ground solid samples are extracted with water in a 5:1 water to solid ratio, the samples are shaken on an orbital shaker.			AD	Yes

Jones Environmental Laboratory - South Africa

Unit 2/5
9 Quantum Road
Firgrove Business Park
Somerset West
7130
South Africa

Golder Associates Africa Ltd
Building 1, Golder House
Magwa Crescent West
Maxwell Office Park
Cnr Allandale Road and Maxwell Drive
Waterfall City, Midrand
South Africa

Attention :	Ilse Snyman
Date :	30th September, 2015
Your reference :	1534189
Our reference :	Test Report 15/12420 Batch 2
Location :	Kempton Park
Date samples received :	10th September, 2015
Status :	Final report
Issue :	1

Five samples were received for analysis on 10th September, 2015 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

All analysis was undertaken at Jones Environmental Laboratory in the UK, which is ISO 17025 accredited under UKAS (4225).

NOTE: Under International Laboratory Accreditation Cooperation (ILAC), ISO 17025 (UKAS) accreditation is recognised as equivalent to SANAS (South Africa) accreditation.

Compiled By:

S. Go

Simon Gomery BSc
Project Manager

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	63-64	65-66	67-68	69-70	71-72								
Sample ID	REF-WETLAND	REF-MISPAH	REF-A	REF-B1	REF-B2								
Depth	0.00-0.70	0.00-0.29	0.00-0.35	0.35-0.65	0.65-1.00								
COC No / misc													
Containers	V	V	V	V	V								
Sample Date	08/09/2015	08/09/2015	08/09/2015	08/09/2015	08/09/2015								
Sample Type	Soil	Soil	Soil	Soil	Soil								
Batch Number	2	2	2	2	2								
Date of Receipt	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015						LOD/LOR	Units	Method No.
Aluminium	15660	14050	12510	20740	14330						<50	mg/kg	TM30/PM15
Antimony	5	6	8	17	15						<1	mg/kg	TM30/PM15
Arsenic #	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	mg/kg	TM30/PM15
Barium #	46	18	64	167	193						<1	mg/kg	TM30/PM15
Beryllium	<0.5	<0.5	0.7	1.5	1.3						<0.5	mg/kg	TM30/PM15
Bismuth	<5	<5	<5	<5	<5						<5	mg/kg	TM30/PM15
Cadmium #	<0.1	<0.1	<0.1	<0.1	<0.1						<0.1	mg/kg	TM30/PM15
Calcium	3522	653	<500	<500	<500						<500	mg/kg	TM30/PM15
Chromium #	494.8$_{AA}$	628.6$_{AA}$	902.3$_{AA}$	1987.0$_{AA}$	1743.0$_{AA}$						<0.5	mg/kg	TM30/PM15
Cobalt #	18.6	84.7	40.1	170.7	83.2						<0.5	mg/kg	TM30/PM15
Copper #	11	20	14	38	26						<1	mg/kg	TM30/PM15
Iron	24810	24890	38190	74020$_{AA}$	75150$_{AA}$						<20	mg/kg	TM30/PM15
Lead #	<5	<5	6	13	9						<5	mg/kg	TM30/PM15
Lithium	7	<5	9	20	7						<5	mg/kg	TM30/PM15
Magnesium	8879	13550	384	111	214						<25	mg/kg	TM30/PM15
Manganese #	214	885	867	2924$_{AA}$	1835						<1	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1						<0.1	mg/kg	TM30/PM15
Molybdenum #	0.3	0.4	1.4	2.8	1.9						<0.1	mg/kg	TM30/PM15
Nickel #	220.1	352.1$_{AA}$	261.4$_{AA}$	770.9$_{AA}$	638.5$_{AA}$						<0.7	mg/kg	TM30/PM15
Phosphorus	193	57	208	391	274						<10	mg/kg	TM30/PM15
Potassium	260	52	230	301	227						<5	mg/kg	TM30/PM15
Selenium #	<1	1	2	3	2						<1	mg/kg	TM30/PM15
Silver	<1	<1	<1	<1	<1						<1	mg/kg	TM30/PM15
Sodium	113	105	78	104	103						<5	mg/kg	TM30/PM15
Strontium	35	5	6	<5	<5						<5	mg/kg	TM30/PM15
Tellurium	6	6	10	21	20						<5	mg/kg	TM30/PM15
Thallium	<1	<1	<1	3	<1						<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1						<1	mg/kg	TM30/PM15
Titanium	230	274	265	377	350						<5	mg/kg	TM30/PM15
Vanadium	36	47	52	110	103						<1	mg/kg	TM30/PM15
Boron (Aqua Regia Soluble)	1.06	0.63	<0.25	<0.25	<0.25						<0.25	mg/kg	TM30/PM15
Zinc #	24	13	12	15	13						<5	mg/kg	TM30/PM15
Zirconium	<5	<5	<5	<5	<5						<5	mg/kg	TM30/PM15
Calcium (2:1 Ext)	8.1	6.3	5.7	2.6	1.7						<0.2	mg/l	TM30/PM20
Magnesium (2:1 Ext)	3.9	5.9	2.3	2.0	6.7						<0.1	mg/l	TM30/PM20
Potassium (2:1 Ext)	0.7	1.2	0.6	0.3	0.7						<0.1	mg/l	TM30/PM20
Sodium (2:1 Ext)	6.1	2.8	1.9	1.1	1.8						<0.1	mg/l	TM30/PM20
Calcium (Water Soluble)	16.2	12.6	11.4	5.2	3.4						<0.4	mg/kg	TM30/PM20
Magnesium (Water Soluble)	7.8	11.8	4.6	4.0	13.4						<0.2	mg/kg	TM30/PM20
Potassium (Water Soluble)	1.4	2.4	1.2	0.6	1.4						<0.2	mg/kg	TM30/PM20
Sodium (Water Soluble)	12.2	5.6	3.8	2.2	3.6						<0.2	mg/kg	TM30/PM20
Natural Moisture Content	36.0	10.4	8.4	10.6	10.2						<0.1	%	PM4/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	63-64	65-66	67-68	69-70	71-72								
Sample ID	REF-WETLAND	REF-MISPAH	REF-A	REF-B1	REF-B2								
Depth	0.00-0.70	0.00-0.29	0.00-0.35	0.35-0.65	0.65-1.00								
COC No / misc													
Containers	V	V	V	V	V								
Sample Date	08/09/2015	08/09/2015	08/09/2015	08/09/2015	08/09/2015								
Sample Type	Soil	Soil	Soil	Soil	Soil								
Batch Number	2	2	2	2	2								
Date of Receipt	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015						LOD/LOR	Units	Method No.
Ammoniacal Nitrogen as NH4 (2:1 Ext)	<0.3	<0.3	<0.3	<0.3	<0.3						<0.3	mg/l	TM38/PM20
Chloride (2:1 Ext) #	<1	2	6	<1	<1						<1	mg/l	TM38/PM20
Fluoride (2:1 Ext)	<0.15	<0.15	<0.15	<0.15	<0.15						<0.15	mg/l	TM27/PM20
Nitrate as NO3 (2:1 Ext) #	<1.25	<1.25	<1.25	<1.25	<1.25						<1.25	mg/l	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	23.5	36.4	54.2	11.8	<1.5						<1.5	mg/l	TM38/PM20
Ammoniacal Nitrogen as NH4 (Water Soluble)	<0.6	<0.6	<0.6	<0.6	<0.6						<0.6	mg/kg	TM38/PM20
Chloride (Water Soluble) #	<2	4	12	<2	<2						<2	mg/kg	TM38/PM20
Fluoride (Water Soluble)	<0.3	<0.3	<0.3	<0.3	<0.3						<0.3	mg/kg	TM27/PM20
Nitrate as NO3 (Water Soluble) #	<2.5	<2.5	<2.5	<2.5	<2.5						<2.5	mg/kg	TM38/PM20
Sulphate as SO4 (Water Soluble) #	47	73	108	24	<3						<3	mg/kg	TM38/PM20
Electrical Conductivity @25C (5:1 ext)	104	<100	<100	<100	<100						<100	uS/cm	TM76/PM58
pH #	7.65	6.37	6.97	7.23	6.59						<0.01	pH units	TM73/PM11

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

SVOC Report : **Solid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	63-64	65-66	67-68	69-70	71-72								
Sample ID	REF-WETLAND	REF-MISPAH	REF-A	REF-B1	REF-B2								
Depth	0.00-0.70	0.00-0.29	0.00-0.35	0.35-0.65	0.65-1.00								
COC No / misc													
Containers	V	V	V	V	V								
Sample Date	08/09/2015	08/09/2015	08/09/2015	08/09/2015	08/09/2015								
Sample Type	Soil	Soil	Soil	Soil	Soil								
Batch Number	2	2	2	2	2								
Date of Receipt	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015						LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Phenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Methylnaphthalene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Naphthalene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Acenaphthylene	<10	22	<10	<10	<10						<10	ug/kg	TM16/PM8
Acenaphthene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Fluorene	<10	25	<10	<10	<10						<10	ug/kg	TM16/PM8
Phenanthrene	15	89	<10	<10	<10						<10	ug/kg	TM16/PM8
Anthracene	16	19	<10	<10	<10						<10	ug/kg	TM16/PM8
Fluoranthene	<10	41	<10	<10	<10						<10	ug/kg	TM16/PM8
Pyrene	<10	33	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(a)anthracene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Chrysene	<10	18	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	<10	13	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(a)pyrene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(b)fluoranthene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Benzo(k)fluoranthene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Diethyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Dimethyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8

Client Name:	Golder Associates Africa Ltd	**SVOC Report :**	**Solid**
Reference:	1534189		
Location:	Kempton Park		
Contact:	Ilse Snyman		
JE Job No.:	15/12420		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	63-64	65-66	67-68	69-70	71-72							
Sample ID	REF-WETLAND	REF-MISPAH	REF-A	REF-B1	REF-B2							
Depth	0.00-0.70	0.00-0.29	0.00-0.35	0.35-0.65	0.65-1.00							
COC No / misc												
Containers	V	V	V	V	V							
Sample Date	08/09/2015	08/09/2015	08/09/2015	08/09/2015	08/09/2015							
Sample Type	Soil	Soil	Soil	Soil	Soil							
Batch Number	2	2	2	2	2							
Date of Receipt	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015					LOD/LOR	Units	Method No.
SVOC MS												
Other SVOCs												
1,2-Dichlorobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Carbazole	<10	12	<10	<10	<10					<10	ug/kg	TM16/PM8
Dibenzofuran	<10	20	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Isophorone	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8
Nitrobenzene	<10	<10	<10	<10	<10					<10	ug/kg	TM16/PM8

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Client Name: Golder Associates Africa Ltd **VOC Report :** **Solid**
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman
JE Job No.: 15/12420

Please see attached notes for all abbreviations and acronyms

J E Sample No.	63-64	65-66	67-68	69-70	71-72								
Sample ID	REF-WETLAND	REF-MISPAH	REF-A	REF-B1	REF-B2								
Depth	0.00-0.70	0.00-0.29	0.00-0.35	0.35-0.65	0.65-1.00								
COC No / misc													
Containers	V	V	V	V	V								
Sample Date	08/09/2015	08/09/2015	08/09/2015	08/09/2015	08/09/2015								
Sample Type	Soil	Soil	Soil	Soil	Soil								
Batch Number	2	2	2	2	2								
Date of Receipt	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015						LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1						<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6						<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7	<7	<7	<7						<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6						<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	<5						<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Styrene	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Bromoform	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2						<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3						<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5						<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6						<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7						<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4						<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27						<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7						<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	75	78	76	108	79						<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	62	79	69	119	89						<0	%	TM15/PM10

Client Name: Golder Associates Africa Ltd
Reference: 1534189
Location: Kempton Park
Contact: Ilse Snyman

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 15/12420						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 15/12420

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 (UKAS) accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x10 Dilution

JE Job No: 15/12420

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM27	Modified US EPA method 9056.Determination of water soluble anions using Dionex (Ion-Chromatography).	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AR	Yes

JE Job No: 15/12420

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.			AR	No
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM58	Dried and ground solid samples are extracted with water in a 5:1 water to solid ratio, the samples are shaken on an orbital shaker.			AD	Yes

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APPENDIX B

SDS for Hydrotac (M) Liquid used for dust suppression

Safety Data Sheet – HYDROTAC (M) LIQUID

Company Details:

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Gauteng
RSA

Tel: 012 648 8900
Fax: 012 665 3456
E-mail: info@dustaside.com

Emergency Telephone Numbers:

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Production Manager	Ms. A Cronje	082 570 0958
Imperial Representative	Mr. Ricardo Basson	083 251 6051
Chief Technical Officer	Mr. F Masipa	082 768 9354
Rapid Spill	24h Response	0800 172 743

1. Product and Company Identification

Trade Name:	HydroTac
Chemical name:	Liquid Lignosulphonate
Hazchem-code:	CAS No: 8061-51-6 (Sodium Lignosulphonate)
EINECS No:	23-25-059 (Sodium Lignosulphonate)
Hazardous Composition:	Non-hazardous

2. Composition / Information on Ingredients

Chemical nature:	Sodium Lignosulphonate
CAS Number:	8061 51 6 (Sodium Lignosulphonate)

3. Hazards Identification

HMIS/NFPA:	Health: 1	Fire: 0	Reactivity: 0
Main Hazard:	Health (low)		
Flammability:	Non-flammable		
Chemical Hazard:	None		
Combustion products:	Carbon dioxide		

4. First-Aid Measures

Eye exposure:	**Effect:** Direct contact may cause redness and irritation. **First Aid:** Immediately flush with large volumes of clean cool water for 15 minutes. See a physician, preferably on Ophthalmologist for further evaluation.
Skin exposure:	**Effect:** Direct prolonged contact may be irritating to the skin **First Aid:** Remove contaminated clothing immediately. Wash off affected area thoroughly with lots of water. If irritation or other symptoms develops seek medical attention.
Inhalation:	**Effect:** Exposure to mists may cause irritation to the nose **First Aid:** Remove from exposure to fresh air. If symptoms persist seek medical attention.
Ingestion:	**Effect:** Vomiting may occur. May be harmful to the mouth, throat and stomach if ingested, although a specific toxic effect is not expected. **First Aid:** Do not induce vomiting. Rinse mouth with water, and then drink a large amount of water. Seek immediate medical attention.

5. Fire-Fighting Measures

The product is non-flammable. Water, foam and carbon Dioxide can be used as distinguishing media. Wear respirator (Pressure-demand, self-contained breathing apparatus) and full protective gear. Decomposition products Sulphur dioxide and carbon Monoxide.

6. Accidental Release Measures

When cleaning spills (large or small), wear appropriate protective clothing**.**

Refer to section 8 below, Exposure Controls / Personal Protection Equipment.

Spills:	When cleaning spillages, contain the contaminated area to prevent the spillage from spreading further. Keep out of municipal or storm water sewers and open bodies of water. Minimise adverse effects on the environment. Recover as much as possible of the neat product into appropriate containers. Clay, soil, or commercially available adsorbents may be used to recover any material that cannot be recovered as neat product.
Environmental Precaution:	Do not discharge concentrated, undiluted product into lakes, streams, ponds, estuaries, oceans and other water born areas

Any surface soil contaminated with the product should be shovelled into appropriate containers.

Refer to section 13 below, Disposal Considerations, for the safe disposal of waste products.

7. Handling and Storage

Handling:	Like most chemicals avoid eye contact. Use safety goggles and gloves
Storage:	Store in a closed container or bulk storage facility with a lid to avoid chemical from being exposed to bacteria. Store away from incompatible materials described in section 10. Keep container closed when not use – check regularly for leaks.
Incompatible Materials:	Incompatible with strong oxidizing agents. Do not store next to strong acids, alkaline and / or oxidisers. When handling, wear appropriate protective clothing.

8. Exposure Controls / Personal Protection

Wear appropriate protective clothing **(PPE)**:

Footwear:	Impermeable safety footwear
Respiratory protection:	When required.
Hand protection:	Rubber gloves
Eye protection:	Safety goggles and or other specified protective eyewear. When loading or unloading tanker, a face shield should be worn.
Head Protection:	Protective helmet
Body protection:	Long sleeves overalls

9. Physical and Chemical Properties

Appearance:	Viscous brown liquid
Odour:	Slight odour
Dry Substance (%):	≥ 30
Density (20°C):	1,20 ± 0,05 (g /ml solution)
Viscosity (20°C)	<100 mPas
pH (Solution):	9.5 ± 0.5
In soluble:	<0.5
Water Solubility:	Miscible in water
Solubility in organic substance:	Very low
Boiling Point:	100°C (Water)

Flash Point (^{0}C):	Not applicable
Explosive Properties:	None
Autoignition Temperature:	Not applicable

10. Stability and Reactivity

Stable under normal conditions
Incompatible with strong oxidizing agents

11. Toxicological Information

Based on actual testing or on data for similar material(s).

Acute Toxicity:	Not Available.
Acute oral LD50:	Single dose oral toxicity is considered to be low. The oral LD50 for rats is >2000mg/kg. No hazards anticipated from swallowing small amounts incidental to normal handling operations.
Acute dermal LD50:	The LD50 for skin absorption in rats is >2000mg/kg.
Acute inhalation LC50:	No adverse effects are anticipated from mild inhalation.
Skin & Eye Contact:	Not Available.
Acute skin irritation:	May cause slight transient (temporary) eye irritation. Corneal injury is unlikely.
Acute eye irritation:	May cause slight transient (temporary) eye irritation. Corneal injury is unlikely.
Dermal sensitization:	Not Available.

12. Ecological Information

Product is classified as nontoxic to aquatic organisms and is classified as inherently biodegradable. However, large spill into natural water systems is expected to cause acute short-term toxicity to aquatic life due to depletion of dissolved oxygen levels in the water. Once enough natural dilution has occurred no long-term effects are expected. The main organic component will tend to bind soil particles together and will naturally decompose over time (Lignosulphonate is used commercially as soil binders for dirt roads). The residual chemical content will not cause toxic contamination of ground water.

13. Disposal Considerations

Disposal Method:	Dispose in accordance with local/national regulations governing the disposal of waste materials.
Disposal of Packaging:	Residues of packing may be incinerated unless local disposal regulations state otherwise.

The concentrated product, absorbed by suitable absorbents as described in Section 6, Accidental Release Measures, can be removed to a dumping site. Dispose according to local regulations.

14. Regulatory Information

Transportation:	Non-hazardous and no transport regulations required for this product.

15. Exposure limit

Information:	Not classified as dangerous for supply or conveyance. Non- hazardous.
Poison Schedule:	Not Applicable.

No exposure limits have been specifically investigated for this product. The primary risks would be associated with skin exposure, inhalation of mists and ingestion. Acute toxicity is not expected on skin exposure. Provided the product is rinsed off the skin promptly after exposure no long-term effects are expected.

16. Other Information

Literary Reference

This Safety Data Sheet meets the requirements of 91/155/EEC and ISO 11014-1.
Refer to the Product Data Sheet

APPENDIX C

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Appendix G4: Traffic Assessment

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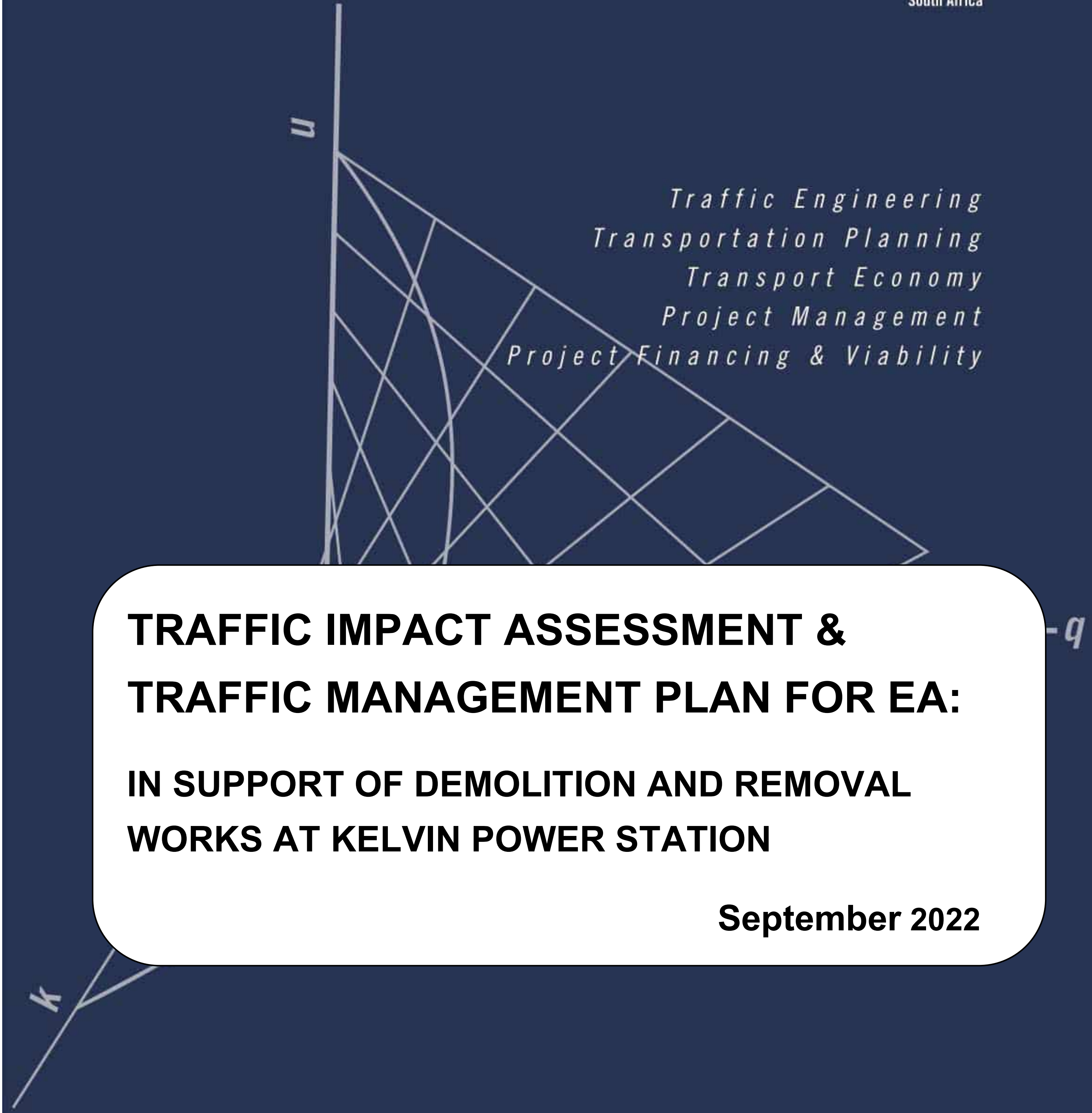

Traffic Engineering
Transportation Planning
Transport Economy
Project Management
Project Financing & Viability

TRAFFIC IMPACT ASSESSMENT & TRAFFIC MANAGEMENT PLAN FOR EA:

IN SUPPORT OF DEMOLITION AND REMOVAL WORKS AT KELVIN POWER STATION

September 2022

TITLE OF REPORT:

TRAFFIC IMPACT ASSESSMENT AND TRAFFIC MANAGEMENT PLAN FOR EA: IN SUPPORT OF DEMOLITION AND REMOVAL WORKS AT KELVIN POWER STATION

DATE: September 2022

STATUS OF REPORT: Final Report

PREPARED FOR:

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REPORT NUMBER:

REP01/TW1254/15Sep22

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DESCRIPTION OF PROJECT:

This traffic impact assessment and traffic management plan is done in support of the demolition of three (3) cooling towers, defunct power generation structures, and buildings of the A-station at the Kelvin Power Station

PROJECT TEAM:

AUTHOR (S) OF REPORT:	P Kruger, J Daling
CHECKED AND DISTRIBUTION APPROVAL:	P Kruger

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1 INTRODUCTION

1.1 PROPOSED PROJECT

The Traffic Impact Assessment and Traffic Management Plan was compiled in support of the application for environmental authorisation for the proposed demolition of three (3) cooling towers, defunct power generation structures and buildings of the A-Station Power Plant at the Kelvin Power Station, Kempton Park, City of Ekurhuleni, Gauteng.

The Kelvin Power Station comprises of two separate power plants, namely the A-Station and the B-Station. The A-Station was in operation for approximately 60 years, until 2012 when it was placed under care and maintenance. Kelvin Power has subsequently decided to decommission and demolish the A-Station. It is expected that, during the demolition phase, trucks and other construction vehicles will move to and from the site to transport demolition waste and equipment.

TECHWORLD was appointed by GOLDER, on behalf of Kelvin Power, to conduct the traffic impact assessment and traffic management plan in support of the application for Environmental Authorisation (EA).

Since the demolition and removal of a power station is a specialist activity, Kelvin Power provided information on the proposed demolition activities, potential types, and quantities of waste to be generated and an expected timeline for the demolition activities.

Figure 1 shows the locality of the project site, *Figure 2* delineates the study area (A-Station power plant), while Appendix A and *Appendix B* contains the demolition information obtained from Kelvin Power.

1.2 SCOPE OF TRAFFIC INVESTIGATED

The Traffic Impact Assessment was compiled in support of the demolition of three (3) cooling towers, defunct power generation structures, and buildings of the A-Station at Kelvin Power Station. It was assumed that the project will start within 12 months and will be completed 12 months thereafter.

The main access to Kelvin Power station is located on Shrike Rd, while a secondary access to the site is located on Lovato Rd. The Access on Lovato Rd will be utilized during the demolition works.

The following methodology was followed:

- Determine existing traffic demand at intersections through classified manual 12-hour traffic counts,
- Determine expected traffic demand during the execution of the works,
- Assign additional traffic demand to the road network,
- Conduct capacity and operational analyses,
- Consider traffic safety implications and design appropriate mitigation measures,
- Draft recommendations and conditions for implementation,

2 CURRENT ROAD NETWORK AND EXISTING TRAFFIC DEMAND

2.1 CURRENT ROAD NETWORK

The Kelvin Power Station is served by the Zuurfontein Rd / Isando Rd (M39) with primary access via Shrike Rd on the southern side of the railway line that crosses over Zuurfontein Rd / Isando Rd (M39) with a secondary access via Lovato Rd on the northern side of the railway line.

The Zuurfontein Rd / Isando Rd is a Class 2 divided four lane major arterial road with local lane widening at signalized intersections along the route. This road provides regional accessibility to the site via the R24 and the N12 in the south and Modderfontein Road (R25) in the north. Shrike Rd and Lovato Rd are Class 5 two-lane undivided local roads.

The proposed routing report prepared by Kelvin Power indicates three routes which will be used to transport demolished waste to a hazardous waste landfill site (EnviroServ Holfontein Landfill, Breswol AH, Breswol), a scrap recycler (New Deal Scrap Metal, Spartan, Kempton Park, 1619) and a general rubble yard (Simmer & Jack Landfill, Meade Crescent, Elandsfontein 90-LR, Germiston) via the secondary access of the Kelvin Power Station on Lovato Rd.

Given these routes, the following intersection were included in the study area:

- Intersection 1: Zuurfontein Rd / Lovato Rd (Signalised)
- Intersection 2: Zuurfontein Rd / Shrike Rd - Spartan Rd (Signalised)
- Intersection 3: Isando Rd / Green Ave (Signalised)
- Intersection 4: Isando Rd / Brabazon Rd (Signalised)
- Intersection 5: Cape Wagtail St / Shrike Rd (One-way Stop Controlled)

Figure 2 shows the study area while *Figure 3* shows the existing road network and lane layout at these intersections.

2.2 EXISTING TRAFFIC DEMAND

The existing traffic demand in the study area was determined on Tuesday 03 June 2021 by means of 12-hour (06:00 to 18:00) manual classified turning counts at the intersections. The weekday morning peak hour occurred between 06:45 and 07:45 while the weekday afternoon peak hour occurred between 15:45 and 16:45.

The existing two-way peak hour traffic volumes on Zuurfontein – Isando Rd north and south of Spartan Rd – Shrike Rd varies between 1000 to 1100 vehicles/hour during the AM peak period and between 900 to 1000 vehicles/hour during the PM peak period.

An additional peak period manual classified count was also conducted on Wednesday 13 April 2022 at the intersection of Cape Wagtail St / Shrike Rd, which included a pedestrian count west of Cape Wagtail St on Shrike Rd to capture the egressing pedestrian movements to and from the power plant.

The existing peak hour traffic demand on Lovato Rd is about 850 and 600 vehicles/hour compared with about 170 and 120 vehicles/hour on Shrike Rd with two-way pedestrian flows of about 170 and 80 pedestrians/hour to and from the power station during the AM and PM peak hours respectively.

Figure 4 and *Figure 5* shows the existing peak hour volumes in the study area.

3 EXPECTED TRAFFIC IMPACT

3.1 DESIGN YEAR AND GROWTH IN BACKGROUND TRAFFIC

A 3% growth per annum was plied for one year to the counted traffic volumes in 2021 to determine the 2022 base year traffic demand while a 3% growth per annum for a subsequent 2 years was applied to determine the future traffic demand, which allows for a 12-month mobilisation period and a 12-month project period.

The expected distribution in vehicle traffic is shown in *Figure 4* and *Figure 5*.

3.2 EXPECTED TRAFFIC GENERATION

Kelvin Power determined the applicable routes and estimated the expected number of vehicles that will be used during the demolishing and removal works. These routes will be used to transport waste to a hazardous waste landfill site, a scrap recycler, and a general rubble yard. It is also estimated that ±50 staff members will be on site during the project.

The expected peak hour trip generation of the site was subsequently determined from the information provided by Kelvin Power. The expected additional peak hour trips will be about 53 vehicle trips of which 35 trips will be light vehicles and 18 trips will be heavy vehicles. The directional split is 37 trips inbound and 16 trips outbound during the weekday AM peak hour and 16 trips inbound and 37 trips outbound during the weekday PM peak hour. The expected trip generation is summarised in *Table 1*.

It should be noted that the round-trip times for the heavy vehicles were determined as twice the one directional trip time plus an allowance for loading and offloading. It was assumed that the expected 15 public transport users will walk to the site from the Zuurfontein Rd / Shrike Rd - Spartan Rd intersection and therefore increase the current pedestrian movements marginally.

The heavy vehicle traffic was subsequently distributed on the road network according to the routing information provided by Kelvin Power.

Table 1: Expected Trip Generation

TYPE	**NO OF VEHICLES**	**PRIVATE – PUBLIC TRANSPORT SPLIT**			**TRIPS / HOUR**	**DIRECTIONAL SPLIT**	
LIGHT VEHICLES							
Staff	50	Private	70%	35	35.0	80%	20%
		Public	30%	15	Considered to be on the network already		
SUB-TOTAL					**35.0**	**28.0**	**7.0**
HEAVY VEHICLES							
TYPE	**NO VEHICLES**	**ROUND-TRIP TIME (MIN)**	**ROUND TRIPS / HOUR PER VEHICLE**		**TRIPS / HOUR**	**DIRECTIONAL SPLIT**	
Hazardous Waste	3	115	0.52		±2	50%	50%
General Waste	15	67	0.90		±13	50%	50%
Scrap Steel	2	39	1.54		±3	50%	50%
SUB-TOTAL					**±18**	**9.0**	**9.0**
TOTAL					**±53**	**37.0**	**16.0**

Figure 4 and *Figure 5* shows the expected future traffic demand including the traffic that will be generated by the demolishing and removal works.

3.3 CAPACITY AND OPERATIONAL ANALYSES

Capacity and operational analyses were subsequently conducted with SIDRA for existing and future scenarios (with project) in 2022 and 2024 respectively.

The results of the capacity and operational analyses are summarised in *Table 2*.

Inspection of *Table 2* shows that the additional expected traffic on the road network will have a negligible impact on the service levels in the study area. No mitigation of the road network, from a capacity point of view, is thus required to support the demolition and removal works.

Table 2: Results of Capacity and Operational Analyses

INTERSECTION	MEASURE OF EFFECTIVE-NESS (MOE)	AM PEAK HOUR		PM PEAK HOUR	
		EXISTING	FUTURE WITH PROJECT	EXISTING	FUTURE WITH PROJECT
		2022	2024	2022	2024
Intersection 1	V/C	0.808	0.880	0.723	0.750
Zuurfontein Rd / Lovato Rd	Delay	27.6	31.6	23.2	23.6
	LOS	C	C	C	C
Intersection 2	V/C	0.429	0.454	0.386	0.425
Zuurfontein Rd / Shrike Rd - Spartan Rd	Delay	8.4	6.8	7.3	7.4
	LOS	A	A	A	A
Intersection 3	V/C	0.773	0.850	0.540	0.573
Isando Rd / Green Ave	Delay	30.7	33.3	22.3	22.1
	LOS	C	C	C	C
Intersection 4	V/C	0.877	0.932	0.612	0.690
Isando Rd / Brabazon Rd	Delay	35.9	39.3	23.2	23.5
	LOS	D	D	C	C
Intersection 5	V/C	0.087	0.099	0.037	0.052
Cape Wagtail St / Shrike Rd	Delay	5.0 (8.2)	4.0 (8.4)	3.8 (8.0)	2.7 (8.1)
	LOS	A (A)	A (A)	A (A)	A (A)

4 PUBLIC TRANSPORT FACILITIES AND PEDESTRIAN ASSESSMENT

4.1 PUBLIC TRANSPORT FACILITIES

Bus/taxi loading zones are currently provided on Zuurfontein Road downstream of the intersection with Shrike Road - Spartan Road.

A taxi layby is also provided on the northern side of Shrike Road between Zuurfontein Road and Cape Wagtail Ave. It is recommended to provide a covered shelter for pedestrians at this taxi layby since pedestrians wait an extended period for taxis to arrive.

4.2 PEDESTRIAN SIDEWALKS

Paved sidewalks are provided from the bus/taxi loading zones on Zuurfontein Road to the intersection with Shrike Road - Spartan Road. No sidewalks are however provided on either side of Shrike Road between Zuurfontein Road and the Kelvin Power Station resulting in pedestrians walking in the roadway to and from the power plant.

A minimum 2.0-meter-wide paved sidewalk is thus recommended on the northern side of Shrike Road between Zuurfontein Road and the Kelvin Power Station to segregate pedestrians and vehicles. This will not only benefit pedestrians during the project phase but also during the future operational phase of the Kelvin Power Station.

5 REQUIRED MITIGATION AND SAFETY INTERVENTIONS

The planned demolishing and removal works of the A-Station at the Kelvin Power Station is only expected to generate about 53 additional peak hour trips during the weekday peak hours. These trips can be accommodated by the existing road network and no mitigation is necessary from a capacity and operational point of view.

The construction of a minimum 2.0m wide paved sidewalk on the northern side of Shrike Road as well as a covered shelter at the existing bus-/taxi loading zone between Zuurfontein Road and the Kelvin Power Station is recommended from a traffic management perspective.

Refer to *Figure 3* for an illustration of the location of the proposed covered shelter and the proposed paved pedestrian sidewalk.

6 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSIONS

The following is concluded based on this traffic investigation:

1) The Traffic Impact Assessment and Traffic Management Plan was compiled in support of the application for environmental authorisation for the proposed demolition of three (3) cooling towers, defunct power generation structures and buildings of the A-Station at the Kelvin Power Station, Kempton Park, Ekurhuleni, Gauteng.

2) The existing traffic demand in the study area was determined on Tuesday 03 June 2021 by means of 12-hour (06:00 to 18:00) manual classified turning counts at the intersections.

3) An additional peak period manual classified count was also conducted on Wednesday 13 April 2022 at the intersection of Cape Wagtail St / Shrike Rd, which included a pedestrian count west of Cape Wagtail St on Shrike Rd to capture the egressing pedestrian movements to and from the power plants.

4) Since the demolition and removal of a power station is a specialist activity, Kelvin Power provided information on the proposed demolition activities, potential types, and quantities of waste to be generated and an expected timeline for the demolition activities.

5) The Kelvin Power Station is served by the Zuurfontein Rd / Isando Rd (M39) with primary access via Shrike Rd on the southern side of the railway line that crosses over Zuurfontein Rd / Isando Rd (M39) with a secondary access via Lovato Rd on the northern side of the railway line.

6) The planned demolishing and removal works of the A-Station at the Kelvin Power Station is only expected to generate about 53 additional peak hour trips during the weekday peak hours. Capacity and operational analyses with SIDRA shows that these trips can be accommodated by the existing road network and no mitigation is necessary from a capacity and operational point of view.

7) The construction of a minimum 2.0m wide paved sidewalk on the northern side of Shrike Road as well as a covered shelter at the existing bus-/taxi loading zone between Zuurfontein Road and the Kelvin Power Station is recommended from a traffic management perspective.

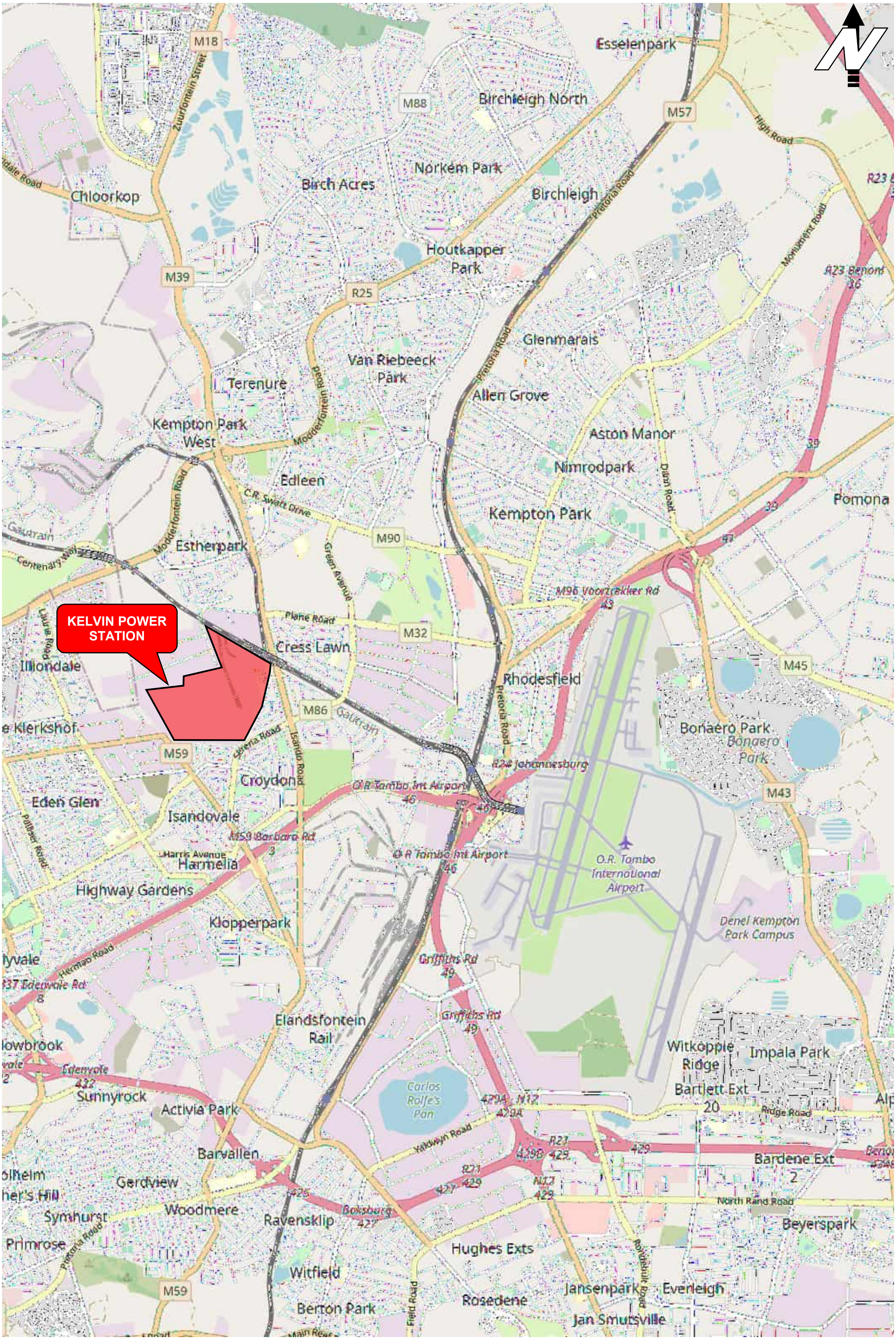
6.2 RECOMMENDATIONS

The project, demolishing and removal works at Kelvin Power Station, is supported from a traffic engineering perspective subject to the following interventions from a traffic management perspective:

> *The construction of a minimum 2.0m wide paved sidewalk on the northern side of Shrike Road as well as a covered shelter at the existing bus-/taxi loading zone between Zuurfontein Road and the Kelvin Power Station.*

FIGURES

Figure 1: Locality Plan



KELVIN POWER STATION DEMOLITION

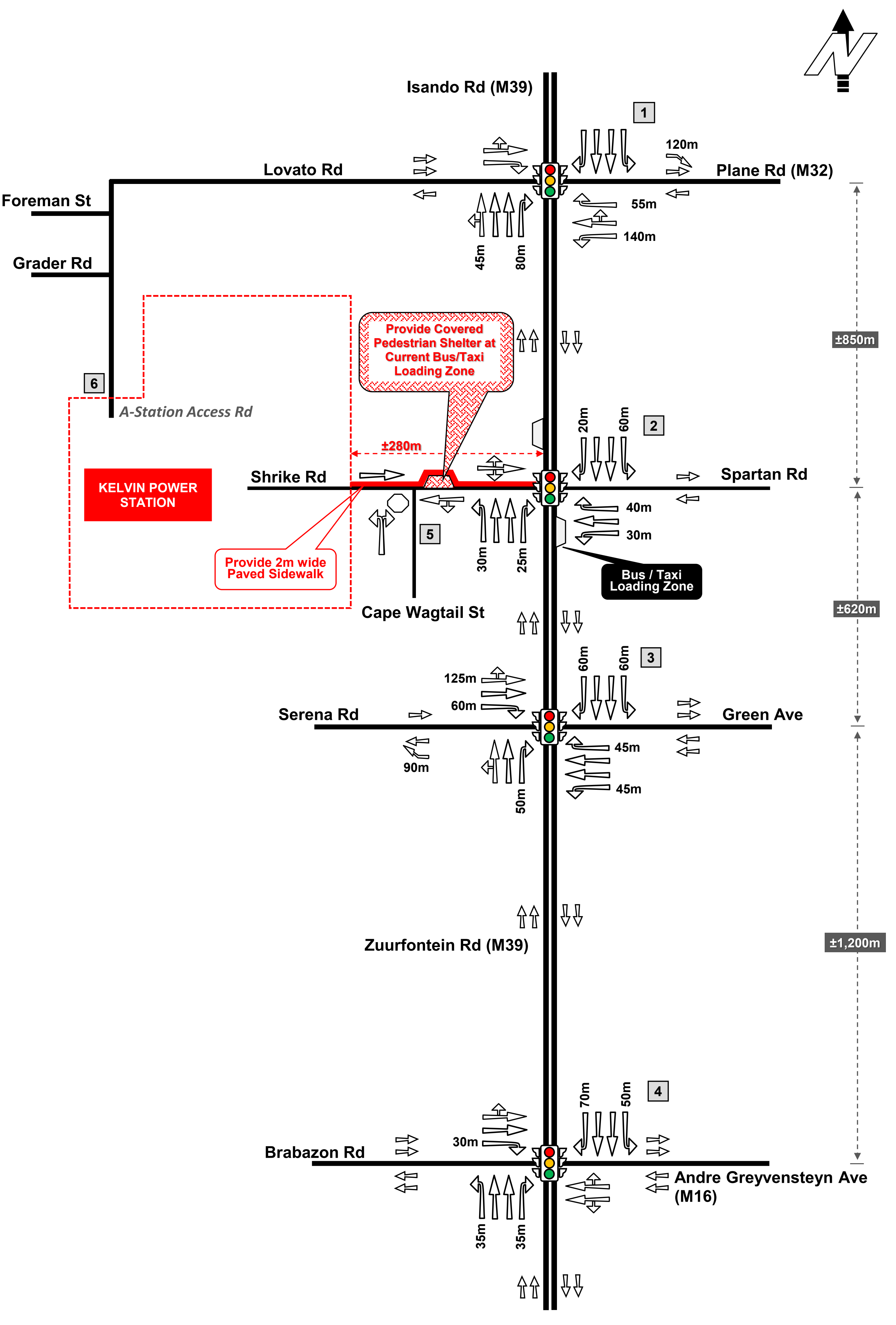
Locality Plan

FIGURE 1

Figure 2: Study Area

TECHWORLD consulting engineers	KELVIN POWER STATION DEMOLITION	Study Area	FIGURE 2

Figure 3: Road Network and Lane Layout

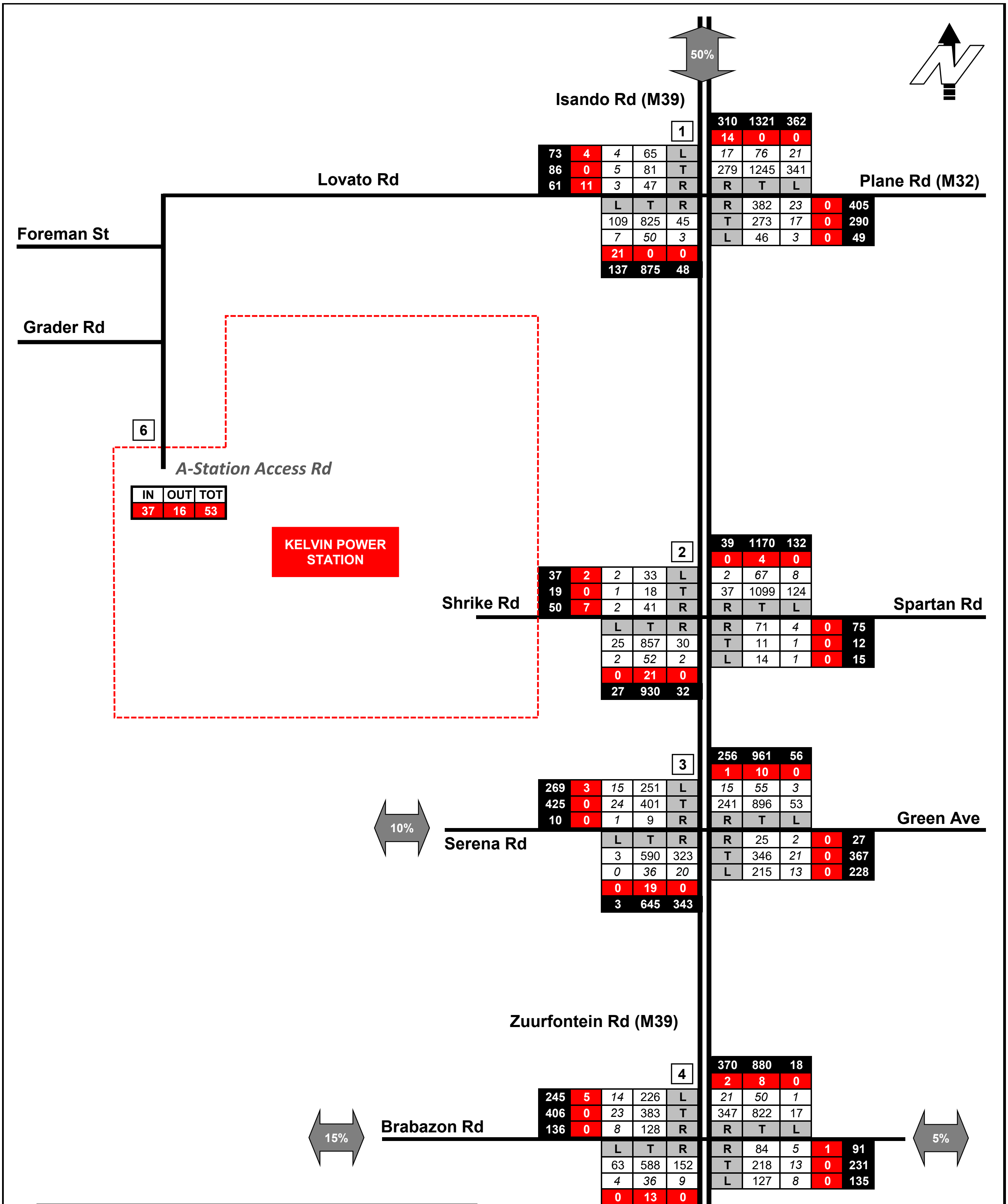


KELVIN POWER STATION DEMOLITION

Road Network and Lane Layout

FIGURE 3

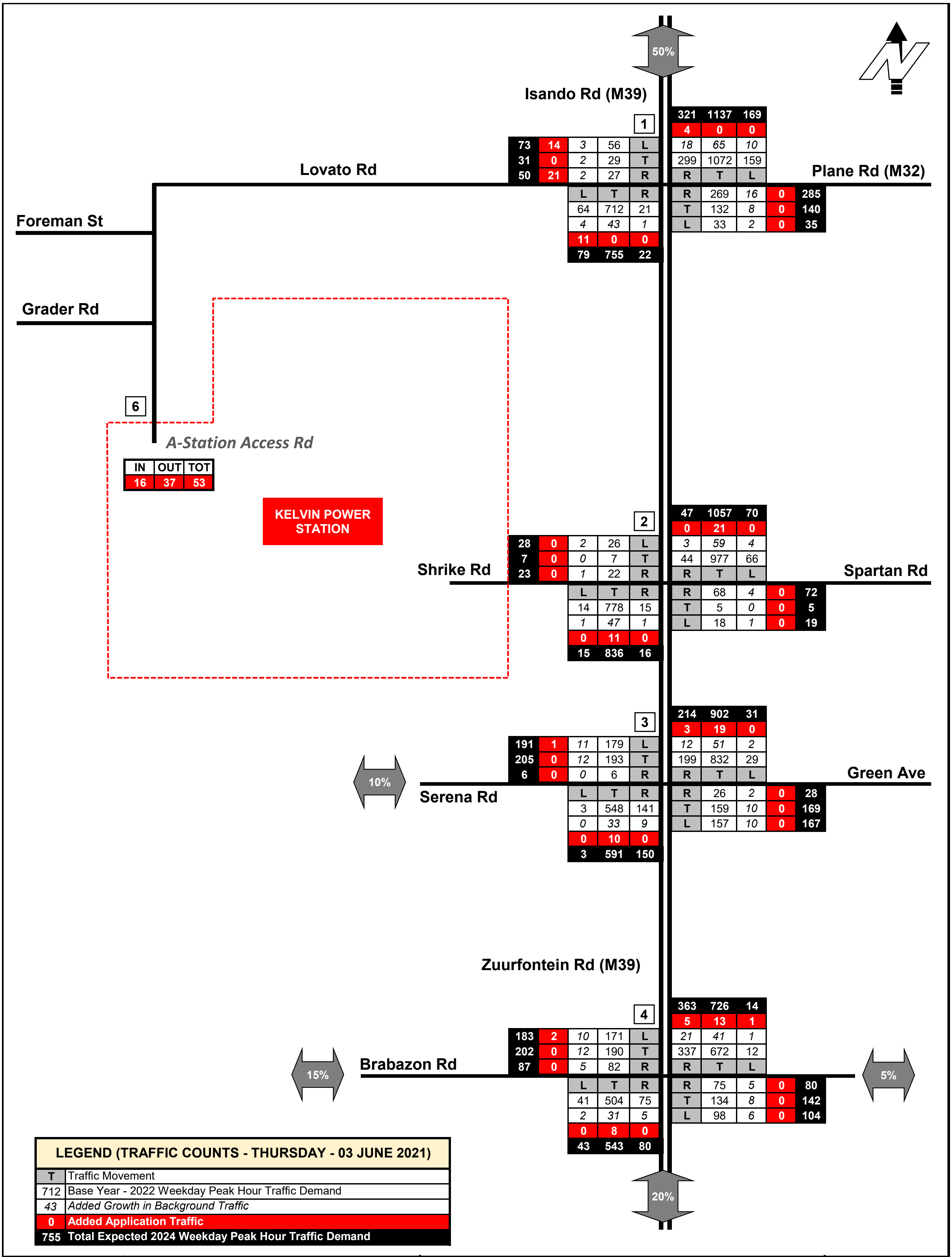
Figure 4: Weekday AM Peak Hour Traffic Demand



LEGEND (TRAFFIC COUNTS - THURSDAY - 03 JUNE 2021)	
T	Traffic Movement
825	Base Year - 2022 Weekday Peak Hour Traffic Demand
50	*Added Growth in Background Traffic*
0	**Added Application Traffic**
875	**Total Expected 2024 Weekday Peak Hour Traffic Demand**

TECHWORLD	**KELVIN POWER STATION DEMOLITION**	**Weekday AM Peak Hour Traffic Demand**	**FIGURE 4**

Figure 5: Weekday PM Peak Hour Traffic Demand



LEGEND (TRAFFIC COUNTS - THURSDAY - 03 JUNE 2021)

T	Traffic Movement
712	Base Year - 2022 Weekday Peak Hour Traffic Demand
43	*Added Growth in Background Traffic*
0	Added Application Traffic
755	**Total Expected 2024 Weekday Peak Hour Traffic Demand**

KELVIN POWER STATION DEMOLITION	**Weekday PM Peak Hour Traffic Demand**	**FIGURE 5**

APPENDICES

Appendix A: Kelvin Power – Waste Management Plan for Demolition Works (15 February 2022)

KELVIN POWER STATION PROJECT

Waste Management Plan – Demolition of A Station

Date:
15 February 2022
Rev:
001

CONTENTS

1. SCOPE

To implement at source waste segregation and improve the collection, storage, transfer and disposal of various types of waste generated at **KELVIN POWER A STATION** site in an environmentally responsible way, which encourages waste avoidance, waste recycling, to avoid contamination of the various waste streams and are in accordance with all applicable legislation. This procedure applies to the CONTRACTOR'S's obligations and duties with regards to Waste Management to be applied to all activities related to the construction and demolition work at **KELVIN POWER A STATION PROJECT**.

2. APPLICABLE DOCUMENTS:

a. Applicable Legislation
  - i. Constitution of the Republic of South Africa Act no 108 of 1996
  - ii. National Environmental management Act no 107 of 1998
  - iii. National Environmental Management Waste Act no 59 of 2009
  - iv. National Water Act no of 1998
  - v. Hazardous Substance Act no 15 of 1973
  - vi. Occupational Health and Safety Act no 85 of 1993
  - vii. National Road Traffic Act of 1996 GN R225

b. Site specific requirements
  - viii. Client EMP
  - ix. CONTRACTOR'S Emergency and Disaster Preparedness and Response Procedure

c. Other Requirements
  - x. SANS 0228 general info on the transportation of dangerous goods
  - xi. SANS 0229 packaging of goods for rail and road
  - xii. SANS 0248 classification of dangerous goods for transportation
  - xiii. DWAF Waste Management Series 1998

3. GENERAL

3.1 Procedure Responsibility

The preparation, review, and approval of this procedure are the responsibility of:

Preparation	CONTRACTOR'S Environmental Dep
Review	CONTRACTOR'S HSE Officer
Approval	CONTRACTOR'S Site Project Manager
Responsibility for implementation	CONTRACTOR'S Supervisor
Issued by	CONTRACTOR'S Document Control

3.2 Applicability

This procedure applies to all Project Areas, Contractor's, Subcontractors and Vendors / Suppliers.

3.3. Review period

This procedure will be reviewed when, significant legal changes are coming to effect, when the clients waste management procedure has been reviewed or when a significant incident and subsequent investigation has found this procedure to be lacking.

3.3 Abbreviations and Definitions

“Building waste” means waste produced during the construction, alteration, repair or demolition of any structure and includes rubble, earth, rock and wood that is displaced during that construction, alteration, repair or demolition;

“Container” means a disposable or reusable vessel in which waste is placed for the purposes of storing, accumulating, handling, transporting, treating or disposing of that waste and includes bins, bin-liners and skips;

“Disposal” means the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto, any air, land or water;

“Flammable waste” means waste, other than those classified as explosives, which are readily combustible or may cause or contribute to fires;

“General waste” means waste that does not pose an immediate hazard or threat to people or the environment and includes domestic waste; building waste; and waste generated through grub and clear process.

“Hazardous waste” means any waste that may, by circumstances of use, quantity, concentration or inherent physical, chemical or toxicological characteristics, have a significant adverse effect on health and the environment;

“Recycle” means to separate and process material from waste for further use as new products or resources;

“Re-use” means to utilize articles from the waste stream again for a similar or different purpose without changing the form or properties of the articles;

“Storage” means the accumulation of waste in a manner that does not constitute treatment or disposal of that waste;

“Waste” includes any substance, whether solid, liquid or gaseous, which is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration to the environment, a surplus substance or which is discarded, rejected, unwanted or abandoned, re-used, recycled, reprocessed, recovered or purified by a separate operation from that which produced the substance or which may be or is intended to be re-used, recycled, reprocessed, recovered or purified. Sewage waste is classified as liquid hazardous waste.

“Waste holding area” is an area where waste is temporarily stored (e.g. until the end of a shift), after which it is taken to the waste management centre;

“Waste management centre” is the area on site that has been designed to hold waste until such time it is collected by the approved waste removal company.

CEMP :	Construction Environmental Management Plan
DWS :	Department of Water and Sanitation

DEFF:	Department of Environmental Affairs, Forestry & Fisheries
ECA :	Environmental Conservation Act
ECO :	Environment Control Officer
EIR :	Environmental Impact Report
EMS :	Environmental Management System
EMP :	Environmental Management Plan
HAZOP :	Hazardous Operation
NEMA :	National Environmental Management Act
PPE :	Personal Protection Equipment
ISO:	International Organization for Standardization
HSE :	Safety, Health and Environment
RoD :	Record of Decision (Also referred to as Environmental Authorisation)

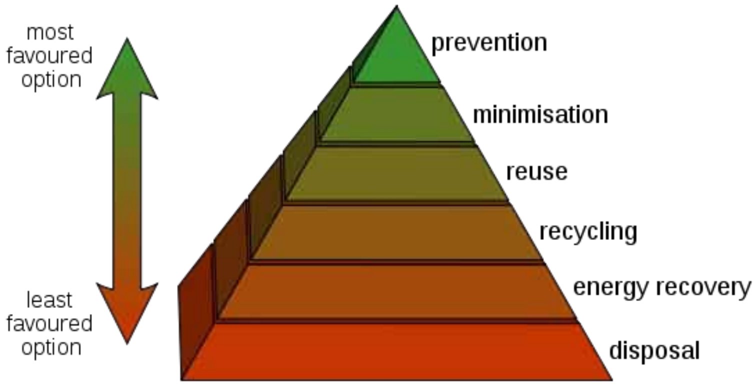
4. PROCEDURE

4.1 General

To establish a system for positive control over waste originating on and leaving the site and to provide compliance with all environmental, health and safety legislation and regulations pertaining to the management of waste so that all personnel will be fully aware of their responsibilities and their fellow colleagues.

4.2 Strategy

CONTRACTOR will follow the waste management hierarchy, by ensuring all method statements that is used on site takes cognisance of the principles of prevention of pollution and waste minimisation. Various mitigation controls will be used at potential sources of pollution or waste, for example: spill kits, drip trays, generator skirting, awareness and education training programs.



4.3 Responsibilities and Accountabilities

CONTRACTOR'S Project Director

1. Identifying long term contracts
2. Establishing a service level agreement for the removal of waste generated on site

CONTRACTOR'S HSE Department

1. Communicating this procedure to the sites of their responsibility
2. Providing training to all relevant employees.
3. Review of method statements when this procedure is updated.
4. Identifying the waste streams on their sites, and providing each area with the adequate number of bins and skips prescribed for each waste stream.
5. Ensuring that employees adhere to the requirements of waste separation as required by this procedure.
6. Ensuring that waste is collected at regular intervals in order to prevent a nuisance from being created.
7. Ensuring that the necessary documentation required in this procedure is in place to create an auditable process.
8. Ensuring that, if waste is collected by a contractor other than the contracted Waste Management Company, the same principles and requirements are applied.
9. Ensuring that CONTRACTOR'S personnel and subcontractors are aware that they are not allowed to store any waste on the site.
10. Monitoring of compliance to this procedure at regular intervals.
11. Reporting of waste figures on a monthly basis to the CONTRACTOR'S management and the client.

CONTRACTOR'S Project Manager

1. The project manager shall be ultimately responsible for the effective implementation of this procedure in their areas.
2. The project manager shall implement corrective actions in the case of non-compliance to this procedure.

All employees

1. Responsible for waste generated in their area and the correct segregation of waste.

Environmental Section

1. Responsible for providing systems to ensure that all waste generated is managed and disposed of in accordance to legal and other requirements and is responsible for all external reporting of waste figures and targets.

Emergency Services

1. Responsible for incidents and emergency situations (contact the HSE Department).

4.4. Specific Requirements

Legal and Ethical Obligations: As a generator of waste, the CONTRACTOR is legally obliged to document the origin and disposal of hazardous waste and to submit these records to the authorities or the client on request.

4.5 Disposal of Different Categories of Waste

1. All wastes are to be disposed of in accordance with the waste management requirements specified. Make sure all waste is disposed of in the legally prescribed manner.

2. If any employee is aware of waste that is generated on site that may be hazardous and/or cause environmental harm but which is not listed, then that employee must immediately notify the HSE Department in order to obtain the correct disposal requirements. The HSE Department shall review the waste stream table should such a situation arise.

3. CONTRACTOR will not dispose of any potentially hazardous waste or contaminated material if it is not sure what it is or how it is classified.

4. The Material Safety Data Sheet should be referred to for information regarding safe handling, storage and disposal of a waste product.

5. Maintenance and repair activity on sub-contractor equipment is to be undertaken off-site where possible to minimise the potential for wastes to be generated on site.

6. Waste drums should always be clearly labelled to indicate what they contain.

7. If a waste container is full, the HSE Department must be informed. Do not dispose of waste in the wrong container because the assigned container is full.

8. Care must be taken when handling and storing waste to minimise the potential for ground, air and water contamination.

9. There may be no incineration of waste on site without the prior approval of the client.

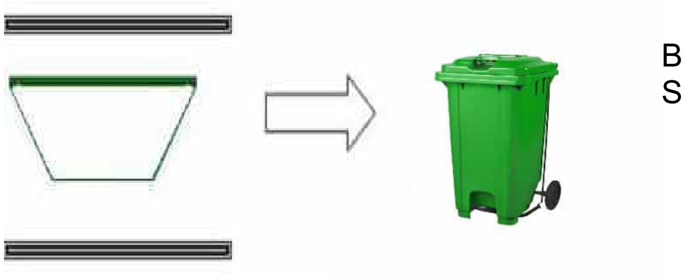
10. No waste that is generated off site may be brought on to site. This includes waste generated at home or due to non-work related activities on site.

NB. On-Site Segregation

11. The efficiency of waste management is increased by segregation at the source. All sites will make use of the following colour coded bins and skips for segregation:

NON-RECYCLABLE WASTE MANAGEMENT

4.6 GENERAL WASTE



BINS AND SKIPS	General compactable waste

a. General waste (all waste that does not fall into the defined waste streams and includes spoiled food, unusable protective gloves and aprons) is placed in green bins, which will then be emptied into skips. CONTRACTOR will use $6m^3$ general non compactable waste skips for all non-compactable waste generated on site. It is the responsibility of each site's HSE practitioners to ensure that only general waste is deposited in these bins and that due control is exercised in these areas.

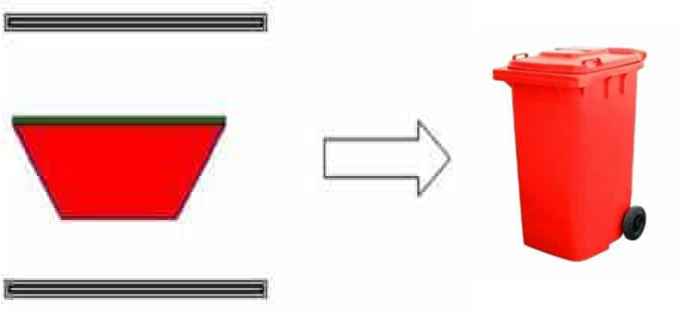
b. CONTRACTOR will then load these skips and return to the yard. Skip loader and or compacter operators and workers are to check that these skips are properly sorted and contains only general waste.

c. CONTRACTOR will then drive to a registered landfill facility to dump the general waste.

d. <u>Littering:</u> Due to CONTRACTOR'S work force, it is anticipated that a certain amount of littering is bound to occur. The following will be done to rectify this:

   i. Conduct daily litter pick and housekeeping exercises. The HSE practitioner responsible for a particular site is to ensure that there are sufficient black bags available and that these exercises are conducted by the entire workforce and is properly documented.
   ii. Weekly Housekeeping competition between business units to encourage participation of all staff.
   iii. Ensure there is more than sufficient wheelie bins in all areas
   iv. Conduct toolbox talks and learning topics on the importance of limiting waste and littering
   v. This process is to be recorded by the Environmental Officers on site

4.7 HAZARDOUS WASTE



RED SKIPS AND BINS

Hazardous (oil rags, filters, etc)

a. **Hazardous waste** (oil rags, filters etc) is to be placed in red skips and bins. Definition as defined by DWAF, Minimum Requirements:

> *Hazardous waste refers to items and/or materials that directly or indirectly represent a threat to man or the environment. Hazardous waste has the potential to have significant adverse effects on the health of the public and the environment, even in low concentrations, due to its chemical and physical components and characteristics. The definition of waste is extremely broad, due to wastes varying in nature, composition, size, appearance, volume and degree of harmfulness*:

b. **Removal of hazardous waste** produced by CONTRACTOR'S remains the sole responsibility of CONTRACTOR'S. Cross reference this section with 4.13 Collection, temporary storage, transport and final disposal: Hazardous waste placed in red hazardous waste skips and bins will be removed by the approved waste disposal contractor to the Hazardous landfill site, this area will be clearly marked with warning signs and have access control, it will further be kept neat and tidy at all times.

c. **Classify Hazardous Ratings**: In order to achieve waste classification, the following steps must be followed by CONTRACTOR'S's approved Waste Disposal company:

Step 1: Confirm that a waste is hazardous
Use SANS 10228 (Identification of Dangerous Goods)

Step 2: Assess hazardous properties
Assess properties of waste against the 9 classes of SANS 10228 (is the waste explosive, flammable, corrosive, radioactive, toxic etc.), waste can have more than 1 property (and fall into more than 1 of the 9 classes)

Step 3: Determine minimum treatment requirements *before* disposal …

Class	**Treatment**
1. Explosives	Explosive Act
2. Gases	Destruction or venting
3. Flammable Liquids	Treat (add ash)
4. Flammable Solids	Treat
5. Oxidising substances	Treat
6. Toxic, Infectious	Incinerate or sterilize
7. Radioactive	Dept. Minerals & energy
8. Corrosive	Treat to pH 6-12
9. Miscellaneous	Consult DWAF/DEAT

The waste will then be transported off-site to a registered hazardous waste disposal site:

d. After final disposal, the waste removal company will submit the safe disposal certificate (i.e.

Waste Manifest) to the CONTRACTOR'S HSE Department. All documents will be kept for verification of correct handling of the waste.

e. Emergency response to spillages of hazardous chemicals that may result in hazardous waste will be addressed as per the CONTRACTOR'S Emergency and Disaster Preparedness and Response Procedure.

f. A further explanation of the CONTRACTOR'S hazardous waste stream is the following:

   i. **Solid waste**: Includes any item contaminated with a chemical (e.g. chemical contaminated rags/ plastic/ containers/ etc., gloves, respirators, filters).

   - Used Personal Protective Clothing & Equipment: Gloves contaminated with chemicals should be placed in the red hazardous waste bins.

   - Vehicle maintenance waste: this includes rags, oil filters etc should be placed in the red hazardous waste bins.

   - Oil contaminated soil: recovered soils from uncontrolled spillage incidents should be placed in the red hazardous waste bins.

   ii. **Liquid waste**: In the case of liquid hazardous substances, the liquid will be stored of in containers capable of containing the waste without leaking or spilling and will be equipped with a form of secondary containment (chemical transfer pallets, over-drum, and/or bunding). This will be explained further in the section on the Waste Separation Area. Containers containing waste chemicals must be labelled as "hazardous waste" and identify the contents within the container as per the chemical labelling requirements as identified in the Chemical Management Standard. Absorbents: Absorbents containing spilled chemicals must be considered as hazardous waste and disposed of as would the chemical. Hydro carbon waste: CONTRACTOR'S will use leak proof waste containers, situated at the CONTRACTOR'S Central Waste Area, for all hydro carbon waste generated. CONTRACTOR'S will collect the hydrocarbon waste and dispose of the waste at a Landfill Site. All drip trays under static generators are to be inspected daily by the site HSE practitioners.

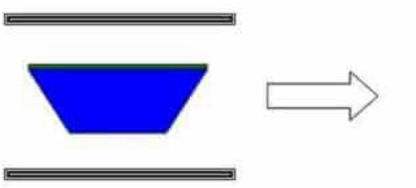
4.8 NON-COMPACTABLE MATERIAL

	TIP TRUCKS	Non compactable waste

a. Non-compactable material shall be described as “Concrete rejected by the Client on technical grounds, as unfit for purpose”

b. This material is to be loaded by front end loader, placed on a tip truck and taken off site. This material will then be re-crushed to a standard and will be reincorporated as backfill for foundations and fill.

4.9 METAL WASTE

	SKIPS	Scrap metal

a. Metal must be placed in skips as per the waste management procedure. CONTRACTOR will recover all redundant material from the site as instructed by the client.

b. CONTRACTOR will supply 6m³ skip or 10 m³ trucks for the storage / transportation of steel materials for the project

c. CONTRACTOR shall provide a weigh bridge slips for all skips removed.

RECYCLABLE WASTE MANAGEMENT

4.10 PAPER

a. All used white office paper must be placed in paper containers provided.

b. Carbon paper, laminated paper, plastic folders, and plastic covers are not considered to be paper and should be disposed of as general waste or plastic as appropriate.

c. Contaminated paper (e.g. oil-polluted paper, serviettes, food wrappers, milk/juice cartons, paper cups) should be disposed of as hazardous waste (e.g. oil/ chemical contaminated paper).

d. Confidential papers should be shredded prior to placement in the containers. Bulk confidential papers requiring shredding can be sent to the approved Waste Disposal Company. The paper will be placed into a security container/envelope.

e. Paper bins will be collected and removed to the demarcated Waste Holding Area.

4.11 PLASTICS

Plastics will be sorted for reuse. Plastics will be sorted in the following categories.

1 PETE	Poly(ethylene terephthalate): Soda bottles, water bottles, vinegar bottles, medicine containers, backing for photography film.
2 HDPE	High-density Polyethylene: Containers for: laundry/dish detergent, fabric softeners, bleach, milk, shampoo, conditioner, motor oil. Newer bullet proof vests, various toys.
3 V	Poly(vinyl chloride): Pipes, shower curtains, meat wraps, cooking oil bottles, baby bottle nipples, shrink wrap, clear medical tubing, vinyl dashboards and seat covers, coffee containers.
4 LDPE	Low-density Polyethylene: Wrapping films, grocery bags, sandwich bags.
5 PP	Polypropylene: Tupperware®, syrup bottles, yogurt tubs, diapers, outdoor carpet.
6 PS	Polystyrene: Coffee cups, disposable cutlery and cups (clear and colored), bakery shells, meat trays, "cheap" hubcaps, packing peanuts, Styrofoam insulation.
7 OTHER	Products labeled as "other" are made of any combination of 1-6 or another, less commonly used plastic.

4.12 SEWERAGE WASTE

a. Responsibilities

- The sanitation provider, who is responsible for supplying, maintaining and servicing the portable toilet systems.
- CONTRACTOR’S HSE, for ensuring that activities are performed as per this procedure.

b. Activities

1. Placing of toilets

Toilets shall be positioned at such places, spaces and intervals as to ensure that it is within easy reach of employees. Toilets shall not be positioned where, in the event of a spillage, spillages cannot be contained. Toilets shall not be positioned where spillages can enter or reach natural waterways.

2. Maintenance of toilets

Toilets will be inspected regularly to ensure proper functioning, hygiene and serviceability. Toilets will be emptied on a frequency that will prevent the possibility of overflowing. Toilets not in proper working condition will be locked and immediately be replaced with a serviceable unit.
No toilets with leaks will be allowed on site.

3. Emptying of toilets

Inspect all pipes and couplings on the vacuum pump system. Ensure that all PPE as required is used. Insert the vacuum pipe into the toilet and complete the vacuum procedure. Keep the pipe over the toilet and rinse with clean water. Keep the pipe in a vertical position and return to the securing point on the trailer. Dispense the prescribed chemicals into the toilet tank.

4. Handling of spillages

Should any spillage occur, contain it with a sand/soil bund or spill kit. Cover the spillage with sand or spill kit, collect in a container and dispose in the hazardous waste bin. All hazardous waste to be disposed of according to current legislation. Report all significant spillages to the HSE office. In the case of large spills, a spill response provider will be called in to provide spill response and cleanup of site to client specifications.

5. Disposal of sewerage waste

All sewerage shall be disposed into the local municipal sewer system as per letter of agreement.

4.13 COLLECTION, TEMPORARY STORAGE, TRANSPORT, AND FINAL DISPOSAL

a. **Collection:** CONTRACTOR will collect all its waste bins and skips on site on its own accord:

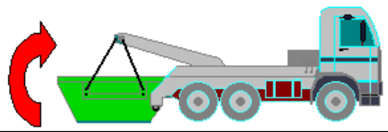
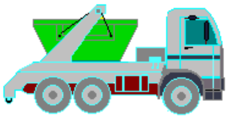
Collection	Transport	Disposal
		

Fig 1: Collection with skip truck:

CONTRACTOR is responsible for the prompt removal of Hazardous waste to a designated landfill site.

b. Temporary Storage and Detailed Separation

Due to the continuous site movement in the Construction area, waste skips will be placed strategically as required as close as possible to the working area.

All of these areas where the skips and or wheelie bins are placed will be demarcated and the skips and or wheelie bins will be marked according to the type of waste it is deemed for. Designated sorting/separation at source areas will be identified and agreed upon with the client.

When full all skips from these work faces are taken away by CONTRACTOR'S.

All Hazardous waste skips will have non pervious flooring to limit leachate from entering the ground water. Skips will also have lids that close properly to prevent rainwater from entering the skips. It will also be demarcated to maintain control. Wind borne littering in this area will be controlled from general waste being directly disposed into wheelie bins.

c. **Transport and Disposal:**

All General Waste will be transported by CONTRACTOR

All waste, with the exception of general waste takes place by the CONTRACTOR for disposal via road transport. The CONTRACTOR contacts the proper disposal facility and transporter to schedule the waste transportations. The CONTRACTOR will direct the driver to the pickup location. CONTRACTOR will verify proper labelling and cleanliness of skips before they are loaded, and prepare the proper waste manifests. After the transportation vehicle has been loaded, CONTRACTOR will provide the completed waste manifests to the client.

CONTRACTOR'S HSE Department shall review the waste manifests and sign them when appropriate. CONTRACTOR'S HSE Department shall retain copies of the waste manifests.

After safe disposal the CONTRACTOR will provide safe disposal certificates to the client. CONTRACTOR'S will make these safe disposal certificates available to the Client.

5. WASTE MANAGEMENT TEAM

a. CONTRACTOR will service all hazardous waste skips and Hazardous Waste wheelie bins on the site. These staff members will be responsible for the overall management of the hazardous waste stream as well as the supply of safe disposal documentation.

b. As per CONTRACTOR'S requirements, a site supervisor will be allocated to manage and supervise the overall management of waste streams generated by CONTRACTOR'S personnel. The site supervisor will be responsible for the formal or in-house training where needed, of all the operational staff which will include the training on safety aspects, risk management and environmental management will also form part of the induction training whereupon a certificate of training will be issued.

c. All staff members (waste subcontractor) will be issued with the necessary Personal Protection Equipment (PPE), which will include the following:

1. Company overalls
2. Safety shoes
3. Gum boots, if required
4. Gloves
5. Respirator / masks

6. DOCUMENTATION

Records shall be kept of all waste removed from site by the CONTRACTOR detailing dates and volumes.

HSE records will be kept in the contract file for the same duration as the file itself.

Valid Documentations and Attachments:

The following documents will be kept:

- Flow Chart Waste Management
- Handling & Storage of Waste Manifest Documents
- Waste Acceptance Form
- Hazardous Waste Acceptance Form
- Safe Disposal Certificates
- Chemical Management Standard
- Waste Streams
- Waste Register

7. AWARENESS AND TRAINING:

Training of personnel will be done according to the CONTRACTOR'S training matrix. Dedicated personnel will be trained with regards to Hazardous Chemicals (Handling, transportation, and storage), as well as the Waste Management Act and waste management principals. A CONTRACTOR will also be allocated to the contract (Hazardous waste only), which will render a contract management role which will include regular meetings, reports and advising CONTRACTOR'S on new waste solutions and / or alternatives.

Appendix B: Kelvin Power – Traffic Assessment Report for Demolition Works (14 March 2022)

KELVIN POWER STATION PROJECT

Traffic Assessment Report – Demolition of A Station

Date:

14 March 2022

Rev:

003

Contents

1. Introduction

This Traffic Assessment Report (TAR) has been developed for the Demolition and Removal Works located at Kelvin Power Station.

2. Project Description

The scope of work entails the demolition of the A-Station infrastructure, namely three cooling towers, structures and buildings, at Kelvin Power Station.

3. Purpose for the report

This report contains a road transport routing and site access for the Kelvin Power A-Station Demolition Project.

4. Kelvin Power Station Location

The site Address: 129 Shrike Road - Zuurfontein 33-Ir Portions 248, Kempton Park

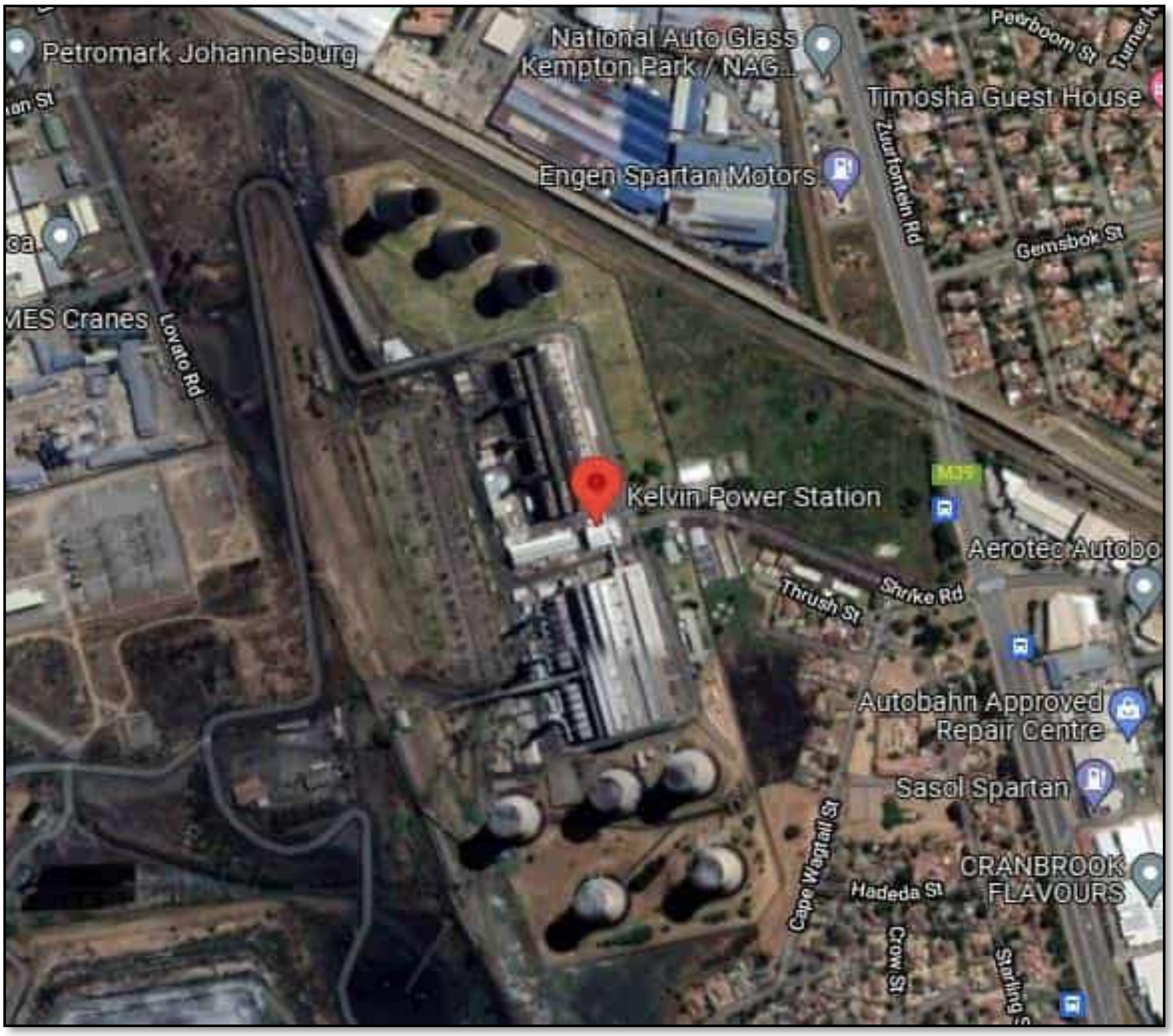


Figure 4-1: Locality Map

5. Site Access

Access to this site during the proposed demolition project, should be primarily from Lovato Road with the alternative access being from Shrike Rd.

Figure 5-1: Access to Site is primarily via Lovato Road (red) and secondary access is via Shrike Road (yellow)

6. Operations

The Kelvin Power A-Station Demolition Project will operate on a single shift, 9-hour day, 6 day working day, having 26 working days per month.

- Number of trucks used per day: ±13 trucks.

- Types of trucks used:
    - 10m^3 Tipper Trucks
    - 16m^3 Tipper Trucks
    - 30m^3 Twin Steer Horse and Trailers
    - 30-ton Flat deck Horse and Trailer

- Frequency of travel and locations (daily as per recorded times above):

Type of Waste	Vehicle and load
Hazardous waste	2 x 30m^3 Twin Steers to remove hazardous waste daily (Approx. 3 loads each).

	1 x Skip Truck and Trailer carrying 4 x 9m^3 Skip Bins with Trailer.
General Waste / Rubble	3 x 10m^3 Tipper Truck
	2 x 16 m^3
Scrap Steel	1 x Horse and Trailer with 10 (30m^3) Black Boxes
	1 x 10-ton Grab Trucks (Estimated capacity 30 tons per day over 5 months.)

The above is based on majority of the waste to be transported off site however, to decrease traffic it is suggested that approximately 50% of the generated demolition debris is crushed into an aggregate based mix such as G7 which can be used in backfilling activities and resurfacing works for rehabilitation of ground areas where demolition occurs.

7. Routes / Roads identified

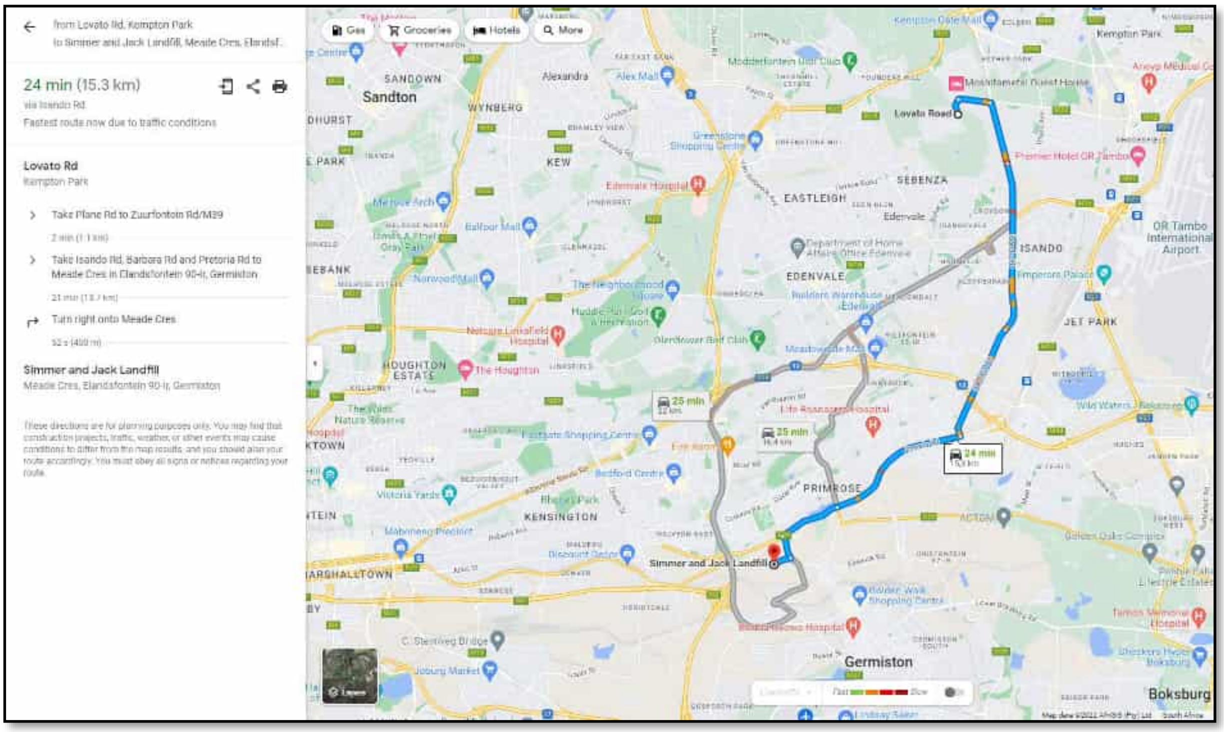
The following routes below shall be used for transportation of hazardous, non-hazardous waste and reclaimed scrap.

7.1 Routes to General Waste Landfill Site (General Waste and Inert Rubble)

Depart: Kelvin Power Station, Zuurfontein 33-Ir Portions 248, Kempton Park

Arrival: Simmer and Jack Landfill, Meade Cres, Elandsfontein 90-Ir, Germiston

Distance to the landfill is approximately 15.3 km.



from Lovato Rd, Kempton Park
to Simmer and Jack Landfill, Meade Cres, Elandsf...

24 min (15.3 km)
via Isando Rd
Fastest route now due to traffic conditions

Lovato Rd
Kempton Park

- Take Plane Rd to Zuurfontein Rd/M39
  2 min (1.1 km)
- Take Isando Rd, Barbara Rd and Pretoria Rd to Meade Cres in Elandsfontein 90-Ir, Germiston
  21 min (13.7 km)
- Turn right onto Meade Cres
  52 s (400 m)

Simmer and Jack Landfill
Meade Cres, Elandsfontein 90-Ir, Germiston

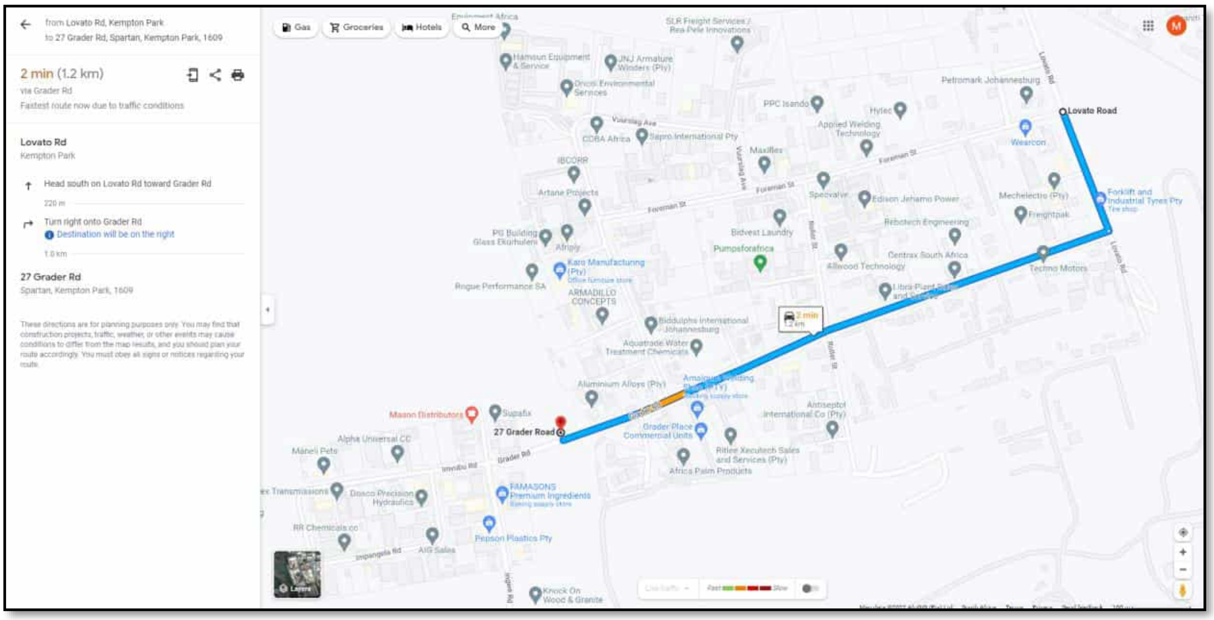
These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

6.2 Routes to Scrap Recyclers

Depart: Kelvin Power Station, Zuurfontein 33-Ir Portions 248, Kempton Park

Arrival: New Deal Scrap Metal, Spartan, Kempton Park, 1619

Distance to the scrap dealer is approximately 1.2 km



from Lovato Rd, Kempton Park
to 27 Grader Rd, Spartan, Kempton Park, 1609

2 min (1.2 km)
via Grader Rd
Fastest route now due to traffic conditions

Lovato Rd
Kempton Park

↑ Head south on Lovato Rd toward Grader Rd
220 m

↱ Turn right onto Grader Rd
Destination will be on the right
1.0 km

27 Grader Rd
Spartan, Kempton Park, 1609

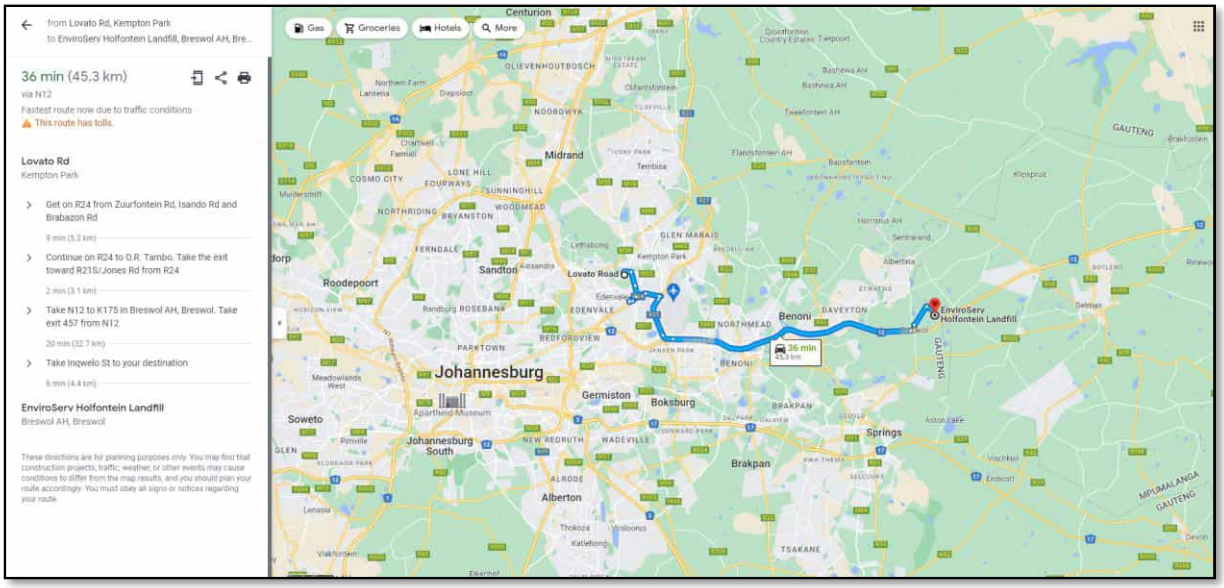
These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

7.3 Routes to Hazardous Waste Landfill Site

Depart: Kelvin Power Station, Zuurfontein 33-Ir Portions 248, Kempton Park

Arrival: EnviroServ Holfontein Landfill, Breswol AH, Breswol

Distance to the landfill is approximately 45.3 km.



from Lovato Rd, Kempton Park
to EnviroServ Holfontein Landfill, Breswol AH, Bre...

36 min (45.3 km)
via N12
Fastest route now due to traffic conditions
⚠ This route has tolls.

Lovato Rd
Kempton Park

› Get on R24 from Zuurfontein Rd, Isando Rd and Brabazon Rd
9 min (5.2 km)

› Continue on R24 to O.R. Tambo. Take the exit toward R21S/Jones Rd from R24
2 min (3.1 km)

› Take N12 to K175 in Breswol AH, Breswol. Take exit 457 from N12
20 min (32.7 km)

› Take Inqwelo St to your destination
6 min (4.4 km)

EnviroServ Holfontein Landfill
Breswol AH, Breswol

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Appendix C: Detailed Traffic Counts

Traffic Count Survey

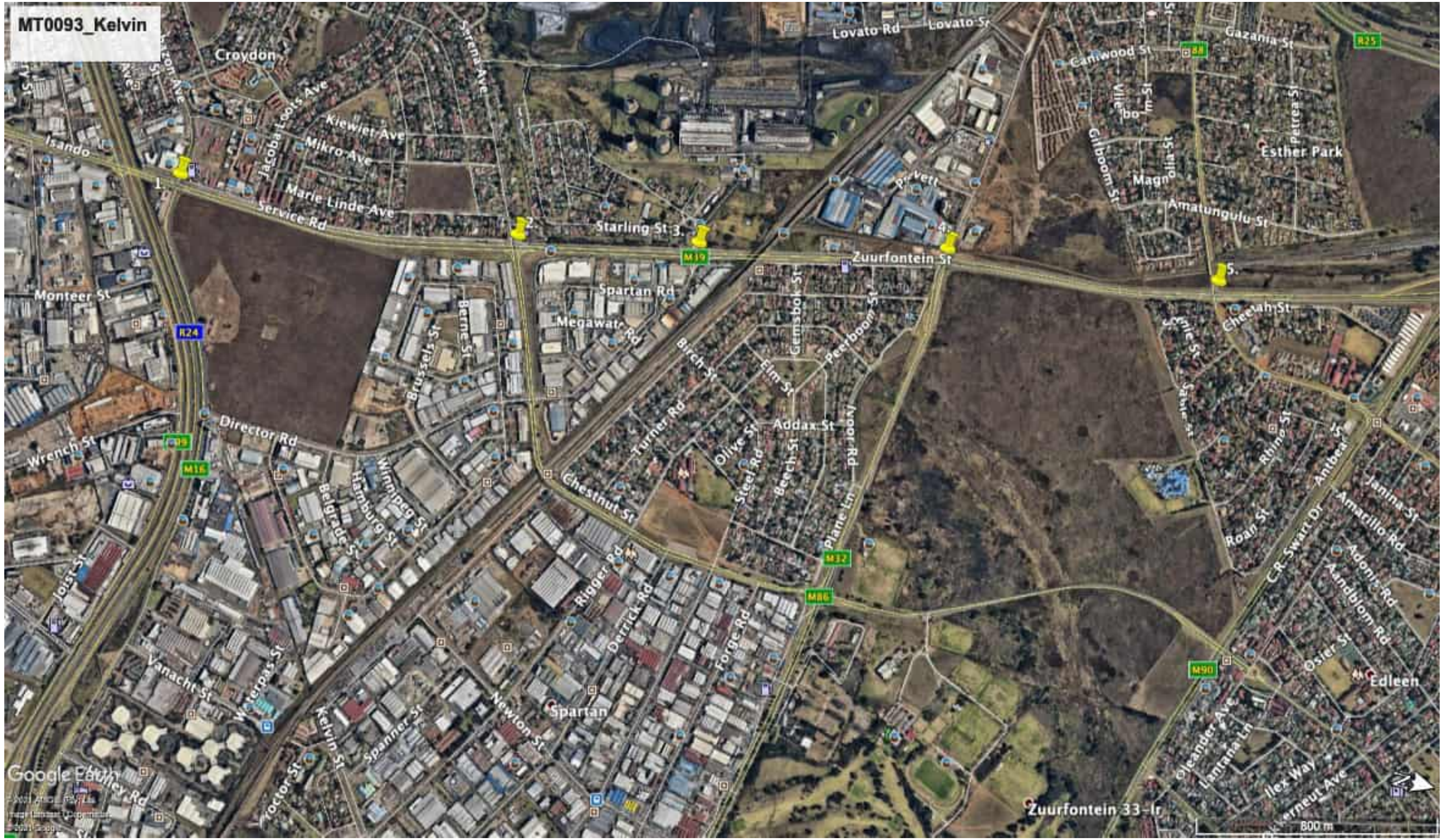
McTRAFF
traffic@mctraff.co.za

Job No:	MT0093
Count Date:	2021/06/03
Site Name:	Kelvin
Count Method	Manual Count

Reg no.	2018/540851/07
VAT no.	4730285055
Address	457 Bramble Street Waterkloof Glen Pretoria 0181
Email	traffic@mctraff.co.za

	Intersection Type		Road Names	
SITE no.	Layout	Traffic Control	Road N/S	Road E/W
SITE1	4 Leg	Traffic Signal	M39 Isando Road	M16 Andre Greyvenst
SITE2	4 Leg	Traffic Signal	M39 Isando Road	M86 Green Avenue
SITE3	4 Leg	Traffic Signal	M39 Isando Road	Spartan Road
SITE4	4 Leg	Traffic Signal	M39 Zuurfontein Stre	M32 Plane Road
SITE5	4 Leg	Traffic Signal	M39 Zuurfontein Stre	Parkland Drive
SITE6				
SITE7				
SITE8				
SITE9				
SITE10				

NOTES:



McTRAFF
traffic@mctraff.co.za

Kelvin

2021/06/03

Project: **MT0093_Kelvin**

Intersection: M39 Isando Road_M16 Andre Greyvensteyn Avenue

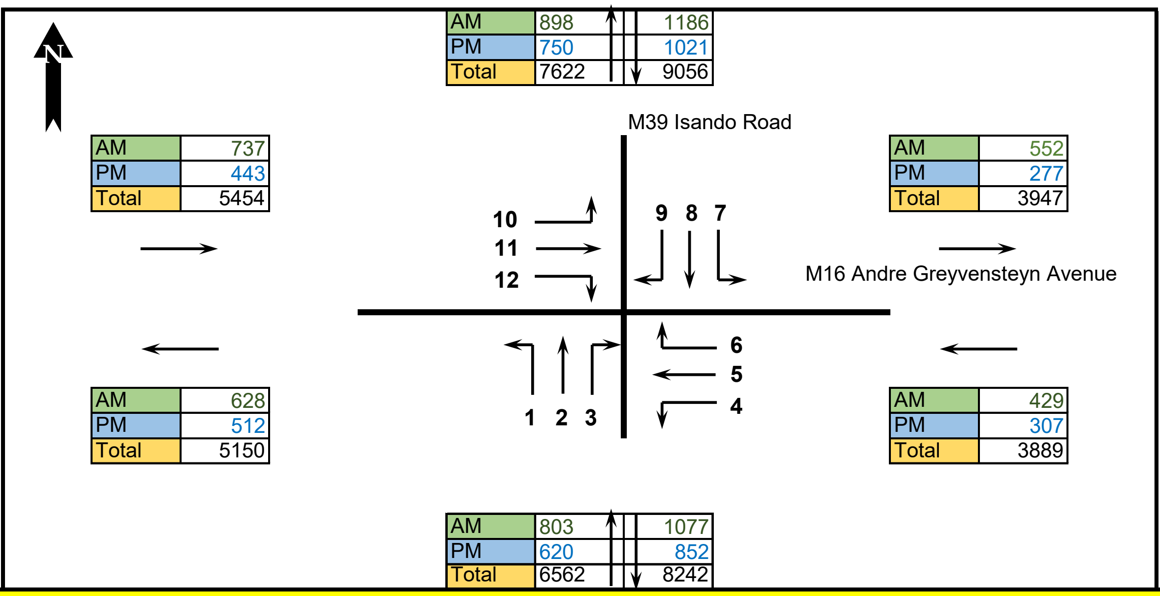
Date: 03-Jun-21

Day: Thursday

Location: 1

AM PEAK: 06h45 07h45

PM PEAK: 15h45 16h45



SITE1_Total_0306

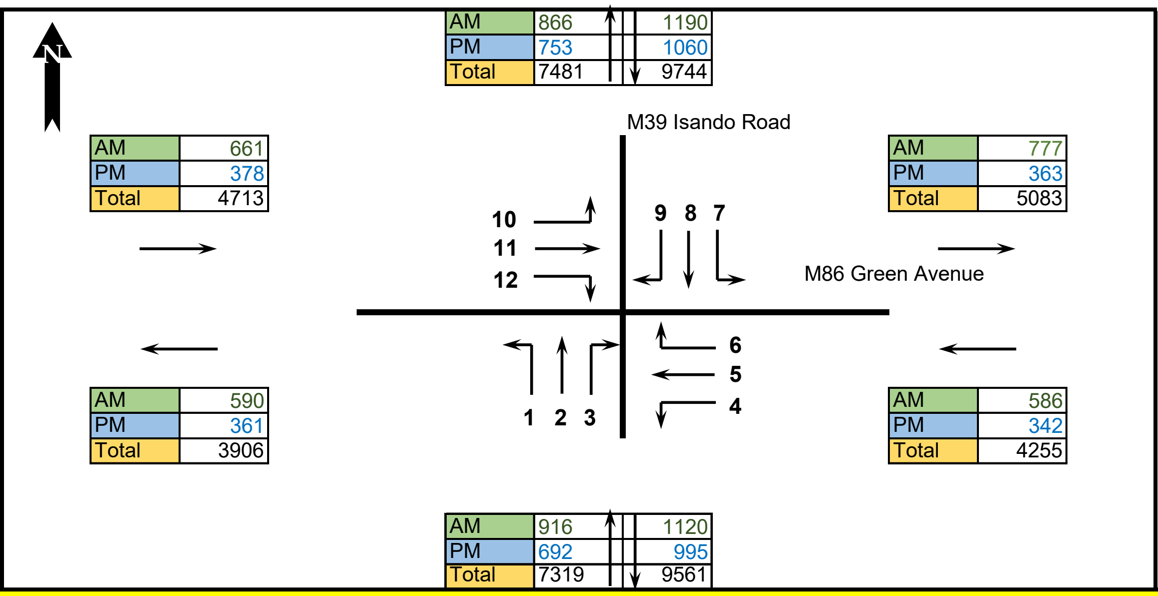
12 Hour

Time		South			East			North			West			Hourly
Start	End	MOV 1	MOV 2	MOV 3	MOV 4	MOV 5	MOV 6	MOV 7	MOV 8	MOV 9	MOV 10	MOV 11	MOV 12	
06:00	06:15	6	111	15	15	12	7	3	135	57	38	29	9	
06:15	06:30	9	138	33	22	31	16	4	209	66	33	60	17	
06:30	06:45	12	122	28	33	13	21	4	181	68	45	73	14	
06:45	07:00	11	179	35	42	44	13	7	248	67	70	76	36	2517
07:00	07:15	13	125	37	22	55	26	2	185	91	41	112	24	2813
07:15	07:30	20	128	47	33	57	17	8	153	102	61	98	34	2933
07:30	07:45	19	156	33	30	62	28	0	236	87	54	97	34	3155
07:45	08:00	21	118	36	29	84	34	1	155	93	47	122	54	3121
08:00	08:15	4	146	59	45	84	34	17	73	26	26	57	15	2974
08:15	08:30	18	109	26	16	79	26	6	125	77	53	78	26	2855
08:30	08:45	15	88	22	34	60	20	3	97	71	37	58	12	2536
08:45	09:00	19	68	28	16	54	14	9	105	71	61	69	26	2282
09:00	09:15	15	99	17	19	56	40	4	130	69	40	46	29	2260
09:15	09:30	9	104	16	32	37	21	3	128	78	69	34	29	2181
09:30	09:45	17	106	27	31	69	15	3	129	72	72	53	30	2288
09:45	10:00	11	102	24	30	10	13	1	125	61	43	23	24	2215
10:00	10:15	21	97	23	26	51	13	1	135	63	33	34	36	2184
10:15	10:30	7	78	13	15	41	10	1	103	91	17	38	16	2054
10:30	10:45	2	31	8	18	3	16	0	42	9	20	19	9	1607
10:45	11:00	13	77	11	18	31	20	1	99	31	22	38	10	1511
11:00	11:15	16	81	13	38	34	17	1	108	39	20	64	10	1419
11:15	11:30	10	76	22	13	34	15	1	128	62	20	69	19	1458
11:30	11:45	9	85	21	34	41	12	1	103	26	23	122	13	1771
11:45	12:00	13	85	9	6	20	12	1	133	56	23	31	17	1806

12:00	12:15	8	93	12	37	44	12	1	133	27	23	76	15	*1846*
12:15	12:30	15	94	20	28	60	16	4	209	63	82	52	45	*2065*
12:30	12:45	13	88	9	25	40	11	4	34	44	45	48	13	*1949*
12:45	13:00	12	101	14	10	48	16	3	94	20	19	58	10	*1948*
13:00	13:15	22	140	19	28	70	18	3	127	37	13	69	19	*2032*
13:15	13:30	9	117	17	20	51	12	3	123	27	9	93	7	*1832*
13:30	13:45	11	139	15	20	67	15	1	152	28	14	58	6	*1984*
13:45	14:00	8	104	21	16	35	20	1	134	71	28	39	13	*2069*
14:00	14:15	7	135	15	10	27	18	4	137	78	23	56	9	*2023*
14:15	14:30	9	79	22	13	24	22	3	100	62	17	62	18	*1966*
14:30	14:45	10	68	23	11	34	26	4	86	69	21	11	5	*1808*
14:45	15:00	8	68	20	13	22	20	3	82	58	32	35	8	*1687*
15:00	15:15	10	78	18	14	35	19	1	95	42	19	76	8	*1583*
15:15	15:30	16	102	32	14	43	21	3	113	47	25	94	19	*1681*
15:30	15:45	13	107	29	12	34	17	3	140	56	42	74	19	*1859*
15:45	16:00	15	125	27	10	24	19	3	158	76	55	54	18	*2074*
16:00	16:15	9	107	21	26	30	18	3	159	73	45	32	14	*2196*
16:15	16:30	12	135	10	28	43	17	3	197	74	33	57	26	*2302*
16:30	16:45	5	137	17	34	37	21	3	158	114	38	47	24	*2391*
16:45	17:00	6	86	20	23	34	18	1	99	11	21	40	20	*2186*
17:00	17:15	4	120	9	32	23	20	1	136	16	80	70	26	*2186*
17:15	17:30	2	104	21	12	33	16	1	141	14	53	52	20	*2020*
17:30	17:45	6	91	10	11	20	17	1	116	13	34	20	10	*1734*
17:45	18:00	3	62	6	4	3	9	0	65	11	16	5	6	*1545*
AM		**63**	**588**	**152**	**127**	**218**	**84**	**17**	**822**	**347**	**226**	**383**	**128**	**3155**
PM		**41**	**504**	**75**	**98**	**134**	**75**	**12**	**672**	**337**	**171**	**190**	**82**	**2391**
TOTAL		**543**	**4989**	**1030**	**1068**	**1943**	**878**	**139**	**6253**	**2664**	**1755**	**2778**	**921**	**24961**

Project: **MT0093_Kelvin**
Intersection: M39 Isando Road_M86 Green Avenue
Date: 03-Jun-21
Day: Thursday
Location: 2

AM PEAK: **06h45** **07h45**
PM PEAK: **15h45** **16h45**



AM	866	1190
PM	753	1060
Total	7481	9744

AM	661
PM	378
Total	4713

AM	777
PM	363
Total	5083

AM	590
PM	361
Total	3906

AM	586
PM	342
Total	4255

AM	916	1120
PM	692	995
Total	7319	9561

SITE2_Total_0306

12 Hour

Time		South			East			North			West			Hourly
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06:15	06:30	0	151	40	38	32	8	9	268	32	38	38	0	
06:30	06:45	0	155	43	28	61	17	17	270	41	51	72	5	
06:45	07:00	0	174	107	59	86	6	14	257	63	56	84	2	*2837*
07:00	07:15	3	137	46	52	107	6	5	213	69	50	87	3	*3100*
07:15	07:30	0	157	82	46	72	6	20	227	69	67	118	2	*3312*
07:30	07:45	0	122	88	58	81	7	14	199	40	78	112	2	*3353*
07:45	08:00	6	148	53	52	63	12	6	202	42	59	116	3	*3207*
08:00	08:15	0	114	59	33	52	4	15	165	50	48	86	1	*3056*
08:15	08:30	0	88	64	42	59	5	10	144	29	56	81	1	*2769*
08:30	08:45	4	107	39	37	46	9	5	146	30	43	84	2	*2520*
08:45	09:00	0	82	43	24	38	3	11	120	36	35	62	1	*2213*
09:00	09:15	1	109	33	32	66	15	10	162	40	42	46	2	*2144*
09:15	09:30	1	113	31	52	44	8	7	159	46	71	34	2	*2133*
09:30	09:45	1	115	53	50	82	5	7	160	42	74	54	2	*2226*
09:45	10:00	1	112	48	49	12	5	5	154	36	45	23	2	*2263*
10:00	10:15	2	105	45	42	60	5	5	167	37	35	34	2	*2244*
10:15	10:30	1	85	25	24	48	3	2	129	53	18	39	1	*2104*
10:30	10:45	0	34	16	30	4	5	1	52	5	20	19	1	*1646*
10:45	11:00	1	84	21	30	37	7	5	122	18	22	38	1	*1540*
11:00	11:15	1	88	25	60	40	6	2	134	23	20	64	1	*1465*
11:15	11:30	1	83	42	21	40	5	2	159	36	20	70	1	*1517*
11:30	11:45	1	93	41	54	48	4	2	129	15	0	123	1	*1841*
11:45	12:00	1	93	17	10	24	4	3	165	32	24	31	1	*1860*

12:00	12:15	1	102	23	58	52	4	5	165	16	24	77	1	*1924*
12:15	12:30	1	103	38	45	72	6	10	258	37	85	53	4	*2156*
12:30	12:45	1	96	16	40	47	4	9	43	25	47	49	1	*2023*
12:45	13:00	1	111	27	15	57	6	7	116	12	19	60	1	*2050*
13:00	13:15	2	153	37	44	83	6	7	157	22	13	70	1	*2117*
13:15	13:30	1	128	33	33	60	4	6	152	16	9	94	0	*1941*
13:30	13:45	1	151	30	33	79	5	5	189	17	14	60	0	*2147*
13:45	14:00	1	113	40	26	42	7	5	166	42	29	39	1	*2226*
14:00	14:15	0	148	30	15	33	6	9	170	46	24	57	1	*2170*
14:15	14:30	1	86	43	21	29	8	7	124	37	18	63	1	*2072*
14:30	14:45	1	75	45	17	40	9	9	106	40	21	12	0	*1863*
14:45	15:00	1	74	39	21	25	7	8	102	34	34	35	1	*1733*
15:00	15:15	1	85	34	23	42	7	5	117	25	19	77	1	*1630*
15:15	15:30	1	112	62	23	51	7	8	140	27	26	95	1	*1745*
15:30	15:45	1	116	56	19	40	6	8	174	33	43	75	1	*1942*
15:45	16:00	1	135	50	15	29	7	6	196	45	57	55	1	*2158*
16:00	16:15	1	116	40	42	35	6	7	197	43	47	32	1	*2289*
16:15	16:30	1	148	19	44	51	6	8	243	44	35	58	2	*2395*
16:30	16:45	0	149	32	56	44	7	8	196	67	40	48	2	*2472*
16:45	17:00	0	93	38	36	41	6	3	122	6	21	41	1	*2283*
17:00	17:15	0	131	16	51	27	7	4	169	10	81	70	2	*2284*
17:15	17:30	0	113	41	20	39	5	5	175	9	55	53	1	*2141*
17:30	17:45	0	99	19	17	23	6	5	143	8	35	20	1	*1868*
17:45	18:00	0	68	10	7	4	3	1	81	6	16	5	0	*1661*
AM		**3**	**590**	**323**	**215**	**346**	**25**	**53**	**896**	**241**	**251**	**401**	**9**	**3353**
PM		**3**	**548**	**141**	**157**	**159**	**26**	**29**	**832**	**199**	**179**	**193**	**6**	**2472**
TOTAL		**43**	**5368**	**1908**	**1679**	**2272**	**304**	**339**	**7814**	**1591**	**1809**	**2836**	**68**	**26031**

Project: **MT0093_Kelvin**

Intersection: M39 Isando Road_Spartan Road

Date: 03-Jun-21

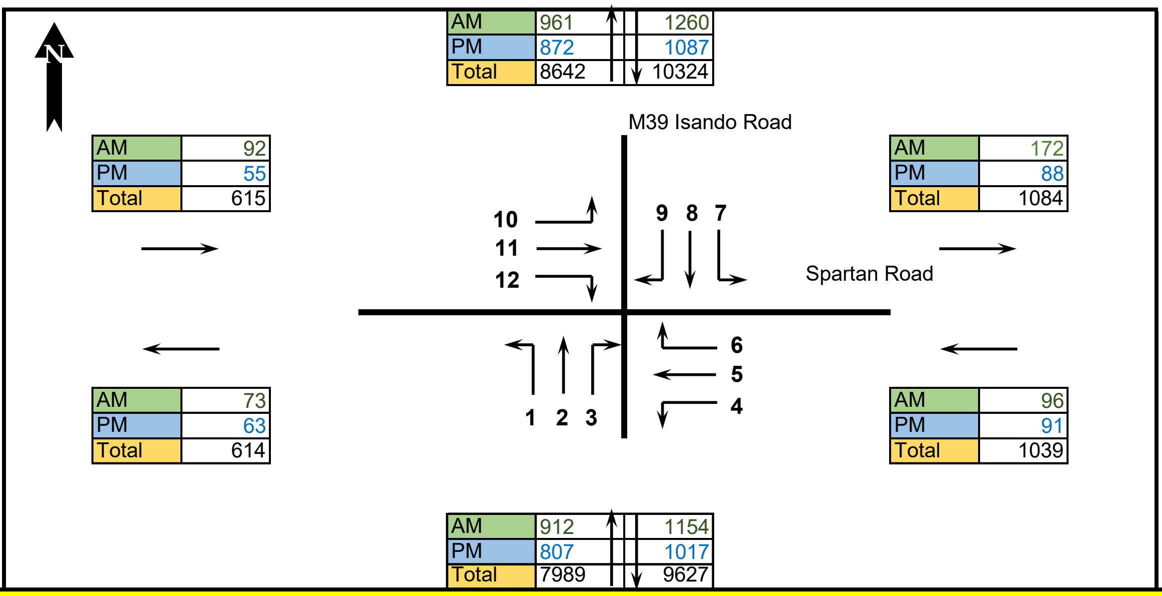
Day: Thursday

Location: 3

AM PEAK: 06h45 07h45

PM PEAK: 15h45 16h45

McTRAFF
traffic@mctraff.co.za



SITE3_Total_0306

12 Hour

Time		South			East			North			West			Hourly
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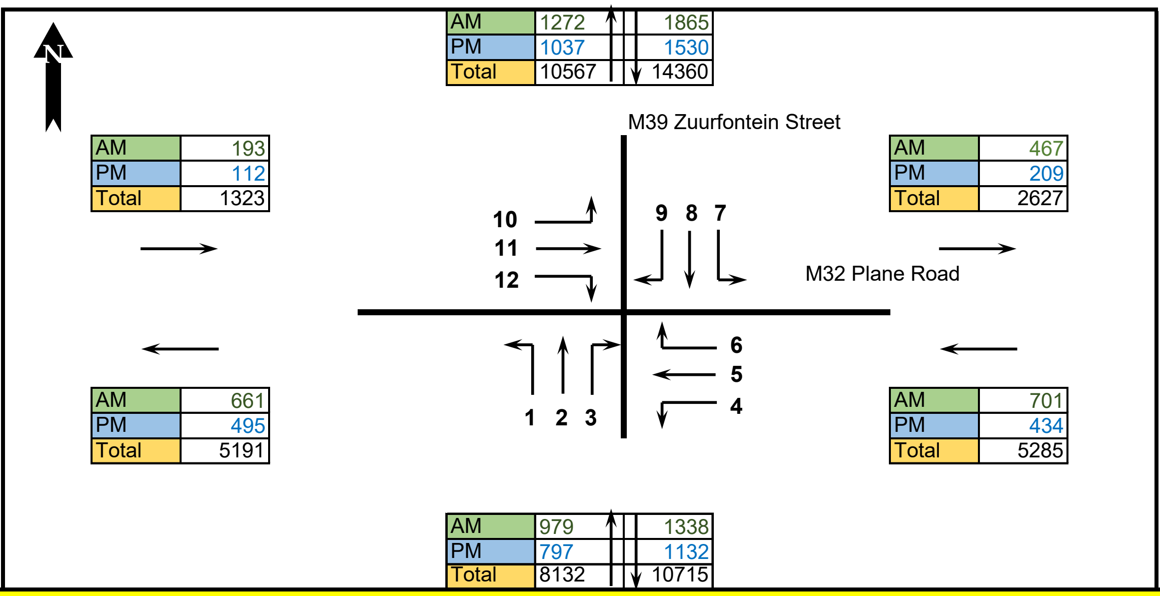
06:15	06:30	3	154	1	1	1	6	22	256	15	6	1	6	
06:30	06:45	12	208	6	5	6	16	27	280	28	10	6	7	
06:45	07:00	7	211	8	2	1	16	37	295	20	10	5	14	*2131*
07:00	07:15	5	193	6	3	3	19	31	240	5	10	5	12	*2241*
07:15	07:30	7	228	9	6	2	16	28	300	4	7	7	8	*2391*
07:30	07:45	6	225	7	3	5	20	28	264	8	6	1	7	*2360*
07:45	08:00	4	194	5	6	1	27	44	232	6	5	3	8	*2269*
08:00	08:15	4	178	6	7	1	24	24	214	6	5	2	5	*2213*
08:15	08:30	4	178	6	7	1	24	24	214	6	5	2	5	*2067*
08:30	08:45	4	162	8	11	2	13	12	190	9	9	0	3	*1910*
08:45	09:00	4	146	7	7	1	19	13	131	5	6	1	4	*1719*
09:00	09:15	5	154	3	4	2	35	25	189	9	6	1	8	*1684*
09:15	09:30	3	160	3	7	1	19	17	187	10	11	1	8	*1635*
09:30	09:45	6	164	6	7	3	13	17	189	9	11	2	8	*1647*
09:45	10:00	4	158	5	5	0	12	10	181	8	7	1	6	*1700*
10:00	10:15	8	149	5	1	2	12	10	195	8	5	1	10	*1665*
10:15	10:30	2	120	2	3	2	8	6	151	12	3	1	4	*1552*
10:30	10:45	1	47	1	4	0	14	2	61	1	3	1	2	*1254*
10:45	11:00	4	119	2	4	1	19	10	143	4	3	1	3	*1170*
11:00	11:15	5	125	2	7	1	15	4	156	5	3	2	3	*1092*
11:15	11:30	3	117	4	3	1	13	6	186	8	3	2	5	*1129*
11:30	11:45	3	131	4	7	2	12	5	151	3	4	4	3	*1321*
11:45	12:00	4	131	2	1	1	11	8	193	7	4	1	4	*1375*

12:00	12:15	3	145	2	7	2	11	10	194	4	4	2	4	*1435*
12:15	12:30	5	146	3	5	2	14	24	304	8	12	2	12	*1621*
12:30	12:45	4	136	2	5	2	9	22	50	6	7	2	3	*1540*
12:45	13:00	4	157	3	1	2	14	17	136	3	3	2	3	*1518*
13:00	13:15	8	217	3	5	3	15	15	185	5	2	2	5	*1595*
13:15	13:30	3	181	3	4	2	11	13	178	4	1	3	2	*1463*
13:30	13:45	4	215	3	4	3	13	10	222	4	2	2	2	*1699*
13:45	14:00	3	160	4	3	1	18	11	194	9	4	1	3	*1765*
14:00	14:15	2	210	3	1	1	15	23	199	10	4	2	2	*1772*
14:15	14:30	3	122	5	3	1	20	15	147	8	3	2	5	*1701*
14:30	14:45	3	106	5	3	1	22	23	125	9	3	0	1	*1518*
14:45	15:00	2	105	4	3	1	18	19	120	7	5	1	2	*1394*
15:00	15:15	3	120	3	3	1	18	10	138	5	3	2	2	*1230*
15:15	15:30	5	158	7	3	2	19	20	165	6	4	3	5	*1293*
15:30	15:45	4	165	6	3	1	15	20	205	7	6	2	5	*1431*
15:45	16:00	5	192	6	1	1	18	13	230	10	8	2	5	*1635*
16:00	16:15	3	165	4	5	1	16	17	231	9	7	1	4	*1790*
16:15	16:30	4	210	2	5	2	15	18	286	10	5	2	7	*1959*
16:30	16:45	2	211	3	7	1	19	18	230	15	6	2	6	*2040*
16:45	17:00	2	132	4	4	1	16	8	143	1	3	1	5	*1869*
17:00	17:15	1	186	2	7	1	18	9	198	2	12	2	7	*1851*
17:15	17:30	1	159	4	3	1	13	11	206	2	8	2	5	*1700*
17:30	17:45	2	140	2	3	1	15	11	168	2	5	1	3	*1533*
17:45	18:00	1	96	1	1	0	8	2	95	1	2	0	2	*1422*
AM		**25**	**857**	**30**	**14**	**11**	**71**	**124**	**1099**	**37**	**33**	**18**	**41**	**2360**
PM		**14**	**778**	**15**	**18**	**5**	**68**	**66**	**977**	**44**	**26**	**7**	**22**	**2040**
TOTAL		**188**	**7606**	**195**	**202**	**74**	**763**	**796**	**9176**	**352**	**273**	**93**	**249**	**19967**

Project: **MT0093_Kelvin**
Intersection: M39 Zuurfontein Street_M32 Plane Road
Date: 03-Jun-21
Day: Thursday
Location: 4

AM PEAK:	**06h45**	**07h45**
PM PEAK:	**15h45**	**16h45**



SITE4_Total_0306

12 Hour

Time		South			East			North			West			Hourly
Start	End	MOV 1	MOV 2	MOV 3	MOV 4	MOV 5	MOV 6	MOV 7	MOV 8	MOV 9	MOV 10	MOV 11	MOV 12	
06:00	06:15	27	132	6	4	20	36	72	264	70	23	4	7	
06:15	06:30	34	179	7	5	42	43	55	299	91	12	4	7	
06:30	06:45	33	190	9	9	57	58	72	317	88	20	23	8	
06:45	07:00	34	186	9	14	74	81	65	291	81	22	18	10	*3212*
07:00	07:15	32	199	16	8	72	92	116	314	85	10	19	11	*3521*
07:15	07:30	13	213	10	14	73	120	84	335	68	17	23	11	*3724*
07:30	07:45	30	227	10	10	54	89	76	305	45	16	21	15	*3738*
07:45	08:00	27	179	9	10	68	78	56	240	43	17	27	18	*3625*
08:00	08:15	20	157	8	9	48	87	64	231	66	11	6	6	*3364*
08:15	08:30	15	137	7	9	40	75	54	215	60	11	5	5	*3016*
08:30	08:45	16	109	6	7	29	35	24	167	78	17	0	3	*2609*
08:45	09:00	12	102	4	6	27	45	19	137	34	13	2	3	*2241*
09:00	09:15	24	141	5	7	55	140	58	207	60	13	7	10	*2255*
09:15	09:30	14	147	4	11	36	77	39	205	69	22	5	10	*2261*
09:30	09:45	28	150	7	11	68	53	39	206	63	23	8	10	*2436*
09:45	10:00	18	145	7	10	10	47	25	199	54	13	4	8	*2572*
10:00	10:15	35	137	6	9	51	47	26	214	57	11	5	12	*2455*
10:15	10:30	11	109	3	5	40	35	15	166	80	6	6	6	*2298*
10:30	10:45	4	43	2	6	3	55	6	67	8	6	3	3	*1838*
10:45	11:00	21	109	3	6	30	73	25	157	26	7	6	4	*1765*
11:00	11:15	27	115	3	13	33	59	11	172	35	6	10	4	*1643*
11:15	11:30	16	107	6	4	33	53	15	205	55	6	11	6	*1678*
11:30	11:45	14	120	6	11	40	45	12	166	23	7	20	4	*1940*
11:45	12:00	21	120	2	2	20	42	20	211	49	7	5	6	*1978*

12:00	12:15	13	132	3	12	44	42	25	212	24	7	12	5	*2021*
12:15	12:30	23	133	5	9	60	56	57	332	56	27	8	15	*2285*
12:30	12:45	21	125	2	8	39	39	51	55	39	15	8	4	*2223*
12:45	13:00	20	143	4	3	48	56	39	149	17	6	9	4	*2216*
13:00	13:15	36	199	5	9	69	61	37	203	33	4	11	6	*2358*
13:15	13:30	14	166	5	7	51	42	33	196	24	3	14	2	*2134*
13:30	13:45	18	197	4	7	66	53	24	243	25	5	9	2	*2381*
13:45	14:00	13	146	6	5	35	70	29	212	63	9	6	4	*2481*
14:00	14:15	10	192	4	3	28	61	54	218	69	7	9	3	*2466*
14:15	14:30	16	111	6	4	25	79	37	160	55	6	10	6	*2424*
14:30	14:45	17	97	6	4	33	90	54	137	61	7	2	2	*2281*
14:45	15:00	13	96	5	4	22	70	44	130	51	11	5	2	*2136*
15:00	15:15	17	110	5	5	35	68	24	151	38	6	12	2	*1951*
15:15	15:30	25	145	9	5	42	74	48	181	42	8	15	6	*2036*
15:30	15:45	21	151	8	4	33	61	46	225	50	13	12	6	*2156*
15:45	16:00	23	176	7	3	25	68	33	252	67	18	8	6	*2389*
16:00	16:15	14	151	6	9	29	64	40	253	65	15	5	4	*2571*
16:15	16:30	20	192	3	9	42	61	43	314	66	11	9	9	*2750*
16:30	16:45	7	193	5	12	36	76	43	253	101	12	7	8	*2873*
16:45	17:00	8	121	5	8	34	64	20	157	9	7	6	6	*2632*
17:00	17:15	7	170	2	11	24	72	23	217	15	25	11	9	*2563*
17:15	17:30	4	146	6	4	32	53	28	226	13	17	8	6	*2327*
17:30	17:45	9	128	3	4	20	60	28	184	12	11	3	4	*2040*
17:45	18:00	6	87	2	2	3	31	6	104	9	5	1	2	*1853*
AM		**109**	**825**	**45**	**46**	**273**	**382**	**341**	**1245**	**279**	**65**	**81**	**47**	**3738**
PM		**64**	**712**	**21**	**33**	**132**	**269**	**159**	**1072**	**299**	**56**	**29**	**27**	**2873**
TOTAL		**901**	**6960**	**271**	**351**	**1898**	**3036**	**1914**	**10054**	**2392**	**571**	**442**	**310**	**29100**

Project: **MT0093_Kelvin**

Intersection: M39 Zuurfontein Street_Parkland Drive

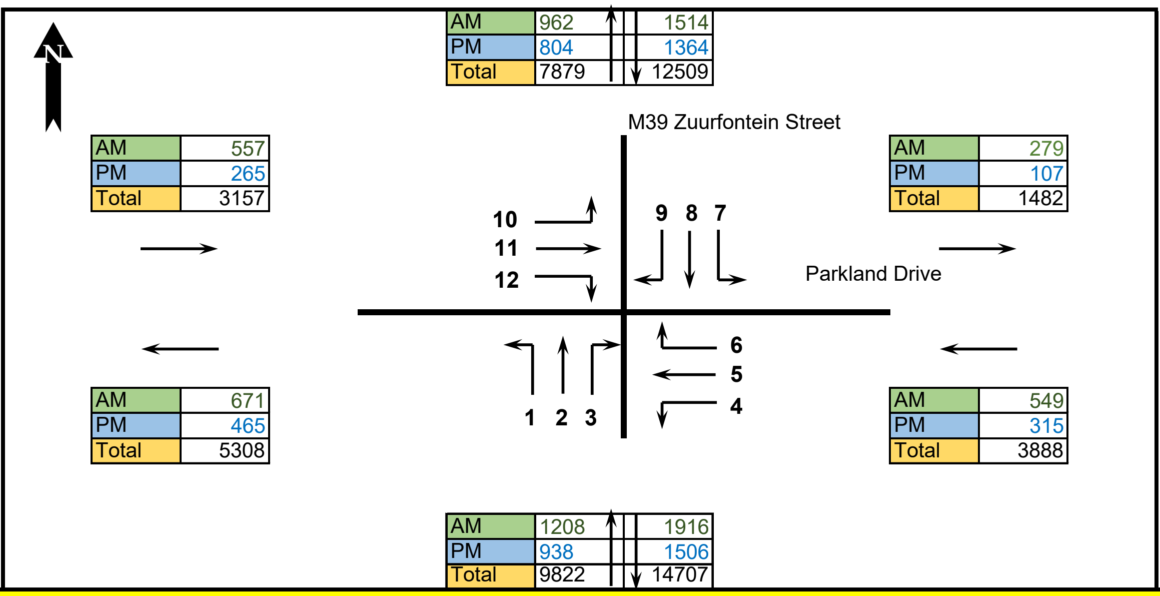
Date: 03-Jun-21

Day: Thursday

Location: 5

AM PEAK: 06h45 07h45

PM PEAK: 15h45 16h45



SITE5_Total_0306

12 Hour

Time		South			East			North			West			Hourly
Start	End	MOV 1	MOV 2	MOV 3	MOV 4	MOV 5	MOV 6	MOV 7	MOV 8	MOV 9	MOV 10	MOV 11	MOV 12	
06:00	06:15	46	146	13	21	23	2	1	282	43	8	10	52	
06:15	06:30	59	199	15	26	48	2	1	320	56	4	10	52	
06:30	06:45	59	212	17	43	65	3	1	340	46	7	50	61	
06:45	07:00	26	218	19	54	90	2	1	358	38	6	45	87	3287
07:00	07:15	36	216	24	56	82	3	1	329	44	4	50	77	3562
07:15	07:30	67	240	20	66	65	6	3	333	54	6	53	100	3783
07:30	07:45	63	247	32	50	69	6	1	315	37	8	30	91	3828
07:45	08:00	46	194	25	46	56	3	1	284	41	4	19	83	3686
08:00	08:15	42	157	17	46	49	4	1	244	48	4	9	40	3425
08:15	08:30	37	137	19	42	40	4	1	227	50	4	7	37	3017
08:30	08:45	31	109	17	34	30	2	0	180	64	6	0	14	2555
08:45	09:00	23	102	11	30	26	2	0	153	28	4	2	21	2155
09:00	09:15	45	153	11	32	59	7	1	224	41	4	13	67	2151
09:15	09:30	26	159	10	54	39	4	1	221	46	8	10	67	2191
09:30	09:45	51	163	17	51	73	2	1	223	43	8	16	69	2421
09:45	10:00	34	157	16	50	11	2	0	215	36	5	7	55	2607
10:00	10:15	65	147	14	43	54	2	0	231	38	4	10	83	2641
10:15	10:30	22	119	8	24	43	2	0	179	54	2	11	37	2497
10:30	10:45	8	47	5	31	4	3	0	73	5	2	6	20	1984
10:45	11:00	39	118	7	31	33	3	0	170	18	2	11	22	1850
11:00	11:15	48	124	8	61	36	3	0	186	24	2	19	22	1692
11:15	11:30	29	117	14	21	36	2	0	221	37	2	20	42	1732
11:30	11:45	27	130	13	56	43	2	0	179	16	3	37	30	2064
11:45	12:00	39	130	6	10	21	2	0	228	33	3	9	39	2130

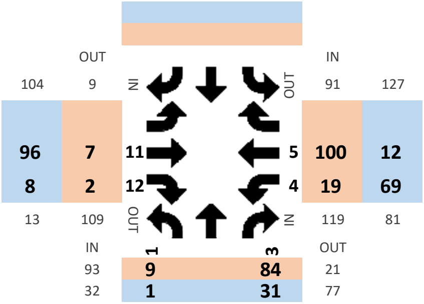
12:00	12:15	24	143	7	59	47	2	0	229	16	3	22	35	*2184*
12:15	12:30	43	144	12	45	64	3	1	360	38	9	15	101	*2478*
12:30	12:45	39	134	5	41	42	2	1	59	26	5	14	28	*2338*
12:45	13:00	38	155	9	16	51	3	1	161	12	2	17	22	*2305*
13:00	13:15	66	215	12	45	74	3	1	219	22	1	20	43	*2439*
13:15	13:30	27	180	11	34	54	2	1	211	16	1	27	16	*2184*
13:30	13:45	34	212	10	34	71	2	0	262	17	2	17	14	*2463*
13:45	14:00	25	159	13	26	38	3	0	229	43	3	11	30	*2556*
14:00	14:15	19	208	10	15	30	3	1	237	46	3	16	20	*2443*
14:15	14:30	28	120	14	21	26	4	1	174	37	2	18	40	*2348*
14:30	14:45	30	105	14	17	36	4	1	148	41	2	3	12	*2086*
14:45	15:00	23	104	13	21	22	3	1	142	34	4	10	19	*1902*
15:00	15:15	30	119	11	24	38	3	0	163	25	2	23	17	*1749*
15:15	15:30	46	157	20	24	46	3	1	195	28	3	28	44	*1859*
15:30	15:45	40	164	18	19	36	3	1	243	33	5	22	43	*2073*
15:45	16:00	42	191	16	15	26	3	1	272	46	6	16	41	*2352*
16:00	16:15	26	164	13	43	31	3	1	273	44	5	10	32	*2542*
16:15	16:30	38	208	6	45	46	3	1	339	45	4	17	60	*2759*
16:30	16:45	14	209	11	57	39	4	1	273	68	4	14	56	*2882*
16:45	17:00	15	131	12	37	37	3	0	170	6	2	12	46	*2678*
17:00	17:15	11	184	5	52	24	3	0	235	10	9	20	60	*2646*
17:15	17:30	7	158	14	20	35	2	0	243	9	6	15	46	*2389*
17:30	17:45	16	139	6	18	21	3	0	199	8	4	6	24	*2083*
17:45	18:00	10	95	4	8	4	1	0	112	6	2	1	13	*1868*
AM		**192**	**921**	**95**	**226**	**306**	**17**	**6**	**1335**	**173**	**24**	**178**	**355**	**3828**
PM		**120**	**772**	**46**	**160**	**142**	**13**	**4**	**1157**	**203**	**19**	**57**	**189**	**2882**
TOTAL		**1659**	**7539**	**624**	**1714**	**2033**	**141**	**30**	**10863**	**1616**	**199**	**828**	**2130**	**29376**

KELVIN POWER STATION PROJECT (TECHWORLD)

LOCATION	1	SHRIKE RD AND CAPE WAGTAIL	13.04.2022
6	HOUR COUNT	TOTAL VEHICLES	WEDNESDAY

AM PEAK 06:15 07:15 **PM PEAK** 15:30 16:30

SHRIKE RD



SHRIKE RD

CAPE WAGTAIL

v3.0

Time	Southern Leg			Eastern Leg			Northern Leg			Western Leg			Hourly	
	1		3	4	5						11	12		
AM PEAK	9		84	19	100						7	2	221	
PM PEAK	1		31	69	12						96	8	217	
06:00	1		12	6	9						3			
06:15	1		22	3	28						2	1		
06:30	4		16	5	30						3	1		
06:45	2		24	8	25						2		208	06:00
07:00	2		22	3	17								221	06:15
07:15			23	5	5						2		199	06:30
07:30			15	10	5						2		172	06:45
07:45			15	9	5								140	07:00
08:00			9	4	6						2		117	07:15
08:15			8	7	4								101	07:30
08:30			8	5	1						3		86	07:45
08:45			6	6	2						3		74	08:00
09:00													53	08:15
09:15													34	08:30
09:30													17	08:45
09:45														09:00
10:00														09:15
10:15														09:30
10:30														09:45
10:45														10:00
11:00														10:15
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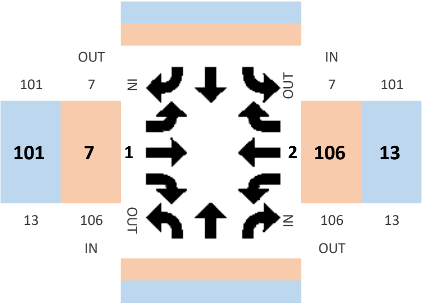
14:00														13:15
14:15														13:30
14:30														13:45
14:45														14:00
15:00			7	18	3						11	1	40	14:15
15:15			9	9	5						7		70	14:30
15:30	1		6	19	5						5	1	107	14:45
15:45			8	18	3						39	2	177	15:00
16:00			9	14	2						41	5	208	15:15
16:15			8	18	2						11		217	15:30
16:30			12	17	4						3		216	15:45
16:45			8	20							3		177	16:00
17:00			5	21	5						7		144	16:15
17:15			15	29	1						5	1	156	16:30
17:30			13	32	2						1		168	16:45
17:45			8	26	3						1		175	17:00

KELVIN POWER STATION (TECHWORLD)

LOCATION	2	SHRIKE RD LINK COUNT	13.04.2022
6	HOUR COUNT	TOTAL VEHICLES	WEDNESDAY
AM PEAK	06:15 07:15		PM PEAK 15:30 16:30

SHRIKE RD



SHRIKE RD

masix
TECHNICAL SERVICES

ROAD

v3.0

Time	Southern Leg	Eastern Leg	Northern Leg	Western Leg	Hourly	
		2		1		
AM PEAK		106		7	113	
PM PEAK		13		101	114	
06:00		11		3		
06:15		28		2		
06:30		34		3		
06:45		26		2	109	06:00
07:00		18			113	06:15
07:15		5		2	90	06:30
07:30		5		2	60	06:45
07:45		5			37	07:00
08:00		6		2	27	07:15
08:15		4			24	07:30
08:30		1		3	21	07:45
08:45		2		3	21	08:00
09:00					13	08:15
09:15					9	08:30
09:30					5	08:45
09:45						09:00
10:00						09:15
10:15						09:30
10:30						09:45
10:45						10:00
11:00						10:15
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13:45						13:00
14:00						13:15
14:15						13:30
14:30						13:45
14:45						14:00
15:00		3		11	14	14:15
15:15		5		7	26	14:30
15:30		6		5	37	14:45
15:45		2		39	78	15:00
16:00		2		45	111	15:15
16:15		3		12	114	15:30
16:30		4		5	112	15:45
16:45				3	74	16:00
17:00		5		7	39	16:15
17:15		1		6	31	16:30
17:30		2		1	25	16:45
17:45		3		1	26	17:00

DETAILS OF THE SPECIALIST

Specialist Information	
Name:	Pieter Kruger
Phone number:	012-348 0386
Email:	admin@techworld.co.za
Professional Registration Number:	Pr Eng 910114
Project:	Kelvin Power Station Decommissioning and Demolition Project

Declaration of Independence by Specialist

I, Pieter Kruger , declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

Pieter Kruger

Appendix G5: Air Quality Assessment

REPORT

Air Quality Screening Assessment for the A-Station Decommissioning and Demolition Project

Kelvin Power (Pty) Ltd

Submitted to:

Kelvin Power Station

Submitted by:

Golder Associates Africa (Pty) Ltd.
Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa
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DETAILS OF THE SPECIALIST

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Declaration of Independence by Specialist

I, Novania Reddy declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed Decommissioning and Demolition Project;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document.

Record of Issue

Client Contact	Version	Author	Reviewer and Approver	Date Issued	Method of Delivery
Kelvin Power	Draft	N. Reddy	M. Schlechter	March 2022	Electronic Copy
Kelvin Power	Final	N. Reddy	M. Schlechter	August 2022	Electronic Copy

Executive Summary

Overview

Kelvin Power (Pty) Ltd (Kelvin Power) consists of two separate power plants, namely the A-station and the B-station. The A-station was in operation for approximately 60 years, until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into a cleaner technology power plant.

Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), was appointed by Kelvin Power as an independent environmental consulting firm to conduct the environmental regulatory process for the proposed decommissioning and demolition of the A-station power plant situated in the City of Ekurhuleni in Gauteng. This includes conducting or updating a number of specialist studies to inform the Basic Assessment Report (BAR). As such, this report presents the Environmental Air Quality Screening Assessment on nearby sensitive receptors associated with the Project.

Baseline Assessment

The baseline assessment included an identification of key pollutants associated with the activities and an overview of available meteorological and ambient air quality data. Key pollutants associated with the proposed decommissioning and demolition activities were identified as dust and particulate matter of aerodynamic diameters less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively).

Meteorological Conditions

Kelvin Power receives most of its rainfall during the summer months and the lowest rainfall levels during the winter months. Total rainfall for the 2020 period recorded was 166.5 mm. Average summer temperatures were around 20 °C and average winter temperatures around 13 °C, with an average humidity of 72.6% (Exito, Dust Fallout Monitoring Report, 2020).

Ambient Air Quality Monitoring

Dust fallout monitoring for Kelvin Power is undertaken by Exito Environmental Projects cc using the approved American Society for Testing and Materials (ASTM) standard method for collection and analyses of dustfall – ASTM D1739:1970. The dust fallout network consists of ten single bucket monitoring locations. Out of the ten sites, six of the locations are classified as non-residential and the remaining four locations (K001, K002, K007 and K008) are classified as residential. The following was noted from the most recent January to December 2020 monitoring period.

- Over the monitoring period for 2020, one exceedance of the National Residential Dust Control Regulations was recorded at the K008 monitoring location during the July/August 2020 monthly period;
- The remaining dust fallout monitoring locations were compliant with the National Dust Control Regulations; and
- The average residential and non-residential dust fallout for the monitoring period was 166 mg/m^2/day and 199 mg/m^2/day, respectively, below the National Dust Control Residential and Non-Residential Regulations.

Impact Assessment

The impact assessment comprised of an emissions inventory and a subsequent screening tool to determine the potential air quality impacts from the proposed decommissioning and demolition operations. An emissions inventory was developed using site-specific data and emission factors which were sourced from the United States Environmental Protection Agency (USEPA) AP42 (USEPA, 1995) database. This emissions inventory was input into a Level 1 screening tool, SCREEN3, to predict ambient air concentrations on the surrounding environment associated with the Project.

Long-term (annual) and short-term (24-hour average) concentrations for the pollutants of concern for the operational phase were compared with the applicable National Ambient Air Quality Standards (NAAQS).

The screening assessment indicated that:

- **PM_{10} Concentrations:**
  - From approximately 800 m from the proposed decommissioning and demolition activities, 24-hour PM_{10} concentrations will drop below the 24-hour PM_{10} NAAQS of 75 µg/m^3. As such, sensitive receptors 1, 6 and 8 (Figure 2) are likely to have concentrations above the 24-hour PM_{10} NAAQS; and
  - From approximately 400 m from the proposed decommissioning and demolition activities, annual PM_{10} concentrations will drop below the annual PM_{10} NAAQS of 40 µg/m^3. However, no receptors are located within 400 m.
- **$PM_{2.5}$ Concentrations:**
  - Predicted 24-hour and annual $PM_{2.5}$ concentrations are below their relevant NAAQSs. As such all sensitive receptor concentrations are below the relevant NAAQSs.

It must be noted that SCREEN3 is not equipped with algorithms for dry deposition (dust fallout). Additionally, there are inherent inaccuracies associated with the screening of this pollutant due to the over estimation of the screening tool, whilst in reality they are likely to be much lower. As such, dust fallout has not been considered for this assessment, however, impacts from dust fallout are likely to be similar to that of PM_{10}.

All impacts of the Project were also evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology.

- During the proposed decommissioning and demolition phase, the impact is predicted to be “moderate” at receptors 1, 6, and 8, given their proximity in location to the proposed decommissioning and demolition activities, whilst the impact is predicted to be “low” at the remaining receptors, with mitigation in place

Conclusion and Recommendations

Based on the findings of the assessment, Golder’s professional opinion is that this Project can be authorised with the recommended mitigation measures implemented and adhered to, especially when working in close proximity to receptors 1, 6, and 8. It is further suggested that dust fallout monitoring data be analysed during the proposed decommissioning and demolition period to ensure that dust levels are kept within acceptable limits. Should these levels exceed the limits additional mitigation measures may need to be implemented and adhered to.

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1.0 INTRODUCTION

Kelvin Power (Pty) Ltd (Kelvin Power) consists of two separate power plants, namely the A-station and the B-station. The A-station was in operation for approximately 60 years, until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into a cleaner technology power plant.

Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Group Africa (Pty) Ltd (WSP), was appointed by Kelvin Power as an independent environmental consulting firm to conduct the environmental regulatory process for the proposed decommissioning and demolition of the A-station power plant situated in the City of Ekurhuleni in Gauteng. This includes conducting or updating a number of specialist studies to inform the Basic Assessment Report (BAR). As such, this report presents the Environmental Air Quality Screening Assessment on nearby sensitive receptors associated with the Project.

It must be noted that the estimation of emissions from decommissioning and demolition activities are highly uncertain due to the site specific and erratic nature of these activities. As such, a screening assessment is considered suitable for a Project of this nature.

1.1 Terms of Reference

The terms of reference, for the assessment are summarised below:

- A baseline assessment of the current air quality climate for the Project;
- Compilation of an emissions inventory during the proposed decommissioning and demolition phase of the A-station;
- Undertake a screening assessment using a Level 1 dispersion model (SCREEN3) to determine the impact of air quality during the proposed decommissioning and demolition phase of the A-station;
- Submission of an Environmental Air Quality Screening Assessment report (this report), detailing all findings from the baseline assessment, emissions inventory and air quality impact findings; and
- Provide recommendations on the scope of any mitigation measures that may be applied to reduce the air quality impact associated with the proposed decommissioning and demolition phase of the A-station, if deemed necessary.

2.0 PROJECT BACKGROUND

2.1 Locality

Kelvin Power operates the Kelvin Power Station in the City of Ekurhuleni and is situated adjacent to, but west of the Zuurfontein Road. The Power Station is also approximately 5 km north-west of the O.R. Tambo International Airport (Portion RE 82 Farm Zuurfontein 33IR). The total extent of the plant is 226.18 ha and the surrounding neighbouring properties zoning description can be classified as industrial. The location map is presented in Figure 1.

2.2 Project Description

The battery limits for the decommissioning and demolition of the A-station power plant will include:

- The A-station boiler house, turbine house and associated two stacks;
- Three cooling towers;
- Workshops and storage facilities;
- External Stockpile A;

- Dry coal storage;
- Old switch yard or high voltage yard; and
- Train wagon tippler or rail tippler.

The current project scope does not include the decommissioning of any waste management facilities as the once currently on site are still in use by the B-station power plant.

2.3 Sensitive Receptors

Sensitive receptors considered for this assessment include residential dwellings, institutional and culturally important sites, such as schools, hospitals and places of worship. Kelvin Power is surrounded by neighbouring commercial and residential properties. These receptors are presented in Table 1 and illustrated in Figure 2.

Table 1: Sensitive receptor locations for the Project

No.	Sensitive Receptor	UTM mE	UTM mS	Distance from Nearest Source (m)	Direction from Site
1	Esther Park	618794	7111886	550	North
2	Croydon	619233	7109996	890	South
3	Spartan	619937	7110847	1360	East
4	Sebenza Area 1	618334	7110119	930	South-west
5	Sebenza Area 2	618003	7110713	1250	West
6	Cresslawn Residential Area	619870	7111151	430	North-east
7	Cresslawn Primary School	620596	7111060	760	East
8	Kempton Park - Kelvin Estate	619629	7110497	500	South-east
9	African Dream Family Church	618211	7108681	1440	South-south-west
10	Allen Grove	623191	7114644	4970	North-east
11	Bushwillow Park	616329	7111329	1840	West-north-west
12	Citraville AH	621998	7115664	4990	North-east
13	Cresecondarylawn Primary	620900	7110962	1290	East
14	Eastleigh	615623	7109504	2840	West-south-west
15	Eden Glen	616901	7109334	1570	North-west
16	Edenglen High School	617593	7108688	1590	South-south-west
17	Edenvale	615270	7108153	3530	South-west

No.	Sensitive Receptor	UTM mE	UTM mS	Distance from Nearest Source (m)	Direction from Site
18	Emerald Estate	615477	7111357	2700	West-north-west
19	Founders Hill	617420	7112050	1430	North-north-west
20	Greenstone Hill	615589	7110697	2490	West
21	Greenstone Park	614515	7110985	3590	West
22	Hoerskool Jeugland	621454	7115271	4420	North-east
23	Hurlyvale	616579	7107204	3420	South-west
24	Illiondale	616775	7111102	1310	West-north-west
25	Intokozo AH	618482	7114701	3140	North
26	Isando	620829	7108336	2290	South-east
27	Jet Park	621872	7106885	4080	South-east
28	Kempton Park West	618686	7114256	2580	North
29	Laerskool Edleen	620585	7113447	2430	North-north-east
30	Laerskool Kreft	623639	7112702	4360	East-north-east
31	Lakeside	614889	7112744	3770	North-west
32	Meadowdale	618072	7107093	3040	South-South-west
33	Restonvale AH	620429	7115854	4630	North-north-east
34	Rhodesfield	623117	7110531	3440	East
35	Sir Pierre Van Reyneveld High School	622642	7112812	3430	East-north-east
36	Terenure	619575	7114716	3180	North-east-north
37	Terenure AH	620184	7114849	3450	North-east-north
38	Thornhill Estate	615194	7112246	3250	North-west
39	Van Riebeeck Park	621766	7115054	4500	North-east

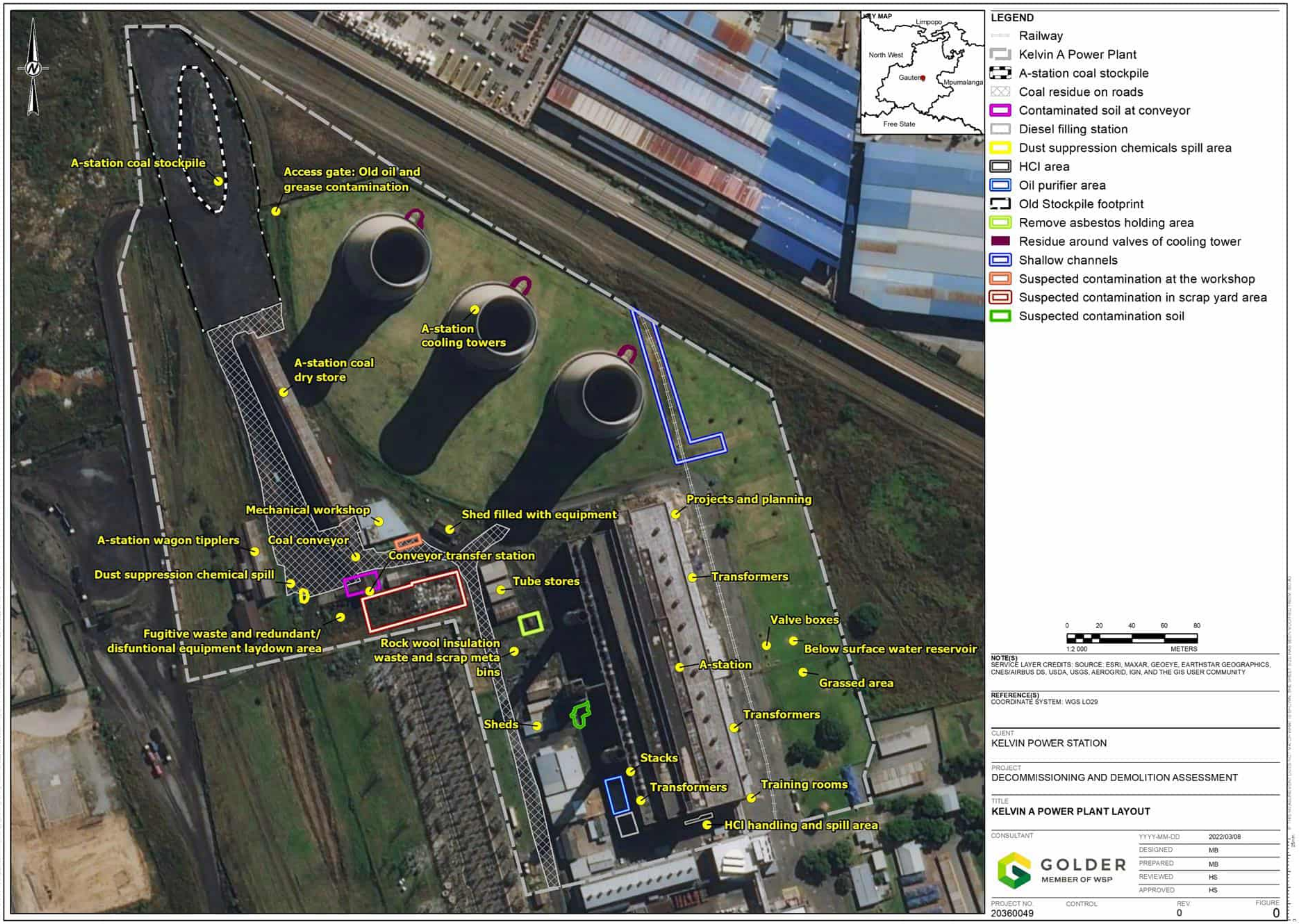

Figure 1: A-Station plant layout

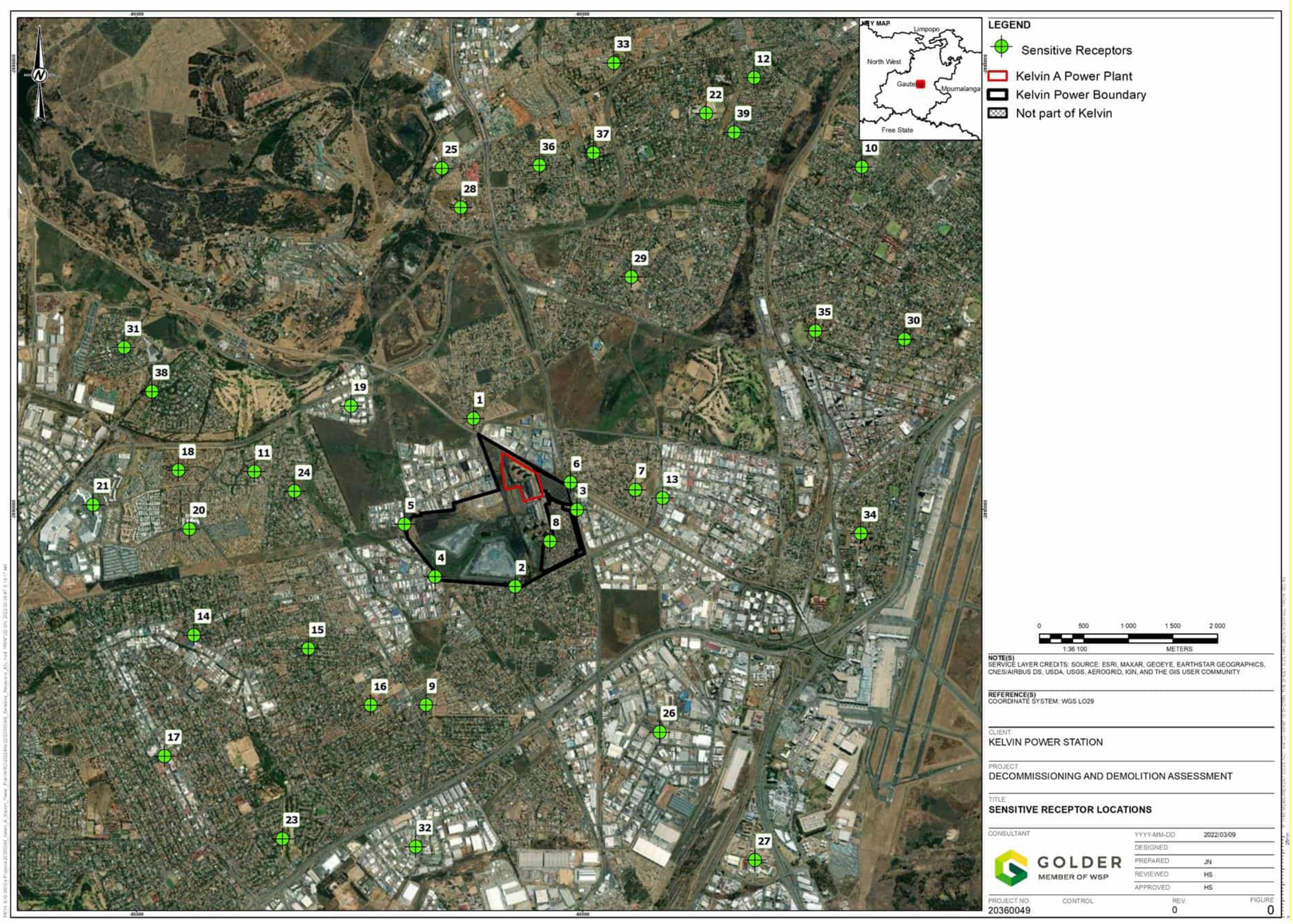

Figure 2: Sensitive receptor locations

3.0 AIR QUALITY LEGISLATION, GUIDELINES AND STANDARDS

3.1 National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The National Environmental Management: Air Quality Act (NEM: AQA) approach to air quality management is based on the control of the receiving environment. The main objectives of the act are to protect the environment by providing reasonable legislative and other measures that (i) prevent air pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development alignment with Sections 24a and 24b of the Constitution of the Republic of South Africa.

3.2 Ambient Air Quality Standards

The national ambient air quality standards (NAAQS) for common pollutants prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area (Table 2). If the standards are exceeded, the ambient air quality is defined as poor and potential adverse health impacts are likely to occur. As such, the contributions to the ambient air quality levels must not exceed or cause exceedances of the ambient air quality standards. The applicable pollutant, under the ambient air quality standards, for the proposed decommissioning and demolition activities is particulate matter of aerodynamic diameter 10 and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively).

Table 2: Ambient air quality standards for criteria pollutants

Pollutant	Averaging Period	Limit Value ($\mu g/m^3$)	Frequency of Exceedance	Compliance Date
NO_2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
PM_{10}	24 hours	75	4	Immediate
	1 year	40	0	Immediate
$PM_{2.5}$	24 hours	40	4	1 January 2016 – 31 December 2029
	24 hours	25	4	1 January 2030
	1 year	20	0	1 January 2016 – 31 December 2029
	1 year	15	0	1 January 2030
O_3	8 hours	120	11	Immediate
Lead (Pb)	1 year	0.5	0	Immediate
CO	1 hour	30 000	88	Immediate
	8 hours	10 000	11	Immediate
Benzene (C_6H_6)	1 year	5	0	Immediate
SO_2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hours	125	4	Immediate
	1 year	50	0	Immediate

3.3 National Dust Control Regulations

On 1 November 2019, the National Dust Control Regulations came into effect under the NEM: AQA, 2004 and published in the Government Gazette No. 41650. The dust fall standard defines acceptable dust fall rates in terms of the presence of residential areas (Table 3). The National Dust Control Regulations are applicable to the proposed decommissioning and demolition activities.

Table 3: Acceptable dust fall rates

Restriction Areas	Dust Fall Rate (mg/m²/day over a 30-day average)	Permitted Frequency of Exceedance
Residential areas	Dust fall <600	Two within a year, not sequential months
Non-residential areas	Dust fall ≤1 200	Two within a year, not sequential months

4.0 ATMOSPHERIC EMISSIONS

4.1 Key Atmospheric Pollutants

The main pollutants of concern for the proposed decommissioning and demolition activities are dust and particulate matter (PM_{10} and $PM_{2.5}$). A description of the key pollutants identified in this assessment, as well as the associated health effects is provided in Table 4.

Table 4: Key pollutants and associate health effects

Pollutant	Description	Health effects
Particulate matter (Dust fallout, PM_{10} and $PM_{2.5}$)	Can be classified by their aerodynamic properties into coarse particles e.g. Total suspended particulate (TSP), PM_{10} and $PM_{2.5}$. The fine particles contain the secondarily formed aerosols such as combustion particles, sulphates, nitrates, and re-condensed organic and metal vapours. The coarse particles contain earth crust materials and fugitive dusts from roads and industries (Fenger, 2002)	Dust fallout is a nuisance and is unlikely to result in health effects. PM_{10} and $PM_{2.5}$ are associated with: airway allergic inflammatory reactions & a wide range of respiratory problems, increase in medication usage related to asthma, nasal congestion and sinuses problems, and adverse effects on the cardiovascular system

5.0 BASELINE ASSESSMENT

5.1 Climatic and Meteorological Data

5.1.1 Regional Overview

Kelvin Power lies within Southern Africa. The atmospheric circulation of Southern Africa plays a major role in determining regional climates (Figure 3). This results in Southern African countries being divided into two Köppen-Geiger climatic groups (Rubel and Kottek, 2010). Class B (Dry climates) countries include those that border Kalahari Desert i.e. Angola, Botswana, Zimbabwe, Namibia and South Africa, with climates ranging from semi-arid and sub-humid in the east, to hyper-arid in the west. Class C (Moist mid-latitude climates) countries are East African nations that experience mild winters (i.e. Tanzania, Malawi, Mozambique, Swaziland, Lesotho and the Indian Ocean islands), with climatic conditions ranging from Dry to Moist Subtropical Mid-Latitude conditions (Ker *et al*., 1978).

Southern Africa is situated in the subtropical high-pressure belt. The mean circulation of the atmosphere over the subcontinent is anticyclonic throughout the year (except for near the surface) (Preston-Whyte and Tyson, 1997). The synoptic patterns affecting the typical weather experienced in the region owe their origins to the subtropical, tropical and temperate features of the general atmospheric circulation over Southern Africa.

The subtropical control is introduced via the semi-permanent presence of the South Indian Anticyclone (HP cell), Continental High (HP cell) and the South Atlantic Anticyclone (LP cell) located in the high-pressure belt located approximately 30°S of the equator (Preston-Whyte and Tyson, 1997). The tropical controls are introduced via tropical easterly flows (LP cells) (from the equator to the southern mid-latitudes) and the occurrence of the easterly wave and lows (Preston-Whyte and Tyson, 1997).

The temperature control is introduced by perturbations in the westerly wave, leading the development of westerly waves and lows (LP cells) (i.e., cold front from the polar region, moving into the mid-latitudes) (Preston-Whyte and Tyson, 1997).

Seasonal variations in the positioning and intensity of the HP cells determine the extent to which the westerly waves and lows impact the atmosphere over the region:

- In winter, the high-pressure belt intensifies and moves northward while the westerly waves in the form of a succession of cyclones or ridging anticyclones moves eastwards around the South African coast or across the country. The positioning and intensity of these systems are thus able to significantly impact the region; and
- In summer the anticyclonic HP belt weakens and shifts southwards and the influence of the westerly waves and lows weakens.

Anticyclones (HP cells) are associated with convergence in the upper levels of the troposphere, strong subsidence throughout the troposphere, and divergence near the surface of the earth. Air parcel subsidence, inversions, fine conditions and little to no rainfall occur because of such airflow circulation patterns (i.e. relatively stable atmospheric conditions). These conditions are not favourable for air pollutant dispersion, especially with regard to those emissions emitted close to the ground.

Westerly waves and lows (LP cells) are characterised by surface convergence and upper-level divergence that produce sustained uplift, cloud formation and the potential for precipitation. Cold fronts, which are associated with the westerly waves, occur predominantly during winter. The passage of a cold front is characterised by pronounced variations in wind direction and speed, temperature, humidity, pressure and distinctive cloud bands (i.e. unstable atmospheric conditions). These unstable atmospheric conditions bring about atmospheric turbulence which creates favourable conditions for air pollutant dispersion.

The tropical easterlies and the occurrence of easterly waves and lows affect Southern Africa mainly during the summer months. These systems are largely responsible for the summer rainfall pattern and the north easterly wind component that occurs over the region (Preston-Whyte and Tyson, 1988).

In summary, the convective activity associated with the easterly and westerly waves disturbs and hinders the persistent inversion which sits over Southern Africa. This allows for the upward movement of air pollutants through the atmosphere leading to improved dispersion and dilution of accumulated atmospheric pollution.

South Africa experiences a large amount of downwelling air to the HP cell located at the towards the northern parts of the country. When this HP is combined with cloudless nights it creates an atmosphere with several layers which reduces vertical mixing. This restriction to vertical mixing combined with counter-clockwise circulation (especially during winter) may keep polluted air in the same place for weeks at a time. Significant variability in precipitation events between summer and winter further affect the amounts of pollution in the air as rainfall brings pollutants down with it.

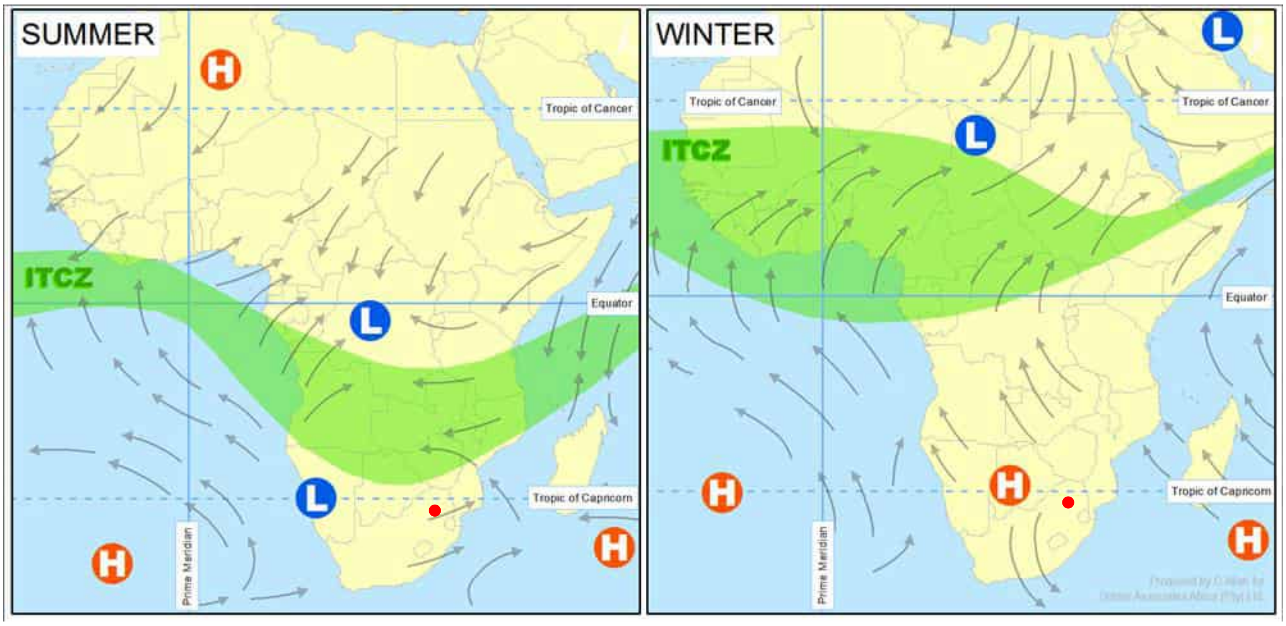

Figure 3: Seasonal circulation patterns affecting the regional climate. The red dot indicts the approximate location of Kelvin Power Station

5.1.2 Local Overview

Kelvin Power receives most of its rainfall during the summer months and the lowest rainfall levels during the winter months. Total rainfall for the 2020 period recorded was 166.5 mm. Average summer temperatures were around 20 °C and average winter temperatures around 13 °C, with an average humidity of 72.6% (Exito, Dust Fallout Monitoring Report, 2020).

5.2 Ambient Air Quality

5.2.1 Local Overview

Existing sources of air pollution within the area have been identified to predominantly include industrial activities.

5.2.1.1 Industrial Activities

The main industrial source of emissions includes the zones on the southern, northern and western boundaries of the property namely; Isando, Spartan Extensions and Sebenza, which are likely to contribute to both gaseous and particulate air pollutants in the area.

5.2.2 Local Ambient Air Quality Monitoring

5.2.2.1 Dust Fallout

Dust fallout monitoring for Kelvin Power is undertaken by Exito Environmental Projects cc using the approved American Society for Testing and Materials (ASTM) standard method for collection and analyses of dustfall – ASTM D1739:1970. The dust fallout network consists of ten single bucket monitoring locations. Out of the ten sites, six of the locations are classified as non-residential and the remaining four locations (K001, K002, K007 and K008) are classified as residential (Figure 4).

Figure 4: Locality of dust buckets at Kelvin Power (Exito Environmental Projects cc Dust Fallout Monitoring Report for Kelvin Power, 2020)

Results of the latest and most recent dust fallout concentrations for the period January to December 2020 is presented in Table 5 for regulatory compliance analysis purposes (must be noted that only a consecutive 12-month period, in accordance with the dust control regulations, needs to be analysed for compliance purposes). Reference however has also been made to some of the historical results.

Dust concentrations were compared to the NEM:AQA (2004). Act No. 39 of 2004 - National Dust Control Regulations R.827 of 1 December 2013. The following was noted for the period January to December 2020:

- Over the monitoring period for 2020, one exceedance of the National Residential Dust Control Regulations was recorded at the K008 monitoring location during the July/August 2020 monthly period;
  - This result is noted as a potential outlier given the much higher concentrations observed in comparison to the other months. This location however resulted in compliance with the National Dust Control Residential Regulations, which allow for two non-sequential exceedances over a rolling twelve-month period; and
  - With dominant west-north-westerly and west-south-westerly winds at strong wind speeds of approximately 29 m/s experienced during the monitoring period, likely sources of dust include activities from the stockpiles on site at Kelvin Power and open exposed areas.
- The remaining dust fallout monitoring locations were compliant with the National Dust Control Regulations; and

- The average residential and non-residential dust fallout for the monitoring period was 166 mg/m^2/day and 199 mg/m^2/day, respectively, below the National Dust Control Residential and Non-Residential Regulations.

Historically, the dust fallout rates at Kelvin Power, for the period 2018 and 2019, indicated:

- **Monitoring period for the period 2018:**
  - Over the 2018 monitoring period, one exceedance of the National Residential Dust Control Regulations was recorded at the K002 monitoring location;
    - This location however resulted in compliance with the National Dust Control Residential Regulations, which allow for two non-sequential exceedances over a rolling twelve-month period.
  - Over the 2018 monitoring period, six exceedances of the National Non-residential Dust Control Regulations were recorded at the K010 monitoring location;
    - This location however resulted in non-compliance with the National Dust Control Residential Regulations, which allow for two non-sequential exceedances over a rolling twelve-month period; and
    - With dominant south-easterly winds during the monitoring period, likely sources of dust include activities from the stockpiles on site at Kelvin Power and open exposed areas.
  - The remaining dust fallout monitoring locations were compliant with the National Dust Control Regulations.
- **Monitoring period for the period 2019:**
  - Over the 2019 monitoring period, one exceedance of the National Residential Dust Control Regulations was recorded at the K002 monitoring location;
    - This location however resulted in compliance with the National Dust Control Residential Regulations, which allow for two non-sequential exceedances over a rolling twelve-month period.
  - Over the 2019 monitoring period, one exceedance and seven exceedances of the National Non-residential Dust Control Regulations were recorded at the K009 and K010 monitoring locations, respectively;
    - The K010 location however resulted in non-compliance with the National Dust Control Residential Regulations, which allow for two non-sequential exceedances over a rolling twelve-month period, whilst the K009 was still compliant; and
    - With dominant south-easterly winds during the monitoring period, likely sources of dust at K010 include activities from the stockpiles on site at Kelvin Power and open exposed areas.
  - The remaining dust fallout monitoring locations were compliant with the National Dust Control Regulations.

As such, the decrease in exceedances in 2020 is most likely attributed to the implementation of dust mitigation measures at the stockpile at Kelvin Power.

Table 5: Dust fallout results for the period January to December 2020 at Kelvin Power

Period	National Residential Standard (mg/m^2/day)	National Non-Residential Standard (mg/m^2/day)	K001[1]	K002[1]	K003[2]	K004[2]	K005[2]	K006[2]	K007	K008[1]	K009[2]	K010[2]
11 Dec – 15 Jan 2020	**600**	**1200**	168	129	207	158	177	93	153	162	230	169
15 Jan – 12 Feb 2020	**600**	**1200**	286	224	240	306	186	155	170	327	605	251
12 Feb – 10 Mar 2020	**600**	**1200**	194	164	137	178	827	145	298	162	121	336
10 Mar – 09 Apr 2020	**600**	**1200**	100	126	84	245	93	55	112	108	75	267
09 Apr – 04 May 2020	**600**	**1200**	77	98	77	91	60	168	106	77	98	344
04 May – 08 Jun 2020	**600**	**1200**	145	85	87	123	179	89	92	563	104	301
11 Jun – 14 Jul 2020	**600**	**1200**	266	Fire Damage	106	141	179	245	162	247	125	567
14 Jul – 14 Aug 2020	**600**	**1200**	223	139	161	238	Fire Damage	152	136	**4 567**	160	389
14 Aug – 15 Sep 2020	**600**	**1200**	226	186	127	218	304	157	63	261	224	463
15 Sep – 14 Oct 2020	**600**	**1200**	246	186	179	Fire Damage	265	70	94	131	68	466
14 Oct – 12 Nov 2020	**600**	**1200**	345	192	139	295	Missing	155	121	154	133	385
12 Nov – 09 Dec 2020	**600**	**1200**	No Access	221	193	263	Missing	160	142	221	150	742
Exceedences	**600**	**1200**	0	0	0	0	0	0	0	1	0	0

Note 1: Residential locations which are compared to the National Residential Standard of 600 mg/m^2/day

Note 2: Non-residential locations which are compared to the National Residential Standard of 600 mg/m^2/day

6.0 STUDY METHODOLOGY

6.1 Emission Estimation

An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. These emission factors have been developed based on test data, material mass balance studies and engineering estimates.

Emission factors are always expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$\mathrm{E} \ = \mathrm{A} \times \mathrm{EF} \ \times \left(1 - \frac{\mathrm{ER}}{100}\right)$$

Where:

E = emission rate

A = activity rate

EF = emission factor

ER= overall emission reduction efficiency (%)

Emission rates for the proposed decommissioning and demolition activities were calculated using the USEPA AP-42 Chapter 13.2.3: Heavy Construction Operation. It must be noted that this equation includes demolition and debris removal (bulldozing, truck loading and unloading of debris, truck travel, etc) and as such, is considered to be suitable for this assessment.

The emission calculations and resultant emission rates are discussed in the section below using the equation presented above and information provided by the Client.

6.1.1 Decommissioning and Demolition Phase

Decommissioning and demolition activities are a source of dust emissions that can have a substantial temporary impact on the local ambient air quality. Dust emissions vary substantially on a daily basis, depending on the level of activity, the specific operations and the prevailing meteorological conditions (USEPA, 1995).

The quantity of dust emissions from these activities is proportional to the area of land being worked and to the level of construction activity. Emissions from these activities are positively correlated with the silt content of the soil and the weight and speed of the average vehicle and negatively correlated with the soil moisture content (USEPA, 1995).

Total suspended particulate (TSP) emissions generated by the proposed decommissioning and demolition activities, were calculated using the following equation:

$$E_{TSP} = 2.69 \text{ tons/ha/month of activity}$$

The emission factor relates the tons of TSP emitted per hectare covered by the proposed decommissioning and demolition activities per month of activity. Based on the USEPA particle size distribution data, PM_{10} and $PM_{2.5}$ constitute 35% and 5.3% of TSP, respectively. A control efficiency of 50% has been applied for water sprays, as per Client data. Further, it is assumed that no more than 30% of the area would be cleared at any one time.

It must be noted that the estimation of emissions from these activities are highly uncertain due to the site specific, erratic and short-lived nature of these activities. As such, a screening assessment is considered appropriate for a Project of this nature. Additionally, the emission rate used to calculate such emissions is an overestimation at most decommissioning and demolition sites and the results presented here may be slightly over predicted to those that will be experienced in reality. The emission rates are presented in Table 6. Importantly, activities will only last during the day-time only (07:30–16:00 from Mondays to Fridays and 07:30-14:00 on Saturdays), as per Client data.

Table 6: Calculated emission rates

Location	Emission Rate (g/m^2/s)		
	TSP	PM$_{10}$	PM$_{2.5}$
Decommissioning and demolition phase	5.49E-05	1.92E-05	2.91E-06

6.2 Assessment

6.2.1 Screening Tool

SCREEN3 is an easy-to-use dispersion model for obtaining pollutant concentration estimates based on screening- level procedures.

SCREEN3 is the recommended tool to calculate screening-level impact estimates for sources. It is a Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources (US EPA 1992). The model is a single source model and impacts from multiple SCREEN3 model runs can be summed to conservatively estimate the impact from several sources. SCREEN3 calculates 1-hour concentration estimates in simple terrain areas. These modelled estimates must be converted to the averaging period of each applicable national ambient air quality standards. SCREEN3 incorporates source related factors and meteorological factors to estimate pollutant concentration from continuous sources. The model assumed that the pollutant does not undergo any chemical reactions, and that no other removal processes (wet or dry deposition) act on the plume during its transportation. SCREEN3 examines a range of stability classes and wind speeds to identify the combination of wind speed and stability that results in the maximum ground level concentrations, the “worst case” meteorological conditions.

The maximum ground level concentration predicted using a screening dataset is normally regarded as conservative, often termed 'worst-case scenario' impacts.

6.2.2 Scenarios

One scenario has been considered:

- Proposed decommissioning and demolition operations only.

The model output figures and tables that follow show concentrations that would be experienced at 1.5 m above the ground (considered representative of average human breathing height). The following statistical outputs were calculated:

- Peak 24-hour and annual averages were calculated using the equation below. The dispersion model’s lowest temporal resolution is one hour. The equation was used to convert P100 1-hour average concentrations over the modelled period to peak 24-hour and annual average concentrations. Values can be compared with the relevant 24-hour and annual average NAAQSs to assess likely air quality impacts across the model domain.

$$C_p = C_M \times \left(\frac{T_M}{T_P}\right)^P$$

Where:

C_P = Peak concentration, expressed on the new averaging time [μ/m^3]

C_M = Mean concentration on one hour averaging time [μ/m^3]

T_M = Averaging time for mean hour [60 minutes]

T_P = New averaging time [minutes]

P = Decay value = 0.2 [non-dimensional]

6.2.3 Results and Discussion

This section presents the results of the screening assessment conducted for the decommissioning and demolition phase of the A-station for the key pollutants, PM_{10} and $PM_{2.5}$.

Concentration results are illustrated graphically to indicate the dispersion of pollutants. Comparison of the predicted concentrations was made with the relevant ambient air quality guidelines to determine compliance.

6.2.3.1 Predicted Concentrations

Figure 5 to Figure 8 shows the dispersion over distance graphs for the predicted PM concentrations for the Project only.

- **PM_{10} Concentrations:**
  - From approximately 800 m from the proposed decommissioning and demolition activities, 24-hour PM_{10} concentrations will drop below the 24-hour PM_{10} NAAQS of 75 µg/m^3 (Figure 5) As such, sensitive receptors 1, 6 and 8 are likely to have concentrations above the 24-hour PM_{10} NAAQS; and
  - From approximately 400 m from the proposed decommissioning and demolition activities, annual PM_{10} concentrations will drop below the annual PM_{10} NAAQS of 40 µg/m^3 (Figure 6). However, no receptors are located within 400 m.
- **$PM_{2.5}$ Concentrations:**
  - Predicted 24-hour and annual $PM_{2.5}$ concentrations are below their relevant NAAQSs. As such all sensitive receptor concentrations are below the relevant NAAQSs (Figure 7 and Figure 8).

It must be noted that SCREEN3 is not equipped with algorithms for dry deposition (dust fallout). Additionally, there are inherent inaccuracies associated with the screening of this pollutant due to the over estimation of the screening tool, whilst in reality they are likely to be much lower. As such, dust fallout has not been considered for this assessment, however, impacts from dust fallout are likely to be similar to that of PM_{10}.

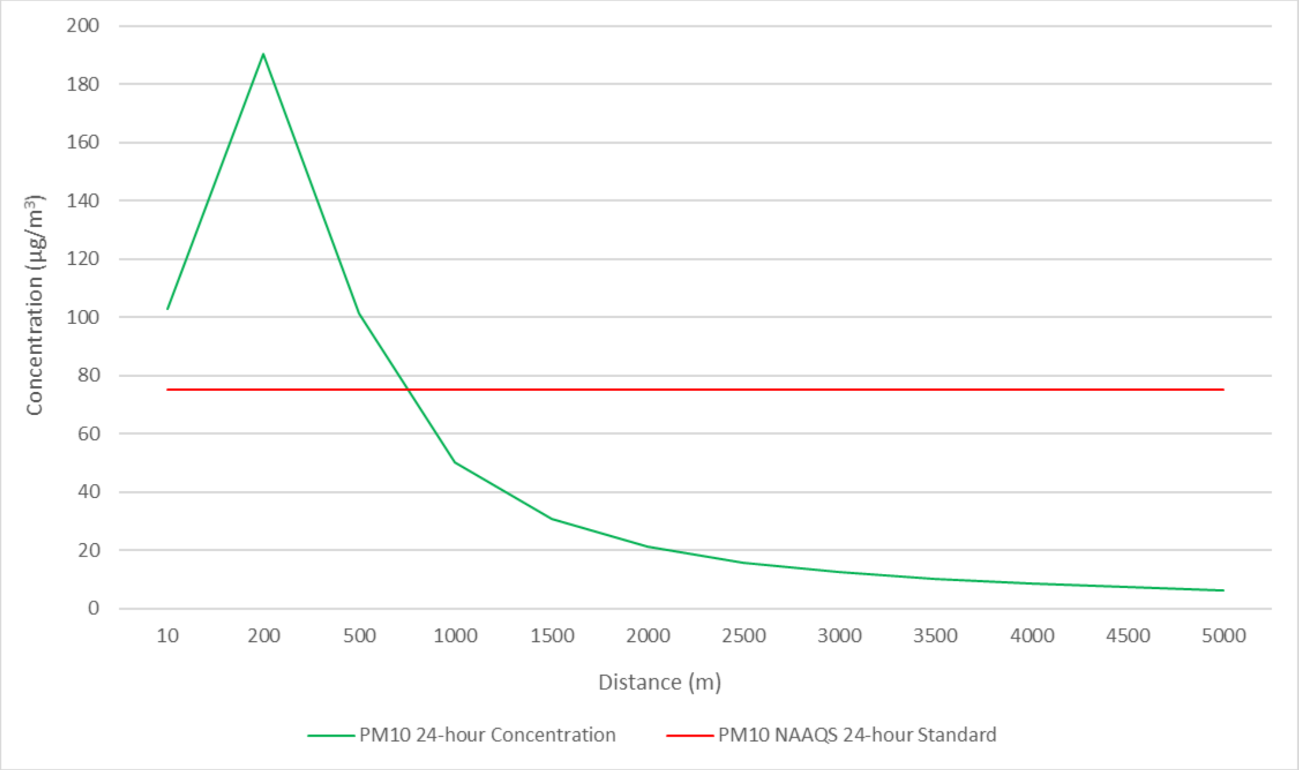

Figure 5: Predicted 24-hour PM_{10} concentrations during the proposed decommissioning and demolition phase only (µg/m^3)

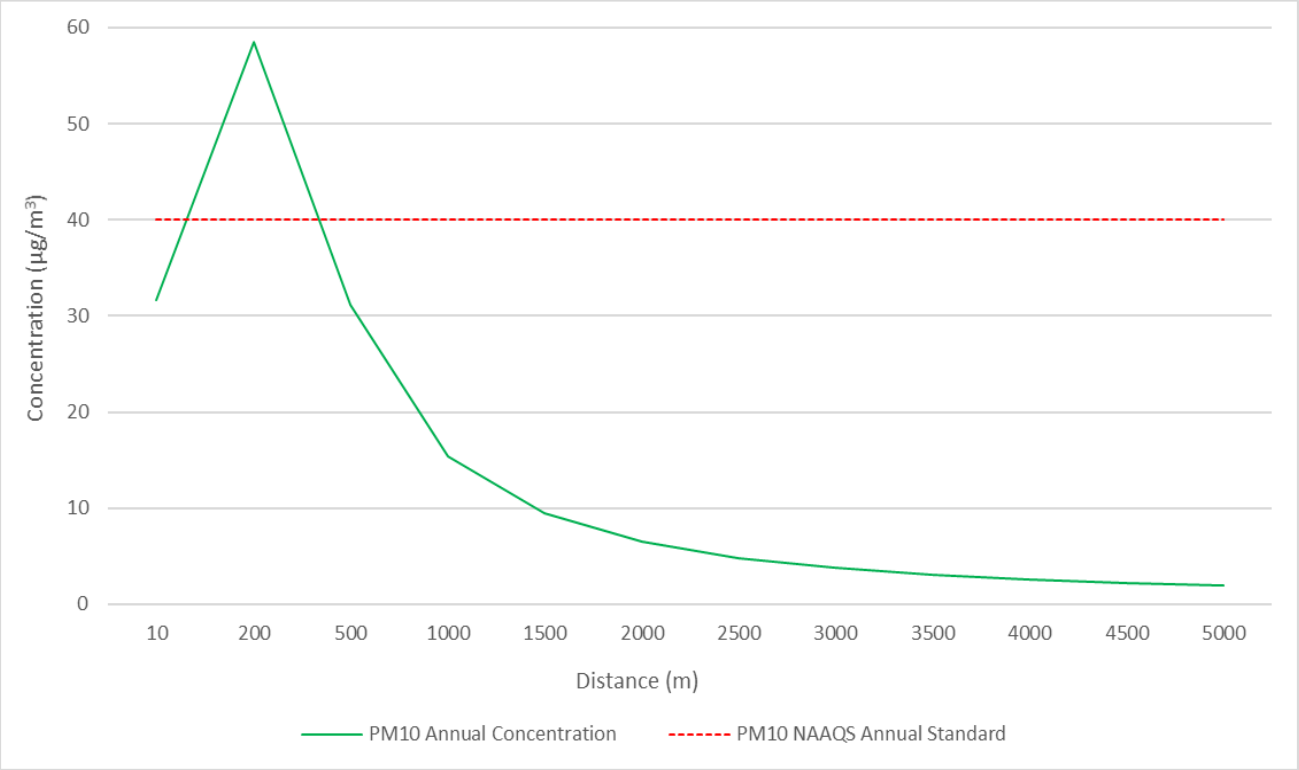

Figure 6: Predicted annual PM_{10} concentrations during the proposed decommissioning and demolition phase only (µg/m^3)

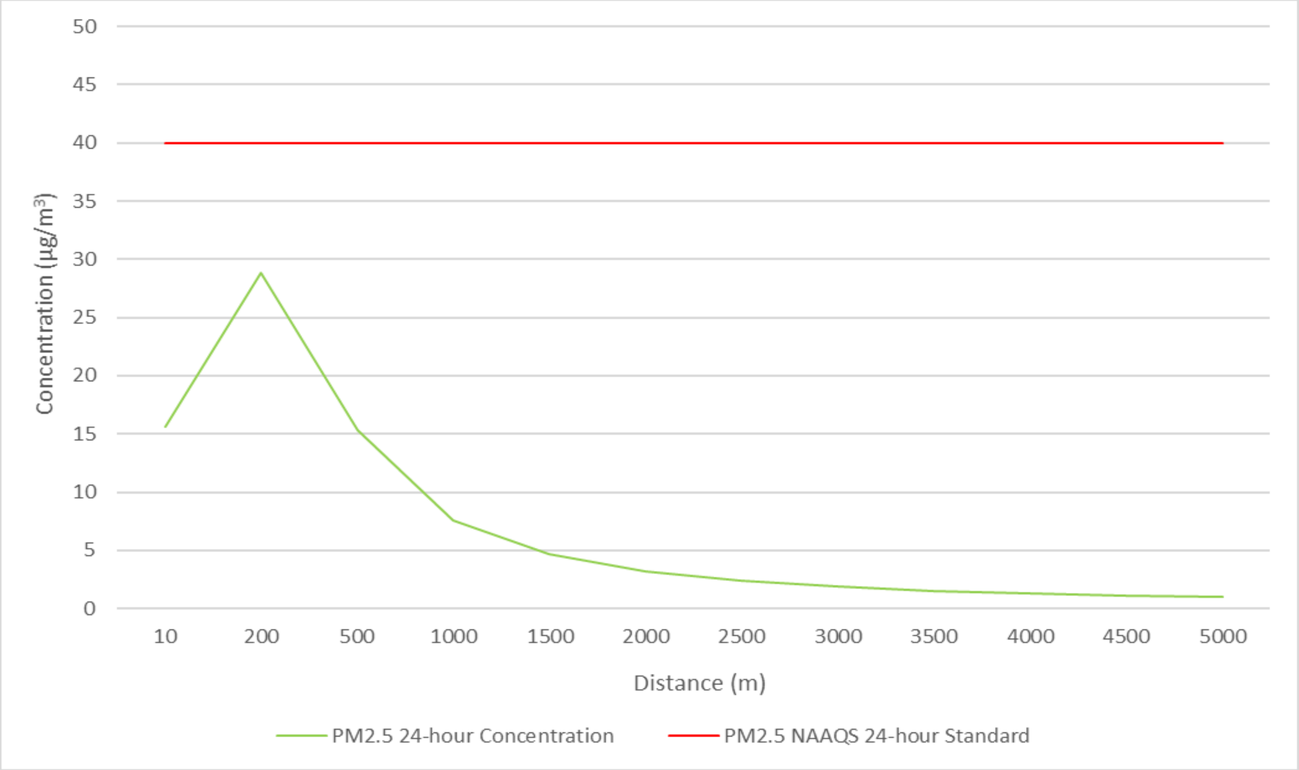

Figure 7: Predicted 24-hour $PM_{2.5}$ concentrations during the proposed decommissioning and demolition phase only ($\mu g/m^3$)

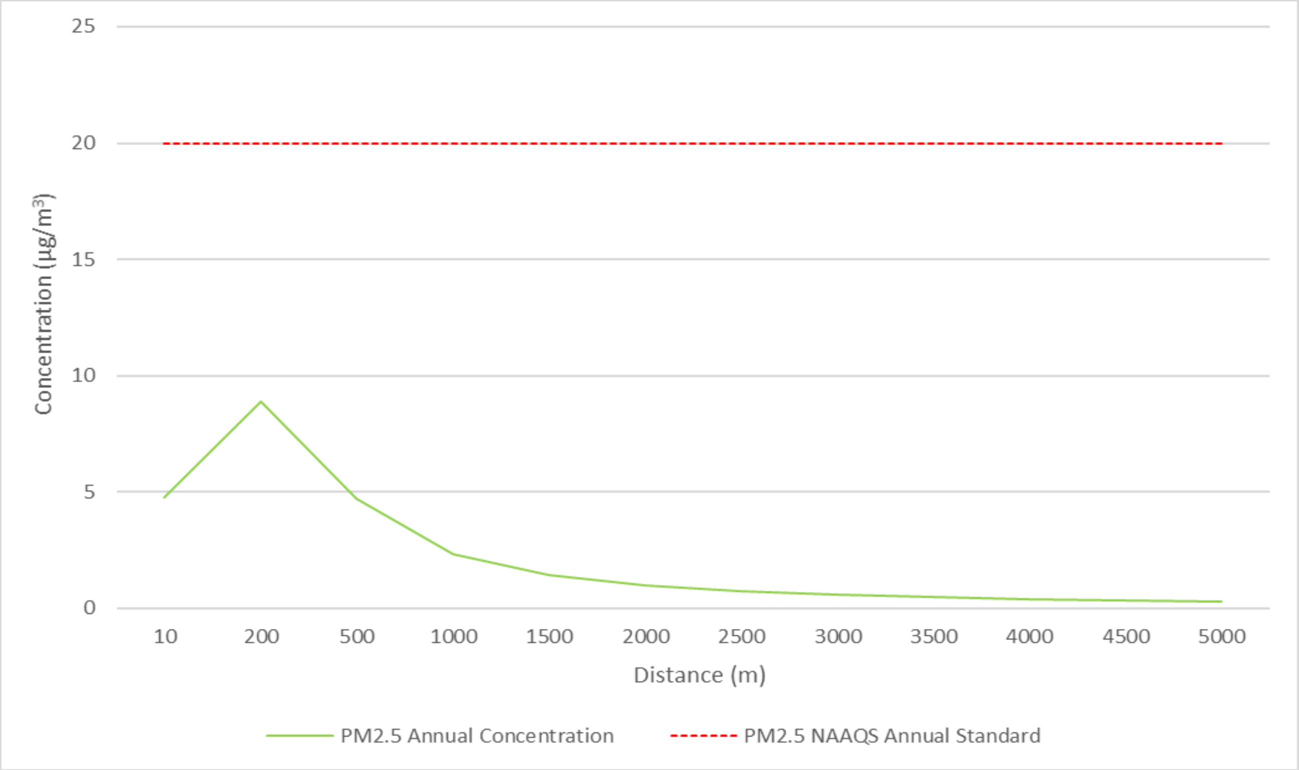

Figure 8: Predicted annual $PM_{2.5}$ concentrations during the proposed decommissioning and demolition phase only ($\mu g/m^3$)

6.2.4 Assumptions and Limitations

- Based on the USEPA particle size distribution data, PM_{10} and $PM_{2.5}$ constitute 35% and 5.3% of TSP, respectively for the proposed decommissioning and demolition activities equation. A control efficiency of 50% has been applied for water sprays, as per Client data. Further, it is assumed that no more than 30% of the area would be cleared at any one time;
- It must be noted that the estimation of emissions from these activities are highly uncertain due to the site specific, erratic and short-lived nature of these activities. As such, a screening assessment is considered suitable for a Project of this nature. Additionally, the emission rate used to calculate such emissions is an overestimation at most decommissioning and demolition sites and the results presented here may be slightly over predicted to those that will be experienced in reality;
- Importantly, activities will only last during the day-time only (07:30–16:00 from Mondays to Fridays and 07:30-14:00 on Saturdays), as per Client data;
- The study has been based on a worst-case scenario, using a screening tool for simple terrain areas; and
- It must be noted that SCREEN3 is not equipped with algorithms for dry deposition (dust fallout). Additionally, there are inherent inaccuracies associated with the screening of this pollutant due to the over estimation of the screening tool, whilst in reality they are likely to be much lower. As such, dust fallout has not been considered for this assessment, however, impacts from dust fallout are likely to be similar to that of PM_{10}.

7.0 MITIGATION MEASURES

It is recommended that the following mitigation measures are implemented for the Project.

7.1 Truck Loading and Unloading Activities

The following techniques can be employed to assist with dust suppression (Katestone, 2011):

- Modifying or ceasing loading activities during dry and windy conditions;
- Avoid double handling of material where possible;
- Minimising the drop height of the material from truck loads/transfer points;
  - A drop height policy should be maintained onsite and all equipment operators should be trained in the policy such that drop height reduction is implemented during materials handling activities;
- Using water carts with boom sprayers or wet suppression systems.

7.2 Wind Erosion

Windbreaks in the form of shade cloth screens may be erected at exposed areas, and as such reduces the wind speed across the surface of the ground (higher wind speeds tend to scour the surface, leading to dust entrainment and subsequent transportation) and therefore reducing the impact of dust emissions on the surrounding environment.

To decrease the erosion potential of stockpiles during the proposed decommissioning and demolition activities, the following mitigation techniques are recommended:

- Water hose spray/ wet suppression system as required;
- Temporary stockpiles be enclosed by porous walls;
- Small, temporary stockpiles can be covered with a porous sheet (preferably hessian); and

- Maintaining the stockpile moisture level to avoid further entrainment of particles.

7.3 Vehicle Entrainment on Roads and Exhaust Emissions

To adequately mitigate emissions of dust associated with vehicle entrainment and exhaust emissions, the following key recommendations are suggested:

- The use of water as a dust suppressant on unpaved roads, which can reduce emissions by approximately 75%;
- Paved areas within the decommissioning and demolition area must be washed down twice a week;
- Implement vehicle speed and access restrictions within the site (approximately 10 – 20 km/h) and try to limit the amount of traffic using the roads;
- Plan routes to be away from residents and other sensitive receptors;
- Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the amount of trips;
- Vehicles carrying loose aggregate should be covered with tarpaulins or sheets at all times;
- Prevention of material deposition onto haul roads by avoiding overloading of truck loads resulting in spillages on the roads and ensure adequate storm water drainage to prevent water erosion of the roads;
- Vehicles need to be clean. Washing facilities, such as hose-pipes and ample water supply should be provided at site exits, including mechanical wheel spinners where practicable. If necessary, all vehicles should be washed down before exiting the site;
- Vehicles and equipment should not emit black smoke from exhaust systems except during ignition at start-up; and
- Engines and exhaust systems should be maintained so that exhaust emissions do not breach statutory emission limits set for the vehicle/equipment type and mode of operation.

7.4 Crushing and Screening

To adequately mitigate emissions of dust associated with crushing and screening of material wet suppression systems should be utilised as required.

7.5 Complaints

Dust related complaints should be directed to the site management and any actions arising from a complaint should be recorded in a complaint register to be maintained by site management.

8.0 MONITORING AND REPORTING REQUIREMENTS

The following monitoring and reporting requirements are recommended.

8.1 Dust Fallout Monitoring

It is recommended that dust fallout monitoring is ongoing and in alignment with the dust regulations. The current covers a good spatial area, at the fenceline and covering all receptors within the immediate vicinity of the station. Monthly/annual reporting to the Environmental Officer should be used to identify problem areas/activities to target mitigation during the proposed decommissioning and demolition phase and to ensure dust levels are within acceptable standards.

9.0 IMPACT ASSESSMENT

All impacts of the Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the magnitude, duration, scale, probability and significance of the impacts. A full description of the risk rating methodology is presented in APPENDIX A. Outcomes of the screening assessment are contained within Table 7. A description of the impacts is provided below.

9.1 Decommissioning and Demolition Phase

During the proposed decommissioning and demolition phase, the impact is predicted to be "moderate" at receptors 1, 6, and 8, given their proximity in location to the proposed decommissioning and demolition activities, whilst the impact is predicted to be "low" at the remaining receptors, with mitigation in place.

Table 7: Impact assessment summary

Phase	Activity	Impact	Without Mitigation						With Mitigation					
			Magnitude	Duration	Scale	Probability	Significance		Magnitude	Duration	Scale	Probability	Significance	
Decommissioning and Demolition Phase	Decommissioning and demolition phase on receptors 1, 6 and 8	Particulate emissions on sensitive receptors	8	2	2	4	48	Moderate	6	2	2	3	30	Moderate
Decommissioning and Demolition Phase	Decommissioning and demolition phase on all remaining receptors	Particulate emissions on sensitive receptors	6	2	2	3	30	Moderate	4	2	2	3	24	Low

Note: This assessment considers the impact of the proposed decommissioning and demolition emissions only

10.0 CONCLUSIONS

This report presents the potential air quality impacts on the surrounding environment for the proposed Project.

The screening assessment indicated that:

- **PM_{10} Concentrations:**
  - From approximately 800 m from the proposed decommissioning and demolition activities, 24-hour PM_{10} concentrations will drop below the 24-hour PM_{10} NAAQS of 75 µg/m^3 (Figure 5) As such, sensitive receptors 1, 6 and 8 are likely to have concentrations above the 24-hour PM_{10} NAAQS; and
  - From approximately 400 m from the proposed decommissioning and demolition activities, annual PM_{10} concentrations will drop below the annual PM_{10} NAAQS of 40 µg/m^3 (Figure 6). However, no receptors are located within 400 m.
- **$PM_{2.5}$ Concentrations:**
  - Predicted 24-hour and annual $PM_{2.5}$ concentrations are below their relevant NAAQSs. As such all sensitive receptor concentrations are below the relevant NAAQSs (Figure 7 and Figure 8).

It must be noted that SCREEN3 is not equipped with algorithms for dry deposition (dust fallout). Additionally, there are inherent inaccuracies associated with the screening of this pollutant due to the over estimation of the screening tool, whilst in reality they are likely to be much lower. As such, dust fallout has not been considered for this assessment, however, impacts from dust fallout are likely to be similar to that of PM_{10}.

All impacts of the Project were also evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology.

- During the proposed decommissioning and demolition phase, the impact is predicted to be “moderate” at receptors 1, 6, and 8, given their proximity in location to the proposed decommissioning and demolition activities, whilst the impact is predicted to be “low” at the remaining receptors, with mitigation in place.

Based on the findings of the assessment, Golder’s professional opinion is that this Project can be authorised with the recommended mitigation measures implemented and adhered to, especially when working in close proximity to receptors 1, 6, and 8. It is further suggested that dust fallout monitoring data be analysed during the proposed decommissioning and demolition period to ensure that dust levels are kept within acceptable limits. Should these levels exceed the limits additional mitigation measures may need to be implemented and adhered to.

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APPENDIX A

Impact Assessment Criteria

The significance of each identified impact was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on Environmental Impact Assessment (EIA) Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows.

Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used.

Impact assessment scoring methodology

Probability	Duration
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 – Improbable	1 – Immediate
0 – None	
Scale	**Magnitude**
5 – International	10 - Very high/don't know
4 – National	8 - High
3 – Regional	6 - Moderate
2 – Local	4 - Low
1 - Site only	2 - Minor
0 – None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows.

Significance of impact based on point allocation

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions,

For the methodology outlined above, the following definitions were used:

- ***Magnitude*** is a measure of the degree of change in a measurement or analysis (e.g. the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely recognised standards are to be used as a measure of the level of impact;
- ***Scale/Geographic extent*** refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- ***Duration*** refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- ***Probability*** of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

APPENDIX B

Document Limitations

DOCUMENT LIMITATIONS

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Appendix G6: Heritage Assessment

APAC
APELSER ARCHAEOLOGICAL CONSULTING
Comprehensive and Professional Solutions for all Heritage Related Matters
CK 2006/014630/23 **VAT NO.: 4360226270**

PHASE 1 HIA REPORT AS PART OF THE ENVIRONMENTAL AUTHORIZATION APPLICATION PROCESS FOR THE DECOMMISSIONING AND DEMOLITION OF THE KELVIN A-STATION POWER PLANT
CITY OF EKURHULENI, GAUTENG

For:

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REPORT: **APAC021/38**

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DISCLAIMER:

Although all efforts are made to identify all sites of cultural heritage (archaeological and historical) significance during an assessment of study areas, the nature of archaeological and historical sites are as such that it is always possible that hidden or subterranean sites, features or objects could be overlooked during the study. APELSER Archaeological Consulting can't be held liable for such oversights or for costs incurred as a result thereof.

Clients & Developers should not continue with any development actions until SAHRA or one of its subsidiary bodies has provided final comments on this report. Submitting the report to SAHRA is the responsibility of the Client unless required of the Heritage Specialist as part of their appointment and Terms of Reference

SUMMARY

APelser Archaeological Consulting (APAC) was appointed by Golder Associates Africa (Pty) Ltd to conduct a Phase 1 Heritage Impact Assessment (HIA) as part of the Environmental Authorization Application Process for the Decommissioning and Demolition of the Kelvin A-Station Power Plant. The study area is located within the City of Ekurhuleni Metropolitan Municipality, Gauteng.

A number of known cultural heritage (archaeological and historical) sites exist in the larger geographical area within which the study area falls. The only site of cultural heritage (archaeological and/or historical) origin or significance identified during the assessment in the study area is the Kelvin Power Station and related infrastructure itself. The report discusses the results of the desktop and field assessment and provides recommendations on the way forward.

From a Cultural Heritage point of view, the proposed decommissioning and demolition work can continue once the recommended mitigation measures provided at the end of the report has been successfully implemented.

CONTENTS

1. INTRODUCTION

APelser Archaeological Consulting (APAC) was appointed by Golder Associates Africa (Pty) Ltd to conduct a Phase 1 Heritage Impact Assessment (HIA) as part of the Environmental Authorization Application Process for the Decommissioning and Demolition of the Kelvin A-Station Power Plant. The study area is located within the City of Ekurhuleni Metropolitan Municipality, Gauteng.

A number of known cultural heritage (archaeological and historical) sites exist in the larger geographical area within which the study area falls. The only site of cultural heritage (archaeological and/or historical) origin or significance identified during the assessment in the study area is the Kelvin Power Station and related infrastructure itself. The report discusses the results of the desktop and field assessment and provides recommendations on the way forward.

From a Cultural Heritage point of view the proposed decommissioning and demolition work can continue once the recommended mitigation measures provided at the end of the report has been successfully implemented.

The client indicated the location and boundaries of the study area and the fieldwork and desktop work focused on this land parcel.

2. TERMS OF REFERENCE

The Terms of Reference for the study was to:

1. Identify all objects, sites, occurrences and structures of an archaeological or historical nature (cultural heritage sites) located on the portion of land that will be impacted upon by the proposed project;

2. Assess the significance of the cultural resources in terms of their archaeological, historical, scientific, social, religious, aesthetic and tourism value;

3. Review applicable legislative requirements; and

4. Part of the work included undertaking a Desktop Study of available prior heritage studies in the area to see if any cultural heritage resources do or did exist here in the past.

In addition, Golder indicated the following Scope of Work for the study:

- **A Heritage Assessment will be conducted to identify and apply for the demolition of any structures older than 60 years of age.**

- **Onsite assessment by the heritage specialist.**

- **Compilation of a report to inform the BA Report and for submission to the South African Heritage Resources Agency (SAHRA).**

- **Application for a Demolition Permit and Liaison with the Gauteng PHRA if required.**

3. LEGISLATIVE REQUIREMENTS

Aspects concerning the conservation of cultural resources are dealt with mainly in two acts. These are the National Heritage Resources Act, 1999 (Act No. 25 of 1999) and the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

3.1. The National Heritage Resources Act

According to the above-mentioned act the following is protected as cultural heritage resources:

a. Archaeological artifacts, structures and sites older than 100 years
b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography
c. Objects of decorative and visual arts
d. Military objects, structures and sites older than 75 years
e. Historical objects, structures and sites older than 60 years
f. Proclaimed heritage sites
g. Grave yards and graves older than 60 years
h. Meteorites and fossils
i. Objects, structures and sites of scientific or technological value.

The National Estate includes the following:

a. Places, buildings, structures and equipment of cultural significance
b. Places to which oral traditions are attached or which are associated with living heritage
c. Historical settlements and townscapes
d. Landscapes and features of cultural significance
e. Geological sites of scientific or cultural importance
f. Sites of Archaeological and palaeontological importance
g. Graves and burial grounds
h. Sites of significance relating to the history of slavery
i. Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.)

A Heritage Impact Assessment (HIA) is the process to be followed in order to determine whether any heritage resources are located within the area to be developed as well as the possible impact of the proposed development thereon. An Archaeological Impact Assessment (AIA) only looks at archaeological resources. An HIA must be done under the following circumstances:

a. The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length
b. The construction of a bridge or similar structure exceeding 50m in length
c. Any development or other activity that will change the character of a site and exceed 5 000m^2 or involve three or more existing erven or subdivisions thereof
d. Re-zoning of a site exceeding 10 000 m^2
e. Any other category provided for in the regulations of the South African Heritage Resources Agency (SAHRA) or a provincial heritage authority

Structures

Section 34 (1) of the mentioned act states that no person may demolish any structure or part thereof which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

A structure means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

Alter means any action affecting the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or the decoration or any other means.

Archaeology, palaeontology and meteorites

Section 35(4) of this act deals with archaeology, palaeontology and meteorites. The act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial)

a. destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
b. destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
c. trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
d. bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
e. alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned may only be disturbed or moved by an archaeologist, after receiving a permit from the SAHRA. In order to demolish such a site or structure, a destruction permit from the SAHRA will also be needed.

__Human remains__

Graves and burial grounds are divided into the following:

- a. ancestral graves
- b. royal graves and graves of traditional leaders
- c. graves of victims of conflict
- d. graves designated by the Minister
- e. historical graves and cemeteries
- f. human remains

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:

- a. destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
- b. destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
- c. bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Human remains that are less than 60 years old are subject to provisions of the Human Tissue Act (Act 65 of 1983) and to local regulations. Exhumation of graves must conform to the standards set out in the **Ordinance on Excavations** (**Ordinance no. 12 of 1980**) (replacing the old Transvaal Ordinance no. 7 of 1925).

Permission must also be gained from the descendants (where known), the National Department of Health, Provincial Department of Health, Premier of the Province and local police. Furthermore, permission must also be gained from the various landowners (i.e. where the graves are located and where they are to be relocated to) before exhumation can take place.

Human remains can only be handled by a registered undertaker or an institution declared under the **Human Tissues Act, 1983** (**Act No. 65 of 1983 as amended**).

3.2. The National Environmental Management Act

This act states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made. In this case no new development will take place, except if new borrow pits are required as part of the rehabilitation and closure process.

Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

4. METHODOLOGY

4.1. Survey of literature

A survey of available literature was undertaken in order to place the project area in an archaeological and historical context. The sources utilised in this regard are indicated in the bibliography.

4.2. Field survey

The field assessment section of the study was conducted in May 2021 according to generally accepted HIA practices and aimed at locating all possible objects, sites and features of heritage significance in the area of the proposed rehabilitation project. The location/position of all sites, features and objects is determined by means of a Global Positioning System (GPS) where possible, while detail photographs are also taken where needed.

4.3 Documentation

All sites, objects, features and structures identified are documented according to a general set of minimum standards. Co-ordinates of individual localities are determined by means of the GPS. The information is added to the description in order to facilitate the identification of each locality.

5. DESCRIPTION OF THE AREA

The study area is located in the City of Ekurhuleni Metropolitan Municipality in the Gauteng Province, close to Kempton Park.

The Kelvin Power Station consists of two independent Stations, namely A-Station and B Station, with related infrastructure. The original natural and historical landscape has been completely altered over the years since the Power Station was developed and had been in use, and as a result, if any significant cultural heritage (archaeological and/or historical) sites, features or material did exist here in the past it would have been completely destroyed or extensively disturbed as a result. Some of the structures and material related to the Power Station (and in this case A-Station) is however older than 60 years of age and has some cultural heritage (historical) significance. This aspect will be discussed further on in the document.

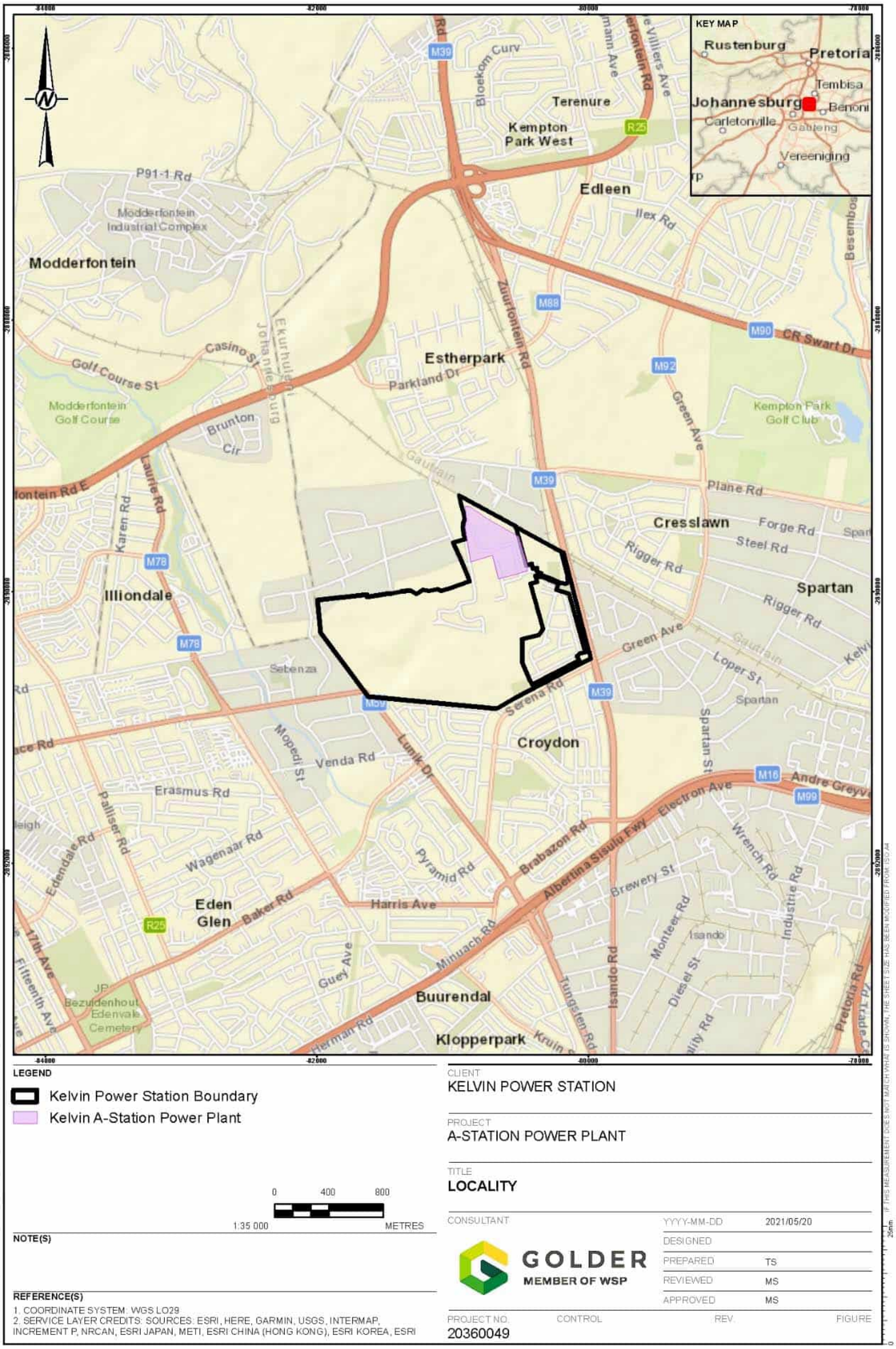

Figure 1: General location of the Kelvin Power Station (Golder, 2021).

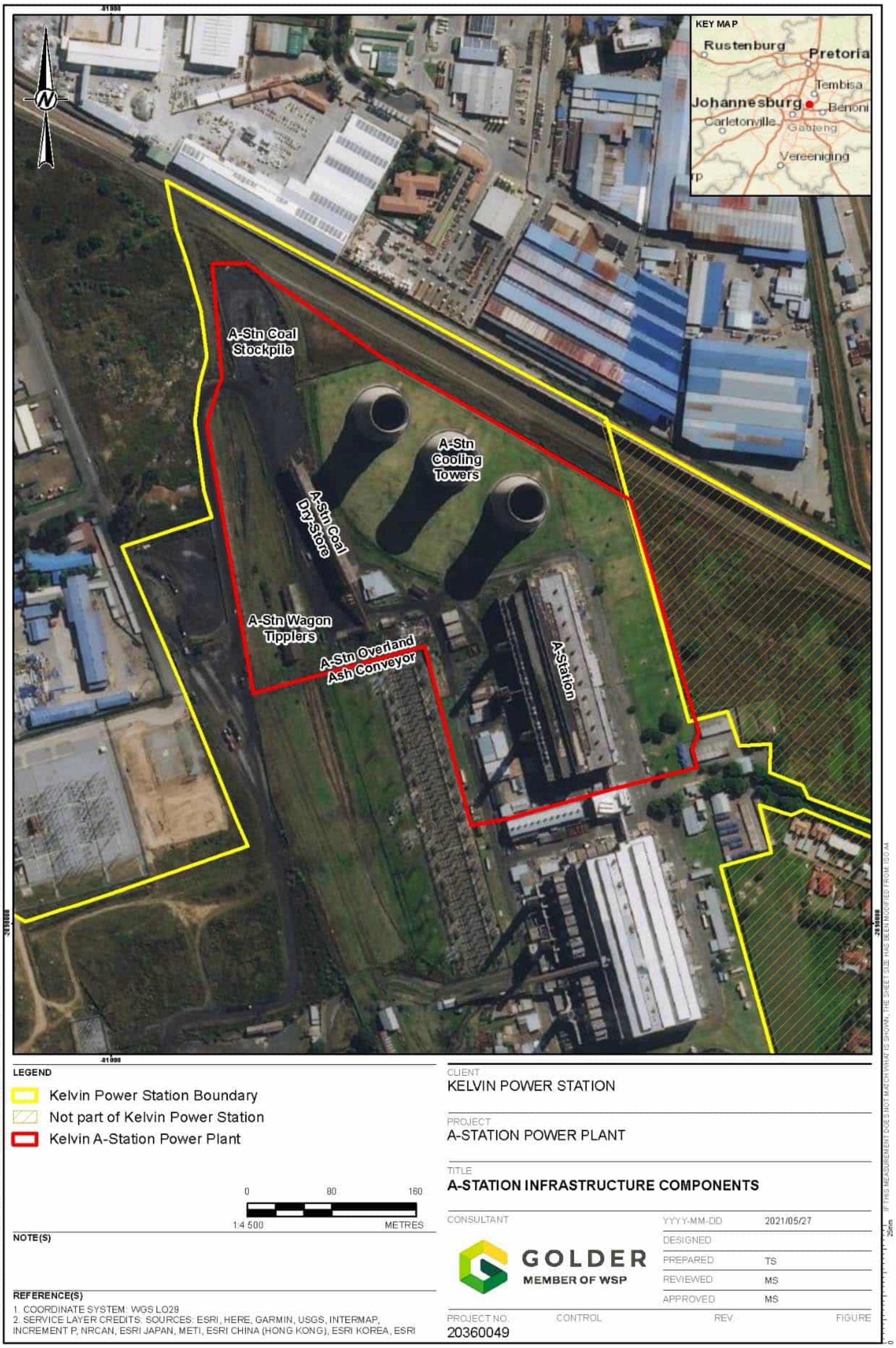

Figure 2: Closer view of the Kelvin Power Station. A-Station is indicated in the red polygon & formed the focus of the assessment (Golder, 2021).

6. DISCUSSION

The Stone Age is the period in human history when lithic (stone) material was mainly used to produce tools. In South Africa the Stone Age can basically be divided into three periods. It is however important to note that dates are relative and only provide a broad framework for interpretation. A basic sequence for the South African Stone Age (Lombard et.al 2012) is as follows:

- Earlier Stone Age (ESA) up to 2 million – more than 200 000 years ago
- Middle Stone Age (MSA) less than 300 000 – 20 000 years ago
- Later Stone Age (LSA) 40 000 years ago – 2000 years ago

It should also be noted that these dates are not a neat fit because of variability and overlapping ages between sites (Lombard et.al 2012: 125).

The closest known Stone Age sites are located at Melvillekoppies, Linksfield & Primrose, dating to the Middle and Later Stone Age periods (Bergh 1999: 4).

There are no known Stone Age sites or features in the specific study area, and no material were identified during the May 2021 assessment.

The Iron Age is the name given to the period of human history when metal was mainly used to produce metal artifacts. In South Africa it can be divided in two separate phases (Bergh 1999: 96-98), namely:

- Early Iron Age (EIA) 200 – 1000 A.D
- Late Iron Age (LIA) 1000 – 1850 A.D.

Huffman (2007: xiii) however indicates that a Middle Iron Age should be included. His dates, which now seem to be widely accepted in archaeological circles, are:

- Early Iron Age (EIA) 250 – 900 A.D.
- Middle Iron Age (MIA) 900 – 1300 A.D.
- Late Iron Age (LIA) 1300 – 1840 A.D.

As with the Stone Age, Bergh (1999) does not indicate any known Early (EIA) Iron Age sites in the specific or larger geographical area, although extensive stone-walled Late Iron Age sites are known to exist in the much larger geographical area (e.g. at Klipriviersberg)[Bergh 1999: 6].

Based on Tom Huffman's research it is possible that LIA sites, features or material could be present in the larger area. This will include the Ntsuanatsatsi facies of the Urewe Tradition, dating to between AD1450 and AD1650 (Huffman 2007: 167); the Uitkomst facies of the same tradition (AD1700 to AD1820) found for example at Linksfield & Klipriviersberg [p.171]; as well as the Buispoort facies of Urewe, dating to around AD1700 – AD1840 (p.203) and found at the Suikerbosrand.

No Iron Age occurrences were identified in the study area during the assessment.

The historical age started with the first recorded oral histories in the area. It includes the moving into the area of people that were able to read and write.

The historical age started with the first recorded oral histories in the area. It includes the moving into the area of people that were able to read and write. The first Europeans to move through and into the area were the group of Cornwallis Harris in 1836 (Bergh 1999: 13). These groups were closely followed by the Voortrekkers after 1844 (Bergh 1999: 14).

Kelvin Power Station is a coal-fired power station, operated by Kelvin Power (Pty) Ltd (Kelvin), situated in the City of Ekurhuleni, Gauteng. It is adjacent but west of the Zuurfontein Road and is approximately 5 km north-west of the O.R. Tambo International Airport. The total extent of the plant is 226.18 ha, on the Farm Zuurfontein 33IR and the surrounding neighboring properties zoning description can be classified as industrial and residential.
Kelvin is the only operational coal fired power station in South Africa that is not owned by Eskom. It was built and operated by the City of Johannesburg until it was privatized in 2001. Kelvin consists of two independent stations. Kelvin has two separate power stations, namely A-station (currently under extended care and maintenance) and B-station (operational). Both have a common High Voltage Yard (now replaced by new Sebenza Sub-Station), Control Room and workshop facilities. The A-Station has six 30MW generators and 11 chain grate boilers. The newer B station has seven 60MW generators and seven pulverized-fuel (PF) boilers. A-Station is the older power plant with first unit commissioned and generated commercial power on the 27th of March 1957. The last unit was placed on extended care and maintenance in November 2012 (Kelvin Power Station Background History Document).

Results of the May 2021 Field Assessment

The assessment of the A-Station and related structures was conducted during May 2021. The aim was to determine if the Station and any of the structures were older than 60 years of age and had any cultural heritage significance. This included the Power Plant, Cooling Towers, workshops and related office and training centre buildings.

A-Station has been under care and maintenance since 2012, with much of the machinery related to the generation of electicity at the Station left in place. The structures related to A-Station is in a fairly good state of preservation, although it is slowly deteriorating.

With the Kelvin Power Station officially openend in 1957, many of the structures and associated machinery related to the generation of electricty are older than 60 years of age, although some changes and additions would have occurred over the years. Based on the National Heritage Resources Act of 1999, being older than 60 years of age, the A-Station and some related infrastructure, is however protected by the Act and contains some cultural heritage significance.

The Cultural Heritage Significance of the Kelvin Power Station

Although the A-Station building itself, as well as the related structures including the Cooling Towers and workshops, is not of very high significance from a historical-architectural perspective, the significance of the site lies in the fact that Kelvin Power Station is the only Power Station of its kind in the larger Johannesburg area. As such it has also become part of the industrial landscape of Ekurhuleni and Kempton Park and demolishing it would remove part of the recent history of the City and region.

Much of the machinery and technology associated with A-Station, even if out of date and obsolete, forms part of this history and the way electrical power was generated in the past. This needs to be preserved in some form after the A-Station has been finally decommissioned and demolished. It however has to be noted here that although B Station is slightly younger than A-Station, a large part of the original Kelvin Power Station will be left intact and therefore be preserved as part of the landscape.

In order to preserve the history of Kelvin Power Station and mitigate the impacts of the decommissioning and proposed demolition of A-Station, the following is however recommended:

1. A selection of the old machinery, equipment and tools associated with the A-Station to be preserved and displayed at the Kelvin Power Station as part of the preservation of its history.

2. The provision & use of the non-sensitive and non-confidential original drawings and plans of A-Station as part of a display on the history of Kelvin Power Station at the site.

3. The erection of a display panel or panels describing the history of Kelvin Power Station and its function and role in the generation and supply of electricity to the greater Johannesburg region.

4. The application for and obtaining a Demolition Permit from the Gauteng Provincial Heritage Resources Authority (Gauteng-PHRA) for the demolition of the A-Station at Kelvin Power Station. This permit can be applied for once the recommended mitigation measures have been accepted by the client and will be used as motivation for issuing the required permit.

Approximate GPS Location of Station A: S26° 06’ 53.00” E28° 11’ 39.80”
Cultural Significance: Medium
Heritage Significance: Grade III: Other Heritage resources of Local importance and therefore worthy of conservation.

Field Ratings: General protection B (IV B): Site should be recorded before destruction (Medium significance)
Mitigation: See Above Recommended Mitigation Measures.

Based on the desktop work and the physical assessment undertaken, from a Cultural Heritage point of view, it is therefore recommended that the proposed decommissioning and demolition of A-Station at Kelvin Power Station be allowed to continue once the recommended mitigation measures have been accepted and implemented and a Demolition Permit has been applied for and issued. Comments on this report should also be obtained from SAHRA as par of the process.

It should however be noted that although all efforts are made to cover a total area during any assessment and therefore to identify all possible sites or features of cultural (archaeological and/or historical) heritage origin and significance, that there is always the possibility of something being missed. This will include low stone-packed or unmarked graves. This aspect should be kept in mind when rehabilitation and development activities commences and if any sites (including graves) are identified then an expert should be called in to investigate and recommend on the best way forward.

7. CONCLUSIONS & RECOMMENDATIONS

APelser Archaeological Consulting (APAC) was appointed by Golder Associates Africa (Pty) Ltd to conduct a Phase 1 Heritage Impact Assessment (HIA) as part of the Environmental Authorization Application Process for the Decommissioning and Demolition of the A-Station at Kelvin Power Station. The study area is located within the City of Ekurhuleni Metropolitan Municipality of Gauteng.

A number of known cultural heritage (archaeological and historical) sites exist in the larger geographical area within which the study area falls. The only site of cultural heritage (archaeological and/or historical) origin or significance identified during the assessment in the study area is the Power Station and related infrastructure itself.

Although the A-Station building itself as well as the related structures including the Cooling Towers and workshops, is not of very high significance from a historical-architectural perspective, the significance of the site lies in the fact that Kelvin Power Station is the only Power Station of its kind in the larger City of Ekurhuleni area. As such it has also become part of the industrial landscape of the area and demolishing it would remove part of the recent history of the City and region.

Much of the machinery and technology associated with A-Station, even if out of date and obsolete, forms part of this history and the way electrical power was generated in the past. This needs to be preserved in some form after the A-Station has been finally decommissioned and demolished. It however has to be noted here that although B Station is slightly younger than A-Station, a large part of the original Kelvin Power Station will be left intact and therefore be preserved as part of the landscape.

In order to preserve the history of Kelvin Power Station and mitigate the impacts of the decommissioning and proposed demolition of A-Station, the following is recommended:

1. A selection of the old machinery, equipment and tools associated with the A-Station to be preserved and displayed at the Kelvin Power Station as part of the preservation of its history.

2. The provision & use of the original drawings and plans of A-Station as part of a display on the history of Kelvin Power Station at the site.

3. The erection of a display panel or panels describing the history of Kelvin Power Station and its function and role in the generation and supply of electricity to the greater Johannesburg region.

4. The application for and obtaining a Demolition Permit from the Gauteng Provincial Heritage Resources Authority (Gauteng-PHRA) for the demolition of the A-Station at Kelvin Power Station. This permit can be applied for once the recommended mitigation measures have been accepted by the client and will be used as motivation for issuing the required permit.

From a Cultural Heritage point of view, it is recommended that the proposed decommissioning and demolition of the A-Station at Kelvin Power Station be allowed to continue once the recommended mitigation measures have been accepted and implemented and a Demolition Permit has been applied for and issued. A Chance Finds Procedure should also be included in the Environmental Management Program. Comments on this report should also be obtained from SAHRA as part of the process.

Finally, it has to be noted that although all efforts are made to locate, identify and record all possible cultural heritage sites and features (including archaeological remains) there is always a possibility that some might have been missed as a result of grass cover and other factors. The subterranean nature of these resources (including low stone-packed or unmarked graves) should also be taken into consideration. Should any previously unknown or invisible sites, features or material be uncovered during any development actions then an expert should be contacted to investigate and provide recommendations on the way forward.

8. REFERENCES

Study Area Location & Footprint: Google Earth 2021.

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Huffman, T.N. 2007. Handbook to the Iron Age: **The Archaeology of Pre-Colonial**

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Knudson, S.J. 1978. **Culture in retrospect**. Chicago: Rand McNally College Publishing Company.

Lombard, M., L. Wadley, J. Deacon, S. Wurz, I. Parsons, M. Mohapi, J. Swart & P. Mitchell. 2012. **South African and Lesotho Stone Age Sequence Updated (I).** South African Archaeological Bulletin 67 (195): 120–144, 2012.

Republic of South Africa. 1999. **National Heritage Resources Act** (No 25 of 1999). Pretoria: the Government Printer.

Republic of South Africa. 1998. **National Environmental Management Act** (no 107 of 1998). Pretoria: The Government Printer.

Background History Document: Provided by Client.

APPENDIX A: DEFINITION OF TERMS:

Site: A large place with extensive structures and related cultural objects. It can also be a large assemblage of cultural artifacts, found on a single location.

Structure: A permanent building found in isolation or which forms a site in conjunction with other structures.

Feature: A coincidental find of movable cultural objects.

Object: Artifact (cultural object).

(Also see Knudson 1978: 20).

APPENDIX B: DEFINITION/ STATEMENT OF HERITAGE SIGNIFICANCE

Historic value: Important in the community or pattern of history or has an association with the life or work of a person, group or organization of importance in history.

Aesthetic value: Important in exhibiting particular aesthetic characteristics valued by a community or cultural group.

Scientific value: Potential to yield information that will contribute to an understanding of natural or cultural history or is important in demonstrating a high degree of creative or technical achievement of a particular period

Social value: Have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

Rarity: Does it possess uncommon, rare or endangered aspects of natural or cultural heritage.

Representivity: Important in demonstrating the principal characteristics of a particular class of natural or cultural places or object or a range of landscapes or environments characteristic of its class or of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province region or locality.

APPENDIX C: SIGNIFICANCE AND FIELD RATING:

Cultural significance:

- Low: A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.

- Medium: Any site, structure or feature being regarded less important due to a number of factors, such as date and frequency. Also any important object found out of context.

- High: Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorized as of a high importance. Also any important object found within a specific context.

Heritage significance:

- Grade I: Heritage resources with exceptional qualities to the extent that they are of national significance

- Grade II: Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate

- Grade III: Other heritage resources of local importance and therefore worthy of conservation

Field ratings:

i. National Grade I significance: should be managed as part of the national estate

ii. Provincial Grade II significance: should be managed as part of the provincial estate

iii. Local Grade IIIA: should be included in the heritage register and not be mitigated (high significance)

iv. Local Grade IIIB: should be included in the heritage register and may be mitigated (high/ medium significance)

v. General protection A (IV A): site should be mitigated before destruction (high/medium significance)

vi. General protection B (IV B): site should be recorded before destruction (medium significance)

vii. General protection C (IV C): phase 1 is seen as sufficient recording and it may be demolished (low significance)

APPENDIX D: PROTECTION OF HERITAGE RESOURCES:

Formal protection:

National heritage sites and Provincial heritage sites – Grade I and II
Protected areas - An area surrounding a heritage site
Provisional protection – For a maximum period of two years
Heritage registers – Listing Grades II and III
Heritage areas – Areas with more than one heritage site included
Heritage objects – e.g. Archaeological, palaeontological, meteorites, geological specimens, visual art, military, numismatic, books, etc.

General protection:

Objects protected by the laws of foreign states
Structures – Older than 60 years
Archaeology, palaeontology and meteorites
Burial grounds and graves
Public monuments and memorials

APPENDIX E: HERITAGE IMPACT ASSESSMENT PHASES

1. Pre-assessment or Scoping Phase – Establishment of the scope of the project and terms of reference.

2. Baseline Assessment – Establishment of a broad framework of the potential heritage of an area.

3. Phase I Impact Assessment – Identifying sites, assess their significance, make comments on the impact of the development and makes recommendations for mitigation or conservation.

4. Letter of recommendation for exemption – If there is no likelihood that any sites will be impacted.

5. Phase II Mitigation or Rescue – Planning for the protection of significant sites or sampling through excavation or collection (after receiving a permit) of sites that may be lost.

6. Phase III Management Plan – For rare cases where sites are so important that development cannot be allowed.

APPENDIX F: PHOTOS

Figure 3: A view of A-Station and its Cooling Towers.

Figure 4: Closer view of A-Station and the "bridge" connecting it with Main Office Block & B Station.

Figure 5: A view of a section of the inside of A-Station.

Figure 6: Some of the olde machinery in A-Station.

Figure 7: More old equipment that should be selected and preserved.

Figure 8: Another view of equipment and machinery in A-Station.

Figure 9: Another old machine and equipment that could be salvaged.

Figure 10: Another interior view of a section of A-Station and the machinery & equipmentt in it.

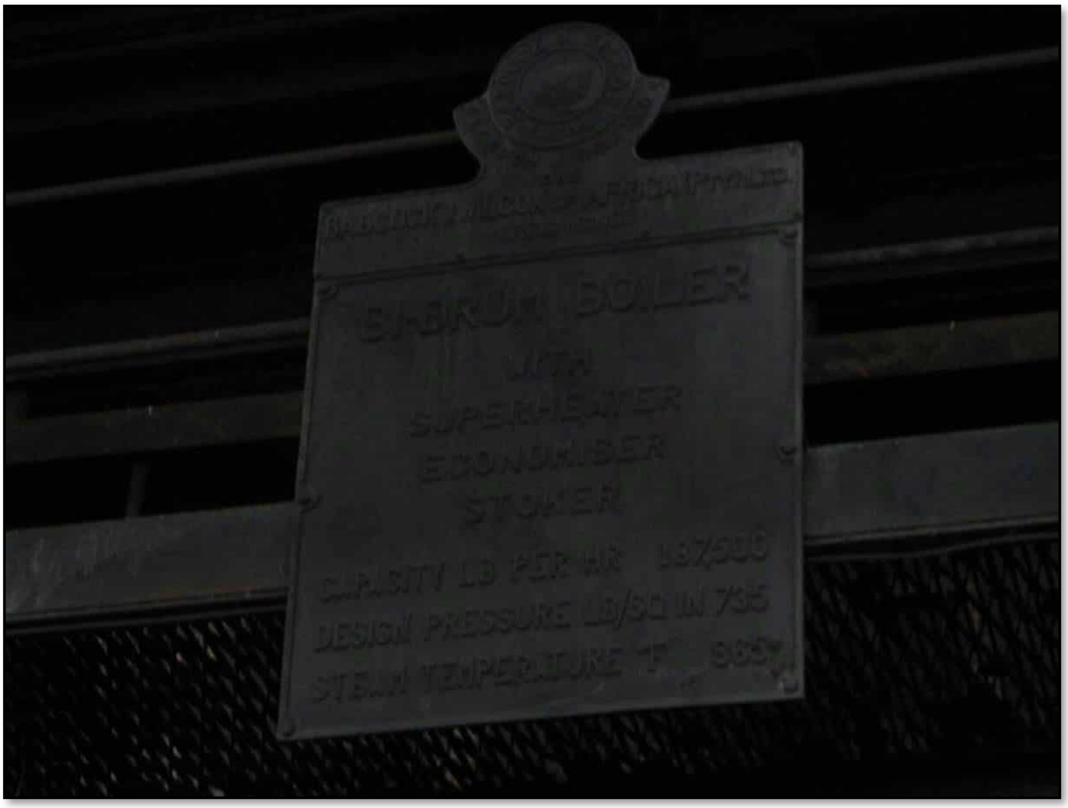

Figure 11: Objects such as this copper plaque should also be salvaged for display purposes.

Figure 12: A view of some of the equipment and material in A-Station.

Figure 13: A view of the Training Centre added onto the A-Station at a later stage.

Figure 14: A view of A-Station's Cooling Towers.

Figure 15: A view of the A-Station smoking stacks/towers looking towards B Station.

KELVIN POWER STATION
THIS ILLUMINATED PANEL COMMEMORATES
THE OFFICIAL OPENING OF THIS POWER STATION
BY
THE MAYOR OF JOHANNESBURG
COUNCILLOR M. GOODMAN
ON
APRIL 24th 1957
D.J.MARAIS-CHAIRMAN OF UTILITIES COMMITTEE - BRIAN PORTER-TOWN CLERK
R.W.KANE-GENERAL MANAGER.ELECTRICITY DEPARTMENT

Figure 16: Display panel in Office Block.

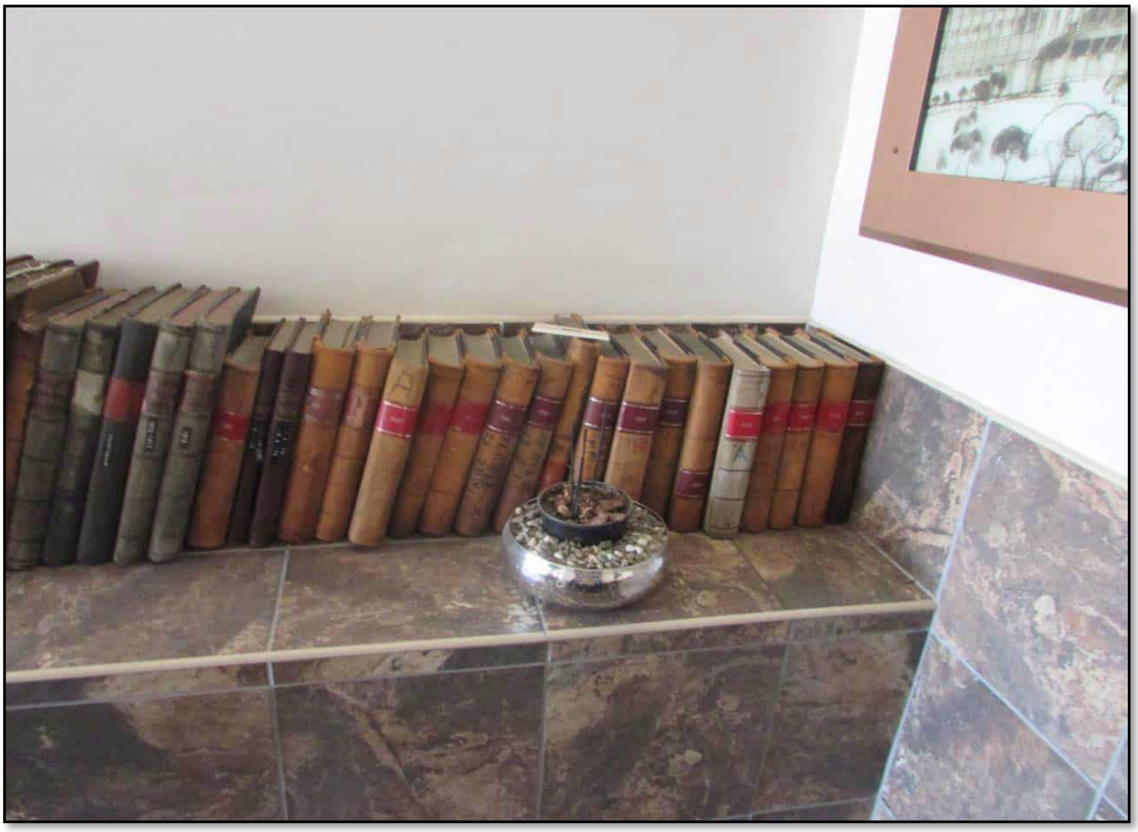

Figure 17: Old registers in the Office Block containing information on meetings and so on that could be used for obtaining material for the recommended display panels.

DETAILS OF THE SPECIALIST

Specialist Information	
Name:	APelser Archaeological Consulting cc
Phone number:	083 459 3091
Email:	apac.heritage@gmail.com
Professional Registration Number:	ASAPA Member #106
Project:	Kelvin Power Station Decommissioning and Demolition Project

Declaration of Independence by Specialist

I, **Anton Johan Pelser** , declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

Anton Johan Pelser

Appendix G7: Social Assessment

REPORT

SOCIAL IMPACT ASSESSMENT FOR THE DECOMMISSIONING OF THE KELVIN POWER, A-POWER STATION

Kelvin Power (Pty) Ltd

Submitted to:

Oupa Seopa
Kelvin Power
P.O. Box 311
Kempton Park, 1620

Submitted by:

Golder Associates Africa (Pty) Ltd.
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20360049-350733-5

August 2022

Distribution List

1 x Kelvin Power (Pty) Ltd

1 x Golder Associates Africa (Pty) Ltd. SharePoint

DETAILS OF THE SPECIALIST

Specialist information	
Name:	Brian Magongoa
Cell phone number:	+27 82 873 6035
Telephone number:	+27 11 254 4801
Email:	bmagongoa@golder.com
Qualifications:	Bachelor of Arts majoring in Geography and Education

Declaration of Independence by Specialist

I, Brian Magongoa, declare that I:

- Act as the independent specialist for undertaking a specialist report for the proposed Decommission and Demolition of Kelvin A-Power Station Project.
- Do not have and will not have any financial interest in undertaking the activity other than remuneration for work performed.
- Do not have nor will have a vested interest in the proposed activity proceeding.
- Have not, and will not engage in, conflicting interests in undertaking the activity.
- Undertake to disclose, to the competent authority, any information that has or may potentially influence the decision of the competent authority or the objectivity of any report, plan, or document.

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ABBREVIATIONS/ACRONYMS

Abbreviation	Explanation
CoE	City of Ekurhuleni
CSI	Corporate Social Investment
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMM	Ekurhuleni Metropolitan Municipality
EMS	Environmental Management System
ESIA	Environmental and Social Impact Assessment
GDP	Gross Domestic Product
GVA	Gross Value Added
HR	Human Resources
IDP	Integrated Development Plan
RSD	Regional Spatial Development
RSDF	Regional Spatial Development Framework
SHE	Safety, health and environmental
SHEQ	Safety, Health, Environmental, and Quality
SIA	Social Impact Assessment
SP	Significance points

1.0 INTRODUCTION

1.1 Background

Kelvin Power Station is a coal-fired power station operated by Kelvin Power (Pty) Ltd (Kelvin) and is situated in the City of Ekurhuleni (CoE) in Gauteng. The site is located west of the Zuurfontein Road and is approximately 5 km northwest of the O.R. Tambo International Airport. The total extent of the plant is 226.18 ha and is located on the farm Zuurfontein 33 IR, in an area classified as mixed industrial and residential.

Kelvin Power Station is an independent power station and does not operate under South Africa's state-owned electricity framework. The power station was constructed and operated by the City of Johannesburg until 2001, when it was privatised. Kelvin has two separate power stations, the A-Power Station, and the B- Power Station.

The A-Power Station was commissioned first and started generating commercial power on March 27, 1957. The technology used in the A-Power Station has become obsolete, and the last unit was placed on extended care and maintenance in November 2021. A decision was made to decommission and demolish the A-Power Station to redevelop the area. The newer B-Station is still operational.

Golder Associates (a member of WSP) has been appointed by Kelvin to assist with the compilation and submission of a Basic Assessment Report and Environmental Management Programme (EMPr) to the Gauteng Department of Agriculture and Rural Development, to obtain an environmental authorisation for the decommissioning of the Kelvin Power Station A-Station, per the requirements of the National Environmental Management Act, 107 of 1998 (NEMA) Environmental Impact Assessment (EIA) Regulations, 2014, as amended.

The proposed project is anticipated to have positive and adverse socio-economic impacts on the receiving environment. Consequently, Golder has undertaken a Social Impact Assessment (SIA) for the proposed project.

1.2 Terms of reference

The terms of reference for this SIA are to:

- Describe the socio-economic conditions of the project area.
- Identify, describe, and rate the significance of the socio-economic implications that may result from the proposed project; and
- Recommend feasible (practical and cost-effective) mitigation measures.

2.0 SOUTH AFRICAN LEGAL AND POLICY REQUIREMENTS

2.1 National legislation

2.1.1 The Constitution of South Africa

The Constitution in Section 151 states that developmental local government should provide a democratic and accountable government for communities. It also encourages local government (municipalities) to provide community services to promote social and economic development sustainably. Local government must promote a safe and healthy environment and encourage community involvement in matters of local government.

According to Section 24 of the Constitution, everyone has the right:

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

i. prevent pollution and ecological degradation;
ii. promote conservation; and
iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

2.1.2 National Environmental Management Act, 1998 (NEMA)

According to NEMA, sustainable development requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of decisions to ensure that development serves present and future generations. NEMA also sets out the process for public participation.

2.1.3 Electricity Regulations Act 4 of 2006

The Electricity Regulation Act gives the minister of energy the power to determine the need for new generation capacity and to take the initiative for its procurement. It also states that one needs a generation licence to produce over 100 megawatts of electricity.

2.2 Municipal development planning

2.2.1 The National Spatial Development Perspective

A spatial development framework (SDF) is a framework that seeks to guide the overall spatial distribution of current and desirable land uses within a municipality to give effect to the vision, goals, and objectives of the municipal integrated development plan (IDP).

According to the National Spatial Development Perspective, spatial development should, where appropriate, accommodate and promote private economic ventures, which can aid sustainable economic growth, relieve poverty, increase social investment, and improve service delivery. Consequently, municipal-level spatial planning has been considered where possible.

2.2.2 Ekurhuleni Integrated Development Plan

The Municipal Systems Act, 32 of 2000 (Act 32 of 2000), requires municipal planning to be developmentally oriented and that municipalities undertake an integrated development planning process to produce IDPs.

The IDP highlights the CoE’s contribution toward international, continental, and regional commitments toward sustainable livelihoods, economic development, and social cohesion, as espoused by the Sustainable Development Goals and the African Agenda 2063.

Further, the CoE is committed to strengthening its involvement in national and provincial planning frameworks and directives, including the National Development Plan 2030 and the Provincial 10-pillar Programme for Radical Transformation, Modernisation, and Reindustrialisation, which will serve as a strategic roadmap for Gauteng City Region over the next five to ten years.

2.2.3 Municipal spatial development framework

The regional SDF divides the CoE Metropolitan Municipality into six regions (see Figure 1). In reference to Figure 1:

- Region An is in the middle west of the Ekurhuleni area, bordering the City of Johannesburg.
- Region B is in the north-western part of the CoE Metropolitan Municipality, bordering the City of Tshwane to the north and the City of Johannesburg to the west. Region B is relevant as it is where the proposed project is located.
- Region C forms the north-eastern part of the Ekurhuleni area, bordering the City of Tshwane.
- Region D is in the middle east of the CoE Metropolitan Municipality, with Lesedi Local Municipality to the east.
- Region E forms the southeast part of the CoE Metropolitan Municipality, with Lesedi Local Municipality to the east and south.

Figure 1: Ekurhuleni Metropolitan Municipality regions (Ekurhuleni Metropolitan Municipality, 2015)

- Region F is in the southwest of the Ekurhuleni area, with Midvaal Local Municipality to the southwest and the City of Johannesburg to the west.

3.0 THE PROJECT

3.1 Project location

The Kelvin Power Station falls under Region B (see Figure 1). The Kelvin Power Station is situated adjacent (west) of the Zuurfontein Road (M39) and is approximately 5 km northwest of the O.R. Tambo International Airport. The power station is located on the farm Zuurfontein 33 IR, in an area classified as mixed industrial and residential land use.

The location of the Kelvin Power Station and the site of the Kelvin A-Power Station is indicated in Figure 2). The A-Power Station is in the northern part of the Kelvin Power Station (see Figure 3).

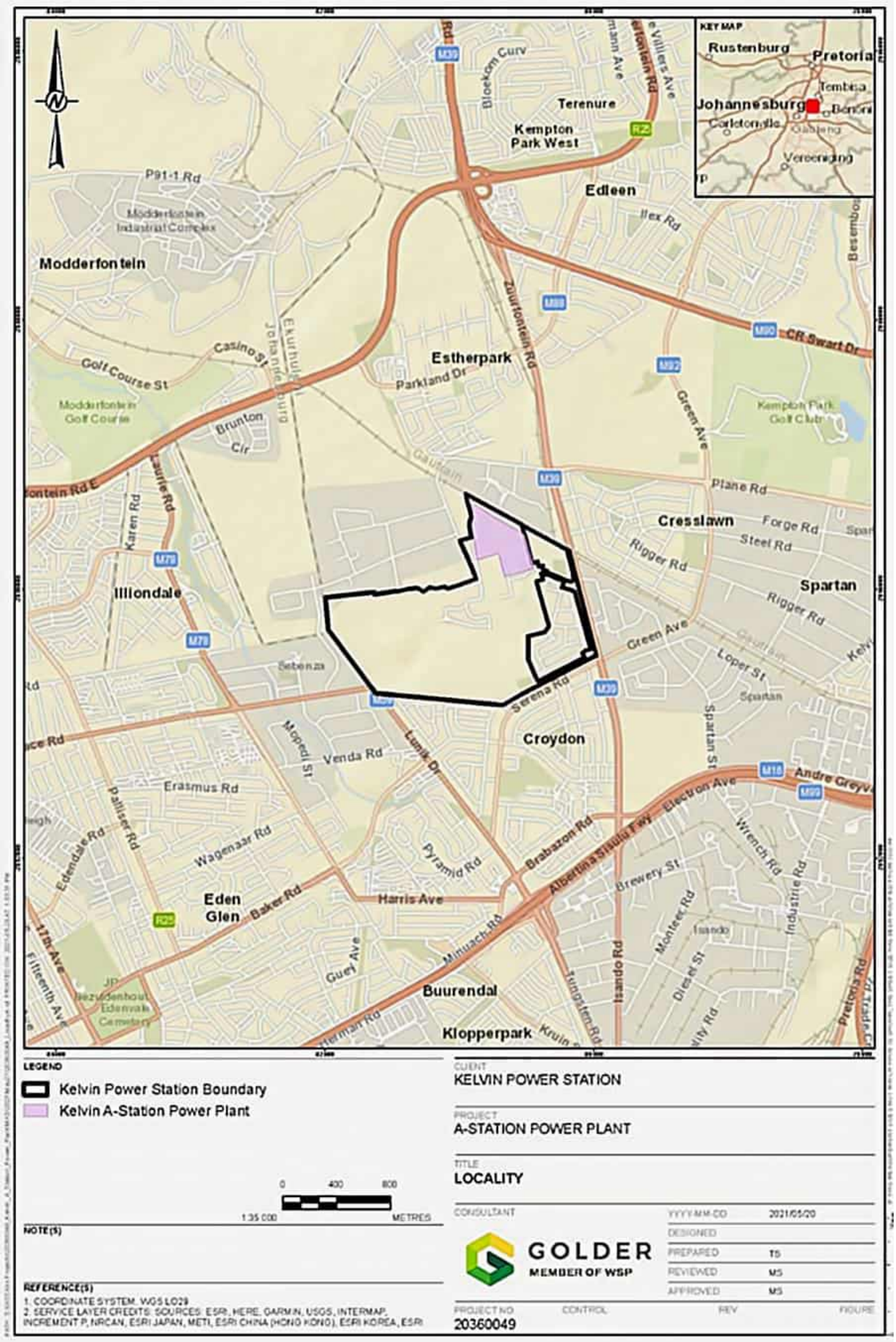

Figure 2: The location of the Kelvin Power Station and the Kelvin A-Power Station.

3.2 Project description

As indicated, the A-Power Station is obsolete. With the shift from coal-fired power generation to cleaner technologies, it was decided to decommission and demolish the infrastructure for future development. The nature of future development remains to be established.

The infrastructure at the A-Power Station will be demolished over 10 months. Figure 3 indicates the location of the components of A-Power Station.

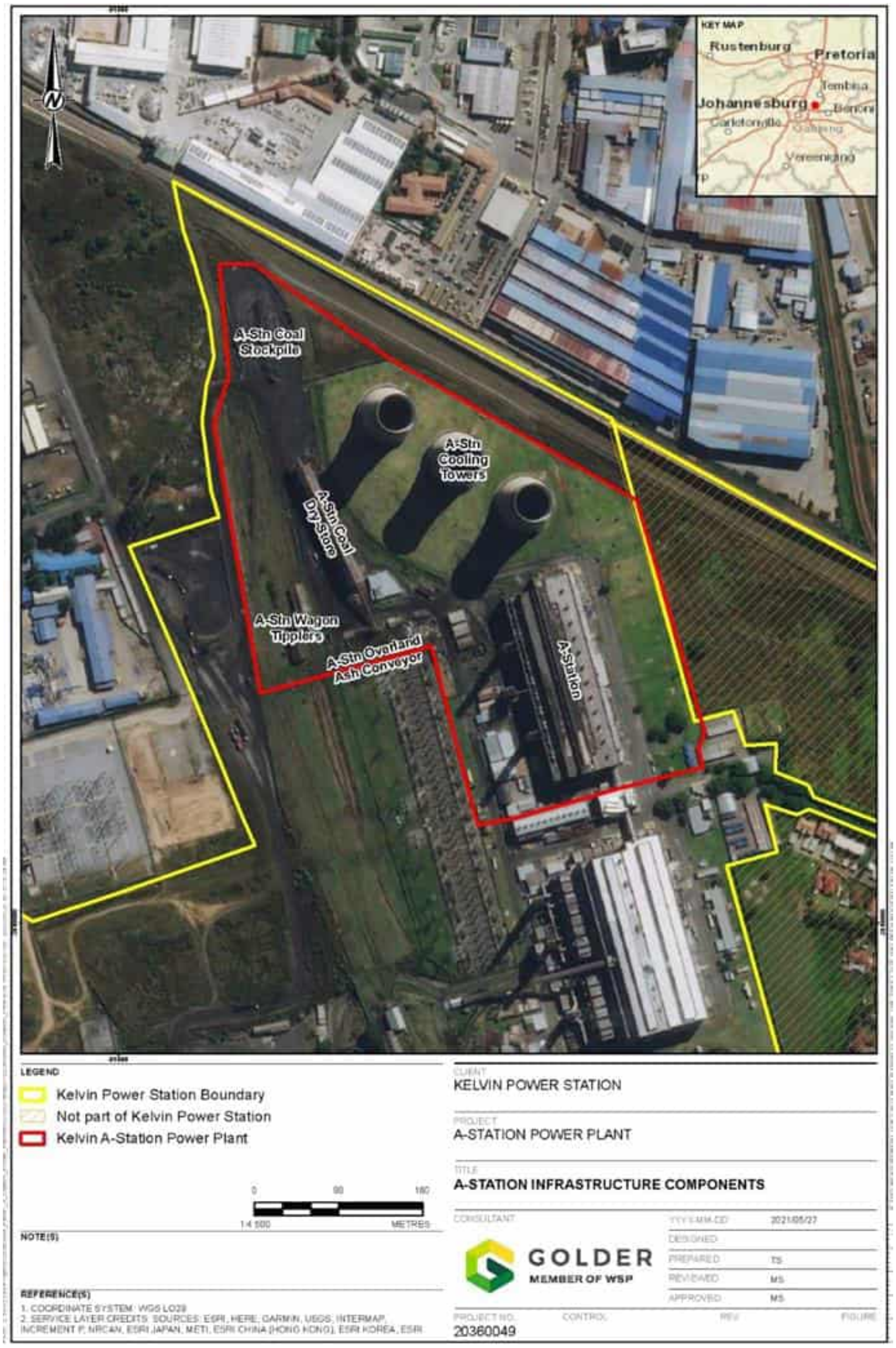

Figure 3: A-Power Station infrastructure located on the north side of the Kelvin Power site

It is intended to demolish at least the structures indicated in Table 1:

Table 1: Structures to be demolished

Structure	Image	Facility	Image
Cooling towers		Wagon tippler	
Dry coal storage		Workshops	
External stockpile A			
Power station building			

4.0 SUMMARISED SOCIO-ECONOMIC BASELINE OF THE STUDY AREA

A comprehensive social baseline was developed. The objective of the social baseline is to provide a social framework to understand the human and socio-economic context of the project-affected area. The focus of the social baseline was on the national, Gauteng Provincial and Ekurhuleni Local Metropolitan Municipality context. Please refer to Section 8.0 in APPENDIX A for the social baseline.

A summary of selected aspects of the socio-economic baseline is provided in this section.

4.1 Ekurhuleni Metropolitan Municipality

4.1.1 Introduction

The CoE is a metropolitan municipality that forms the local government of the East Rand Region of Gauteng, South Africa. The municipality is a large suburban area to the east of Johannesburg. Ekurhuleni is one of the five districts of Gauteng Province and one of the eight metropolitan municipalities of South Africa. The seat of Ekurhuleni is Germiston. O.R. Tambo International Airport falls in the Kempton Park area of Ekurhuleni. The municipality was established in 2000, superseding the Eastern Gauteng Services Council, the Khayalami Metropolitan Council, and the previous administrations of Alberton, Benoni, Boksburg, Brakpan, Edenvale/Lethabong, Germiston, Kempton Park/Tembisa, Nigel, and Springs.

4.1.2 Social baseline summary[1]

This section provides a summary of select CoE social aspects. Please refer to Section 8.0 in APPENDIX A for the detailed social baseline.

Demography

According to the 2016 figures, the CoE demographic information indicated:

- A population of 3,379,104. There has been an influx of people due to industrialisation.
- A relatively young population, with only 6% of the population older than 65.
- A large percentage of working-age people (66%).
- A slightly larger male population (51% of the population), except for Kempton Park, Edenvale, and Alberton, where women constitute 51-53% of the population (CoGTA, 2020).
- Ethnic distribution of 82% Black African, 14% White, 3% Coloured, and 2 % Indian.[2]
- The most spoken languages are Isizulu at some 34%, followed by Sepedi (12%), Sesotho (11%), English (10%), Afrikaans (9%), IsiXhosa (8%), and others at 16%.
- The population live in 1,299,490 households. Of these:
  - Women-headed households in the city account for 32.8% of the households.
  - Children under the age of 18 head some 3 737 households.
- The poverty headcount ratio[3] was 6.6%, with an intensity of poverty[4] of 44.7% in 2016.
- Some 14% of the CoE's population has matriculated, 33% has completed some secondary education. About 7% have some primary education, and 3% completed primary school. About 4% of the population has no schooling. There are 671 schools in Ekurhuleni, of which 137 are independent.

Service delivery

The 2016 CoE service delivery statistics are as follows:

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[1] All statistics are from 2016, unless otherwise specified.

[2] Rounded figures

[3] The percentage of the population living below the national poverty line.

[4] An indicator of the average percentage of dimensions in which the poor are disadvantaged, where the three dimensions of poverty are health, education, and standard of living.

- Some 66% of the CoE population have prepaid electricity metres, 21% have conventional electrification, 1% with free electricity and 10% have no access to electricity. About 1% of the population uses alternative methods to generate electricity.

  Based on the status quo, Region B does have the installed capacity to support development in future, but the security of supply cannot be confirmed. The CoE had installed about 10 MW of rooftop PV by 2020. The CoE also owns 1 MW of landfill gas electricity generation. These initiatives are insignificant compared to the total CoE demand, which exceeds 2000 MW.

  Kelvin Power Station is the only privately owned coal-fired plant in the country, owned by the Public Investment Corporation and Anergi. Kelvin Power Station has a high generating capacity compared to other independent power producers developing renewable energy projects throughout the country. Approximately 10% of Johannesburg City Power's requirements are met by Kelvin Power Station's current output of 180MW. As a result of the closure of the A-Power Station, this output has been reduced from 600 MW.

- Sixty per cent of the population has access to water in the house, some 30% have yard connections, 4% get water from communal stands, and a further 4% get water from communal taps.
- In 2017/18, there were 761,065 sewer connections. Some 89% of the population had flushing toilets, 4% used pit latrines, and 3% still used bucket systems.
- Almost 90% of the CoE population had access to refuse removal services. About 87% of the people had their refuse removed regularly.
- There are 11, 24-hour clinics in Ekurhuleni managed by the Gauteng Department of Health. The clinics offer the same essential services provided by hospitals. In addition, 21 chronic medication pick-up points are located within communities. By mid-2017, the CoE had opened three clinics serving no less than 300 000 people and constructed six health facilities.
- On March 10, 2020, the first COVID-19 case was discovered in the city. Vulnerability areas included Tembisa, Katlehong, and Daveyton/Etwata, mostly due to poverty, unemployment, healthcare, and population density. The central district of Ekurhuleni, around Kempton Park, O.R. Tambo International Airport also displayed vulnerability.

Economy

- Due to its industrial characteristics and contribution to the national economy, the CoE is a significant economic player in South Africa. It is estimated that the CoE generates 32% of the national manufacturing output. The refinery and smelting complex in Ekurhuleni is the largest in the world.
- The average 2016 annual household income for Ekurhuleni was R24,000, similar to that of Gauteng and South Africa. About 18% have no income, 4% have under R4,800, and 5% have between R5,000 and R10,000.
- Regarding household goods, about 93% of households had a cell phone, 82% had a television, but only 37% had a car.
- The 2018 General Household Survey reported that 30.8% of households receive a social grant (CoGTA, 2020).

4.2 Summary of Kelvin social development programme

The company has designated funds for giving back and improving the community. These funds are registered within the company as Corporate Social Investment (CSI) and coordinated by five Kelvin Power Station staff members. In instances of need, some staff expertise, such as engineers, is requested to assist in these projects. These donations aim to improve the lives of disadvantaged children, disabled people, schools in need of financial assistance, and the surrounding environment. The programme has been running for over five years and continues to assist many in need.

4.2.1 Schools

Phomolong Primary, a no-fee public school in Tembisa, required infrastructure improvements, and the Kelvin Power social development programme was able to assist. The school needed a kitchen and a modification of the mobile classes. Donations from the Kelvin Power social development programme significantly improved the situation in O.R. Tambo primary school in Tembisa. The school needed essential maintenance and general infrastructure improvements. Broken windows needed to be fixed, security doors, and kitchen repairs. Kelvin Power kindly donated to fix all these issues and improve the school's situation. Kelvin Power assisted Cresslawn Primary by doing essential maintenance in the school. Kelvin Power also helps by offering bursaries to children in need. Bursars were awarded from Little Star Early.

4.2.2 Water issues

Many schools in Tembisa suffer from the inaccessibility of water. When the service provider fails to deliver, many people in Ekurhuleni are left in compromising situations. Jiyana High school is an example that has resorted to borehole water. However, the entire borehole system was dysfunctional due to a lack of funds. The Kelvin Power social programme assisted this school by providing a pump for the borehole and JOJO tanks. The school has a vegetable garden that uses the borehole's water.

4.2.3 Home for disabled

Avalon home for the disabled also had issues with their borehole. Kelvin Power helped with the borehole as well. The home also needed maintenance, such as fixing doors and leaks in pipes.

The Kelvin Power social programme extends outside the Ekurhuleni perimeter to other areas, such as Dimphonyana Tsa Lapeng in Centurion. This is a foster home that takes care of abused children. Kelvin helped modify the mobile container rooms and donated food. The kitchen was also refined, and the home needed essential equipment, which the Kelvin Power social programme provided.

4.2.4 Areas outside Ekurhuleni

A school in Soweto, King Zwelithini Primary, is an example of how the Kelvin Power social development programme extended beyond the Ekurhuleni Municipality. In this school, donations were made for school uniforms. The plead for help was initiated by an individual in the City of Johannesburg Municipality in September 2021. The donations were made on December 4, 2021.

4.2.5 Community work

The Kelvin Power social programme is genuine in helping improve society, committing money and devoting time and labour to assisting others. The staff helps clean the Modderfonteinspruit River along Tembisa (sometimes through a contractor). A group of environmentalists called "Wetland buddies" requested this support.

In conclusion, the Kelvin Power social programme (funded by Kelvin Pty Ltd) is a genuine organisation that aims to help those in need. It prioritises education for the youth. Hence many projects are in schools. The organisation does not give out money but helps sponsor those in need by providing services and goods. The organisation does all of this without any media publication. Many schools and organisations assisted are subject to investigations and research to check their legitimacy before any engagement.

5.0 SOCIAL IMPACT ASSESSMENT

5.1 Methodology

All project impacts have been evaluated using a semi-quantitative risk assessment methodology (i.e., a screening-level assessment per the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This system derives an environmental impact level based on the impact's magnitude, duration, scale, probability, and significance. There is a clear understanding of the impact of implementing post-mitigation measures.

Project impacts have been evaluated using a semi-quantitative risk assessment methodology (i.e., a screening-level assessment in accordance with the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This system determines an environmental impact level based on the impact's magnitude, duration, scale, probability, and significance. There will be a comparison between pre- and post-mitigation impacts in the assessment. A full description of the impact assessment methodology is presented in APPENDIX C.

5.2 Area of influence

The area of influence focus on Region B (where the proposed project is located) is in the north-western part of the CoE Metropolitan Municipality. Region B includes the areas of Tembisa, Edenvale, Bedfordview, Olifantsfontein/ Clayville, Bredell Agricultural holdings, and a portion of Kempton Park. The transport network in the area of influence includes the Isando Road from Croydon, Cresslawn to Esther Park; the Gautrain railroad from O.R. Tambo International Airport to Sandton, the regional roads R24, R25, R21 interlinking Kempton Park to Tshwane, Mpumalanga, Johannesburg, and the N3 to Durban (Figure 3).

The key social residential receptors are indicated in Figure 4. The following social residential receptors are indicated:

i. Esther Park, some 580m to the north
ii. Cresslawn Residential Area, about 400m north-east
iii. Cresslawn Primary School, about 1 km east
iv. Kempton Park – Kelvin Estate, some 480 to the southeast

Croydon, another residential area, is buffered by a discard dump, minimising the intrusion impacts.

The impact assessment and the associated mitigation measures consider social and related impacts that could occur throughout the A-Power Station's decommissioning and demolition.

Figure 4: Residential receptors

5.3 Assumptions and limitations

This screening process has not involved stakeholder engagement. It is necessary to implement a stakeholder engagement process as part of the regulatory process. Therefore, stakeholder inputs were not available for this study. The social impacts presented in this report are the opinion of Golder's social specialists

5.4 Statement on social impacts

Typically, infrastructure projects have a variety of potential social impacts. Nevertheless, due to the specialist nature of the Project, the use of external contractors not living on-site or in a nearby construction camp, and the specific timeframe of the project, it is unlikely that all these social impacts will unfold. There is a greater likelihood that more of the typical social effects will occur when the end-use of the cleared portion has been determined.

Hence, it is the opinion of the social assessment team, considering the specific dynamics of the project, that:

- There is unlikely to be an influx of job seekers. Although a continuous influx of newcomers characterises the CoE, the unique nature of this project, its short 10 month timeline, and its technical requirements suggest that the project will not exacerbate the influx of newcomers or job seekers.
- There is little likelihood of institutionalised conflict between residents and newcomers. As with any social system, there may be instances of conflict. It is unlikely that institutionalised conflict will arise between the newcomers and the residents of the area as the specialist contractors do not live in the area, work under controlled conditions, and will only be on site for the daily tasks.
- Due to the short project timeline (10 months) and the fact that contract workers will be transported in and out daily, it is unlikely that:
  - there will be changes in the characteristics and dynamics of the population;
  - there will be adverse effects on the community and institutional structures; and
  - negative social impacts will realise at the recipient communities' individual, community and family levels.

5.5 Social Impacts

The following social impacts are anticipated. This section describes the impact of the assessment and makes suggestions for mitigating the impact, along with a significance rating (before and after mitigating the impact).

5.5.1 Intrusion impacts

Typical intrusion impacts include dust, noise, and light pollution. The residential receptors likely to be most affected by intrusion impacts include:

i. Esther Park
ii. Cresslawn Residential Area
iii. Cresslawn Primary School
iv. Kempton Park – Kelvin Estate

Refer to Figure 4 for the location of these receptors.

The intrusion impacts are described below.

Dust intrusion

Impact description

The facility's buildings (notably the cooling towers) will be demolished in a phased manner, without blasting or implosion. A substantial amount of dust may be released into the surrounding areas (Golder Associates Africa (Pty) Ltd, 2022a).

Mitigation measures

- The measures identified in the Golder Screening Air Quality Impact Report must be implemented diligently, particularly the dust suppression and monitoring activities (Golder Associates Africa (Pty) Ltd, 2022a).
- A grievance and communication procedure should be established to manage impacts, address grievances, keep the public informed of progress, and warn of intrusive activities.

Significance rating

The intrusion impact of dust was rated as moderate, with 40 significance points (SP) before mitigation. After mitigation, the significance rating is expected to be low (21 SP).

Noise intrusion

Impact description

The Noise Impact Assessment (Golder Associates Africa (Pty) Ltd, 2022b) indicates that the demolition of the A-Power Station will result in moderate noise intrusion into the receptor communities identified above.

According to the noise impact report, a strong to very strong community response is anticipated from Esther Park, Cresslawn Residential Area, and Kempton Park- Kelvin Estate. Cresslawn Primary School is expected to respond in a medium to strong manner (Golder Associates Africa (Pty) Ltd, 2022b). Therefore, some social mobilisation against the project may occur. The relatively short duration of the activities will likely mitigate the level of mobilisation.

Mitigation measures

- The mitigation measures indicated in the noise screening impact assessment (Golder Associates Africa (Pty) Ltd, 2022b) should be implemented diligently.
- The mentioned stakeholder grievance and communication procedure should be utilised to inform the affected communities of demolition-related information and address concerns.
- Consider the Cresslawn Primary School operating times in the timing of significant noise-generating activities.

Significance rating

Noise intrusion was rated moderate, with 55 SP before mitigation. The significance rating is expected to be low after mitigation (28 SP)).

Light pollution

Impact description

Light pollution is the excessive and disruptive use of artificial light. It is known that light pollution can disrupt sleeping patterns, cause headaches and fatigue, and affect the quality of life of the recipient.

As the power stations have been operating for decades, various sources and occurrences of light intrusion are expected. However, there is the potential for increased light pollution in the immediate area of influence because of decommissioning and demolition activities. Paradoxically, after the demolition of the A-Power Station, the overall light pollution will be lower, due to the removal of the infrastructure and associated lighting.

Mitigation measures

- Minimise construction lighting during night times.
- Position lights at such an angle that the light is focused on the immediate site, not the surrounding area.
- Screen construction sites from and other visual points where possible.
- Use focused light sources, ensuring that light is focused on the immediate site, not the surrounding area.

Significance rating

Light pollution was rated moderate, with 35 SP before mitigation. The significance rating is expected to be low after mitigation (18 SP).

5.5.2 Increased traffic load

Impact description

According to the traffic impact report, the decommissioning and demolition works on the A-Power Station will generate some 53 additional peak hour trips per day for the duration of the works (Techworld Consulting Engineers, 2022). While the traffic impact indicated that the existing road network could accommodate this increase, some aspects must be considered.

- The increase in traffic, particularly near the site and along Zuurfontein Road, may increase the risk of road accidents.
- There are no paved sidewalks from Zuurfontein Road to the Kelvin Power Station, posing an increased pedestrian risk due to the additional heavy vehicle activity.
- Further deterioration of roads poses an increased safety risk to motorists.

Mitigation measures

Mitigation measures to minimise traffic impacts would include:

- Implement the mitigation measures indicated in the traffic impact report diligently (Techworld Consulting Engineers, 2022).
- Establish a dedicated grievance and consultation procedure for the project. The appointment of a community liaison officer (CLO) is recommended. The CLO will interact with stakeholders, address grievances, provide information, and consult with them regularly.
- Using the dedicated grievance and consultation procedure, communicate information regarding the decommissioning and related transportation routes, peak operational times, and hazards associated with the process to the ward councillor and the relevant community organisations.
- Aim to avoid peak traffic hours for project transport movements.
- Construct a 2m wide paved sidewalk between Zuurfontein Road and the Kelvin Power Station, on the same side of the road as the existing bus and taxi loading zones north of Shrike Road, as recommended by the traffic impact study (Techworld Consulting Engineers, 2022).

Significance rating

Before mitigation, the traffic impact was rated moderate, with 45 SP. After mitigation, the significance rating is expected to be low (24 SP).

5.5.3 Community health, safety, and security impacts

Impact description

A specialist subcontractor will carry out the demolition of the A-Power Station. As this work is highly technical, the subcontractor will likely provide its own labour force. In this case, the labour force will not reside on-site or nearby but will be transported in and out of the site daily, as required. Due to the nature of the project and the location, it is not anticipated that there will be significant interaction or movement between subcontractors and the local community.

There is, however, a link between increasing the number of people in one area and increased crime and adverse effects on community health. This scenario is particularly true when outsiders arrive to work in a local area.

Mitigation measures

Mitigation measures would include:

- To prevent any potential impacts from this variable on proximate residential areas, construction workers should limit their movement to the work site.
- The movement of unknown individuals through projected sites should be avoided at all costs.
- Discuss safety and security issues and the construction schedule with the Ward Councillor, the local community policing forum, and the SAPS.
- It is recommended that the demolition area be fenced.
- There should be control over access to the demolition area.
- The workers must possess identity cards and be distinguishable, for example, by wearing company apparel.

Significance rating

The community safety and health aspect were rated low before mitigation, with a score of 28 SPs. As a result of mitigation, the significance rating is expected to be low, with 24 SP.

5.5.4 Formation of attitudes toward the project

Impact description

An attitude is an ongoing, general assessment made by an individual. Personal experiences, social media, newspapers, and discussions with family and friends can influence individual attitudes. Understanding the attitudes of I&APs to gauge their feelings and sentiments better is essential. Depending on their experiences, attitude formation can lead to social mobilisation against a project. Based on the results of the noise impact study, strong (e.g. vocal) community responses are anticipated from the recipient residential areas and Cresslawn Primary School regarding noise pollution (Golder Associates Africa (Pty) Ltd, 2022b). Unless well managed, such responses may lead to social mobilisation against the project. The relatively short duration of the activities will likely mitigate the level of mobilisation.

Mitigation measures

- Implement all the indicated mitigation measures for the project.
- Implement all monitoring actions.
- Engage with communities in a transparent manner using the grievance management and consultation procedure.

- Inform the recipient communities of project events, expected loud noises and so forth. The CLO can play a significant role in this process.
- Closely supervise the contractor workforce to prevent them from leaving the demolition site, minimise social interaction with the recipient communities, and avoid social ills such as drunkenness, substance abuse, or trade.

Significance rating

- A score of 36 SPs was assigned to the potential for forming attitudes towards the project before mitigation. The significance rating is expected to be low (18 SP) because of mitigation.

5.5.5 Positive impacts

Considering the nature of the A-Power Station decommission and demolition project, there are not many positive impacts considered from a social perspective. From an economic benefit perspective, very few local labour opportunities will be created, seeing that a specialist contractor will implement the project. The demolition of the power station will not have clear economic benefits nor cause job losses as the plant has been on extended care and maintenance since November 2021.

Positive impacts flowing from the project, if the mitigation measures are implemented, include the following.

- Improvement of pedestrian safety if the proposed 2m wide paved sidewalk between Zuurfontein Road and the Kelvin Power Station is constructed.
- There will be a slight improvement in light pollution once the A-Power Plant has been demolished.
- This project is a predecessor to the development of the area created by demolishing the A-Power Plant. In that sense, the positive impact of this project is that it will create a portion of land to be developed in the future. The type and nature of such a development could hold significant economic benefits.

5.6 Significance assessment

The significance of the specific social impacts is indicated in Table 2

Table 2: Significance assessment

Indicator of the impact	**Pre-mitigation**					**Post-mitigation**				
	Probability	**Duration**	**Scale**	**Magnitude**	**Significance**	**Probability**	**Duration**	**Scale**	**Magnitude**	**Significance**
Noise	5	1	2	8	55	4	1	2	4	28
Dust	5	1	2	6	40	3	1	2	4	21
Light	5	1	2	4	35	3	1	2	3	18
Increased traffic load	5	1	2	6	45	4	1	2	3	24
Community health, safety, and security	4	1	2	4	28	4	1	2	3	24
Formation of attitudes towards the project	4	1	2	6	36	3	1	2	3	18

6.0 CONCLUSION

The proposed decommission and demolition of the A-Power Station will not significantly impact the social environment if the mitigation measures are implemented. Based on the SIA findings, Golder's opinion is that this project should be authorised, depending on the consistent application of the mitigation measures from all the specialists.

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Signature Page

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APPENDIX A

KELVIN SOCIAL BASELINE

8.0 APPENDIX A: SOCIAL BASELINE

8.1 National profile

South Africa, officially the Republic of South Africa, is the southernmost country in Africa. With over 59 million people, it is the world's 23rd-most populous nation and covers an area of 1,221,037 square kilometres (471,445 square miles). South Africa has three capital cities: executive Pretoria, judicial Bloemfontein, and legislative Cape Town. The largest city is Johannesburg. About 80% of South Africans are of Black African ancestry, divided among various ethnic groups speaking different African languages. The remaining population consists of Africa's largest communities of European (White South Africans), Asian (Indian South Africans), and Coloured South African) ancestry.

It is bounded to the south by 2,798 kilometres (1,739 mi) of coastline, stretching along the South Atlantic and Indian Oceans. South Africa is bordered to the north by the neighbouring countries of Namibia, Botswana, and Zimbabwe, and to the east and northeast by Mozambique and Eswatini (former Swaziland). South Africa surrounds the enclaved country of Lesotho. It is the southernmost country on the mainland and the most populous country located entirely south of the equator.

South Africa is a biodiversity hotspot with diverse, unique biomes and plant and animal life.

South Africa is multi-ethnic, encompassing various cultures, languages, and religions. Its pluralistic makeup is reflected in the constitution's recognition of 11 official languages, the fourth-highest number in the world. According to the 2011 census, the two most spoken first languages are Zulu (22.7%) and Xhosa (16.0%). The following two are of European origin: Afrikaans (13.5%) developed from Dutch and serves as the first language of most Coloured and White South Africans; English (9.6%) reflects the legacy of British colonialism and is commonly used in public and commercial life. The country is one of the few in Africa never to have had a coup d'état, and regular elections have been held for almost a century.

The provinces are, in turn, divided into 52 districts: 8 metropolitan and 44 district municipalities. The district municipalities are further subdivided into 205 local municipalities. The metropolitan municipalities, which govern the largest urban agglomerations, perform the functions of both district and local municipalities. Table 3 shows nine provinces of South Africa with the provincial capital, largest city, area, and population of 2016.

Table 3: Provinces population of South Africa

Provinces	Provincial capital	Largest city	Area (km^2)	Population (2016)
Eastern Cape	Bhisho	Port Elizabeth	168,966	6,996,976
Free State	Bloemfontein	Bloemfontein	129,825	2,834,714
Gauteng	Johannesburg	Johannesburg	18,178	13,399,724
KwaZulu-Natal	Pietermaritzburg	Durban	94,361	11,065,240
Limpopo	Polokwane	Polokwane	125,754	5,799,090
Mpumalanga	Mbombela	Mbombela	76,495	4,335,964
North West	Mahikeng	Klerksdorp	104,882	3,748,435
Northern Cape	Kimberley	Kimberley	372,889	1,193,780

Provinces	Provincial capital	Largest city	Area (km^2)	Population (2016)
Western Cape	Cape Town	Cape Town	129,462	6,279,730

8.2 Provincial government

Gauteng covers an area of 18,178 km² or approximately and is the smallest province in South Africa. It covers only 1.4% of the country's total surface area and is bordered by the Free State, North West, Limpopo and Mpumalanga provinces. Gauteng's population is 13,399,725, making it the most populous of all provinces. Gauteng lies on the highest part of the interior plateau on the rolling plains of South Africa's Highveld. Johannesburg is the capital city of Gauteng. Pretoria, the East Rand, West Rand, and the Vaal area are also with the province[5].

Over 34.8% of South Africa's Gross Domestic Product (GDP) is generated in Gauteng, making it the country's economic engine. The most important sectors contributing to GDP are finance, real estate, business services; manufacturing; and general government services. Gauteng is also the financial services capital of Africa. More than 70 foreign banks have their head offices in Gauteng, as do at least the same number of South African banks, stockbrokers, and insurance giants.

Figure 5 shows the municipalities of Gauteng Province. Gauteng Province is divided into three metropolitan municipalities, CoE, the City of Johannesburg, and the City of Tshwane.

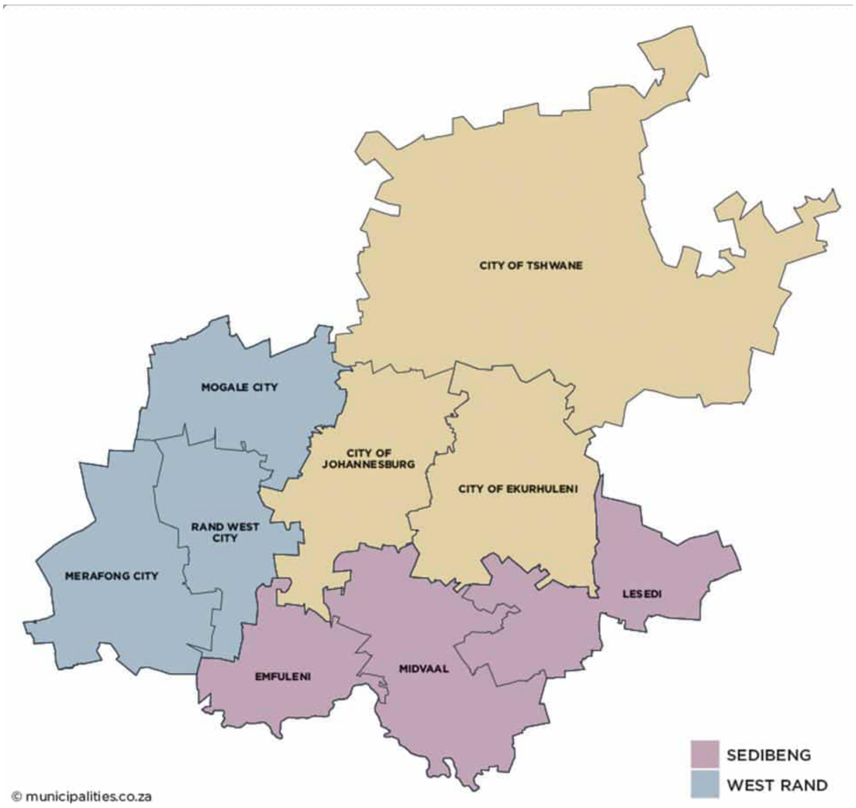

Figure 5: Municipalities of Gauteng Province (IDP, 2016-2021)[6]

Gauteng Province has two district municipalities, Sedibeng District Municipality and West Rand District Municipality. There are six local municipalities in Gauteng Province: Lesedi, Merafong, Midvaal, Mogale, Rand West City, and Emfuleni Local Municipality.

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[5] https://municipalities.co.za/provinces/view/3/gauteng

[6] https://municipalities.co.za/provinces/view/3/gauteng

8.3 Ekurhuleni Metropolitan Municipality

The CoE is a metropolitan municipality that forms the local government of the East Rand Region of Gauteng, South Africa. The municipality itself is a large suburban region east of Johannesburg. The name Ekurhuleni means place of peace in Xitsonga. The name Ekurhuleni meaning place of peace alludes to the fact that the East Rand townships were the site of severe political violence between supporters of the Inkatha Freedom Party and the ANC in the early 1900s, before South Africa's first multiracial elections in 1994.

8.3.1 Demographic profile

The CoE had 3,178,470 people in 2011, increased to 3,379,104 in 2016. There was an increase of 200,634 people between 2011 and 2016, indicating a 0,014 growth rate. About 22.7% were under 15 years old, 71.2% were between the ages of 15-64, and 6.1% were older than 65. Ekurhuleni had 1015465 households in 2011, which increased to 1,299,490 households in 2016. The average number of people per household was 3.1% in 2011, which decreased to 2.6. 80.2% of people lived in formal dwellings, and 52.9% owned housing. The poverty headcount increased from 6.4% in 2011 to 6.6% in 2016, and the intensity of poverty increased from 44.5% in 2011 to 44.7% in 2016.

8.3.2 Age and gender

The population in CoE mostly ranges between working ages of 18-64 years (66%), with the highest range being between 20-29 and 30-39 years (both 19%). The median age is 30, a year higher than the Gauteng median at 29. A relatively large percentage (16%) is made up of 0-9 years old, and only 1% are 80 or older. The male population is 51% of the 1 833 264, except in Kempton Park, Edenvale, and Alberton, where women constitute 51-53% of the population (CoGTA, 2020).

8.3.3 Ethnicity

About 82% of the total CoE population are Black African, three per cent Coloured, 2.14% are Indian, and 14% White. In addition, 95% of the inhabitants of the CoE are South African born, with 62% born in Gauteng, 10% born in Limpopo, 7% born in Kwazulu-Natal, 5% born in the Eastern Cape, and the remaining 10% born elsewhere in the country and 5% born outside South Africa.

8.3.4 Migration patterns

It is estimated that approximately 94.8% of the total CoE population was born in South Africa, which is almost the same as Gauteng's rate of 93.05% and less than the South African rate of 97.05%. The majority at 62% were born in Gauteng, 10% in Limpopo, 7% Kwazulu-Natal, 5% in Eastern Cape, 5% in Mpumalanga, 5% were from the South African Development Countries, and the other 5% were unspecified. Ekurhuleni has seen quite an influx of people due to industrialisation. 96% of the population have South African citizenship, while 4% did not have South African citizenship.

8.3.5 Education

Fourteen per cent of the CoE's population has matriculated, while 33 per cent has completed some secondary education. About 7% have some primary education, and three per cent completed primary school. A similar number of individuals do not have any educational background. The number of undergraduates is the same as the number of postgraduates. Ekurhuleni is made up of two school districts, Ekurhuleni north and south. There are 704 schools in Ekurhuleni, 524 are public schools and 180 are independent schools. Within the CoE, 131 independent schools receive subsidies, whereas 49 do not.

8.3.6 Language

The majority, 34%, are Zulu speaking, Sepedi 12%, Sesotho 11%, English speaking 10%, Afrikaans 9%, IsiXhosa 8%, and others 16%. Generally, the population of the CoE speaks more than one official South African language, and all 11 languages are spoken within the CoE.

8.3.7 Access to electricity

In Ekurhuleni, 66% percent of the CoE population has prepaid electricity metres, while Gauteng has 61%. About 21% have conventional electrification, whereas Gauteng has 28%, 10% have no access to electricity, while Gauteng has 7%. Only 1% of the population has other sources they do not pay for, Gauteng has 2%. About 1% uses alternative methods to generate electricity, while Gauteng has 2% of the population with alternative power sources. To achieve sustainable energy sources, the CoE has established a solar farm project in the O.R. Tambo Precinct in Wattville. Moreover, the CoE has also installed portable solar lighting units in informal settlements. These units are a source of energy for households while the electrification process is being completed.

8.3.8 Water source

There are water interruptions that occur at least every week in the CoE area, 4% of the population experiences these interruptions while 38% do not. This is due mainly to the ageing sanitation infrastructure and increasing infrastructure backlog in new developments (CoGTA, 2020). Ekurhuleni has 60% of the CoE population with access to water in the house, while Gauteng has 63%. About 30% have water connection in the yard, which is more than Gauteng, which has 28%, and 4% have water at a communal stand, compared to only 3% in Gauteng. Approximately 3% of the population in Ekurhuleni has access to communal water taps, while only 2% per cent of the people in all of Gauteng use communal taps.

8.3.9 Sewerage

From 2014/15 to 2017/18, the CoE increased the number of sewer connections to households by 43 965. The total number of connections reached 761,065, and much progress was made. Approximately 89% of the CoE population in Ekurhuleni has flushing toilets, while 88% of the Gauteng population does. About 4% of the people in Ekurhuleni use pit latrines, about 3% use bucket latrines, while 2% use the bucket system in Gauteng.

8.3.10 Refuse disposal

About 89.6% of the CoE population gets refuse disposal from local authorities, private companies, or community members. This is much lower than the 85% for the entire Gauteng. Moreover, about 87% of the people in Ekurhuleni receive refuse disposal services regularly, whereas 3% do not receive these services. In the entire Gauteng, 2% do not receive these services and use communal dumping.

8.3.11 Road network

CoE is connected to the main motorways in South Africa via the M2, N3, N17, R21, R24, and R59 highways. As CoE is part of the Johannesburg Conurbation, Transport routes in Ekurhuleni share the same metropolitan route numbering system as Johannesburg. The road network in Ekurhuleni spans 8,024 km of paved roads and approximately 1,200 km of gravel roads.

8.3.12 Aviation

CoE is home to the largest airport in South Africa and houses the largest hub in the country. Ekurhuleni is Gauteng's first aerotropolis. This is a metropolis with an airport at its centre. One should be able to get to the airport from anywhere in Ekurhuleni in 25 min. The major aim will be logistics and connecting the local industry and agriculture to the world markets. O.R. Tambo International Airport has two terminals handling domestic and international flights. Terminal A handles international traffic, and Terminal B domestic flights. The airport services airlines from all five continents and plays a vital role in serving the local, regional, intra-, and inter-continental air transport needs of South Africa and sub-Saharan Africa. It is the biggest and busiest airport in Africa.

8.4 Households

8.4.1 Household composition

In 2016, there were 1,299,490 households in the CoE, of which 18.7% lived in informal housing. A quarter of the households in Gauteng and about 10% in South Africa are in Ekurhuleni. About 18.7% of households reside in informal housing, while 9% live in backyard dwellings, below the provincial average of 10%. A little over 3% of the population lives in apartments, which aligns with the South African average. In the city, 32.8% of households are headed by women, and 3,737 households are headed by children under 18. The value of 31.3% in 2011 is marginally higher than that of 31.3% in 2012.

8.4.2 Household ownership

Approximately 52% of the households within the city live in fully paid off properties or properties that are in the process of being fully paid off. 22% of the households live in properties rented out from a private individual, slightly less than in Gauteng at 23%. Some 11% occupied properties rent-free, almost equal to the provincial rate.

8.4.3 Head of household

In Ekurhuleni, 67% of households are headed by males, while females head 32.8%. About 90% of the women-headed households are in Ekurhuleni, compared to 3.86% in Gauteng. There are 3737 households headed by 18-year-olds, representing about one-quarter of the Gauteng figure of 15,241 and less than 10% of the South African figure of 111,471.

8.4.4 Health

Life expectancy in the CoE is 61.2 years for males and 66.7 years for females (Stats SA, 2017). The infant mortality rate is estimated at 32.8 per 1000 live births. The overall HIV prevalence in South Africa is estimated at 12.7%. Life expectancy in the city has increased in line with national numbers.

According to the mortality rates and causes of death report released in February 2017, South Africa is experiencing fewer deaths. This has positively impacted the population as life expectancy is on the rise.

Mid-year population estimates for 2016 stated overall HIV prevalence at 12.7%, which translates into approximately 7.03 million infections. Of the population of adults aged 15 to 49, an estimated 18.9% of the population is HIV positive. Access to primary healthcare is high.

The number of baby deliveries in a clinic increased from 83% in 1998 to 96% in 2016. A total of 97% of these were provided by a skilled health provider, compared with 84% in 1998.

The Gauteng Department of Health manages 11, 24-hour clinics in Ekurhuleni. The clinics offer the same essential services provided by hospitals. This is a step in the right direction to reducing the cost of travelling in emergencies and the strain of relying on overloaded emergency medical services linked to the few hospitals in the city. In addition, 21 chronic medication pick-up points are located within communities. This is viewed within the strategic context of bringing medication to the doorstep of those who need it the most and reducing clinic queues as part of the city’s commitment to effective healthcare provision. The city has also opened the Khumalo, Tsietsi, and Dukathole clinics, which serve no less than 300 000 people and constructed six health facilities by June 2017.

8.4.5 COVID-19

The first COVID-19 case was discovered in the city on March 10, 2020. The CoE, part of the Joint Operation Centre, dealt with the outbreak involving officials from all levels of government (CoGTA, 2020). Vulnerability areas included Tembisa, Katlehong, and Daveyton/Etwata, mostly due to poverty, unemployment, healthcare, and population density. The central district of Ekurhuleni, around Kempton Park, O.R. Tambo International Airport also displayed vulnerability. The Council for Scientific and Industrial Research, CSIR, conducted a study to identify vulnerable areas in need to target coordinated intervention and early response. Figure 6 shows the vulnerability map around the Ekurhuleni area.

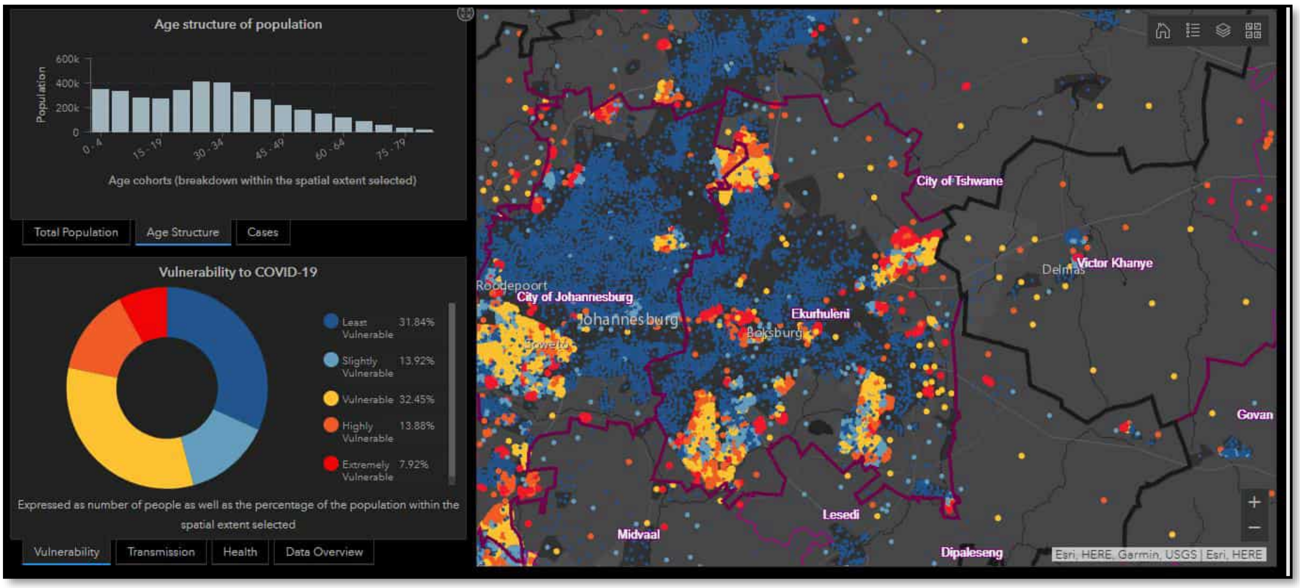

Figure 6: Ekurhuleni Vulnerability Map for Covid-19 (CSIR, 2021)

8.4.6 Education

Ekurhuleni has two school districts: Ekurhuleni North and Ekurhuleni South. There are 671 schools in Ekurhuleni, of which 137 are independent. Ekurhuleni has two colleges of further education and training and two centres of adult education and training. The municipal government under Executive Mayor Mzwandile Masina conducted a feasibility study and lobbied the national government to establish a University in Ekurhuleni, which President Cyril Ramaphosa formally announced in the 2020 State of the National Address.

8.4.7 Economy

The CoE is a significant economic and social role player in South Africa, using its strong industrial characteristics and contribution to the national economy and the size and extent of the population contained within its administrative boundary. The CoE is projected to grow at an average annual rate of 1.75% from 2018 to 2023. Gauteng and South Africa are projected to grow at 1.72% and 1.60%, respectively. Ekurhuleni has in Rand Refinery the largest integrated single-site precious metals refining and smelting complex in the world. The city is an important manufacturing centre in South Africa, contributing 32% of manufacturing production, and it has been described as “the workshop of the country”. Ekurhuleni has held the “Manufacturing Indaba” Conference every year since 2014. This two-day conference provides contacts and networking between business owners, industry owners, capital providers, experts, and the government.

8.4.8 Gross domestic product

The CoE contributed 19.67% to Gauteng’s GDP of R 1.7 trillion in 2018, a significant increase from 19.57% in 2008. It had a GDP of R 334 billion in 2018 (up from R 160 billion in 2008). The CoE contributed 6.85% to the

GDP of South Africa, which had R 4.87 trillion in 2018 (measured in current prices). In 2018, the CoE achieved an annual economic growth rate of 1.09%, close to the Gauteng rate of 1.12% and higher than South Africa, at 0.79%. In 2018 the CoE ranked third relative to other regional economies to Gauteng Provincial GDP. This ranking has remained the same since 2008, with its share, in 2018 (19.7%) comparable to what it was in 2008 (19.6%).

8.4.9 Gross Value Add by economic sector

In 2018, the community services sector was the largest within CoE, accounting for 22.7% of the city's Gross Value Added (GVA), followed by manufacturing at 20.8%, the finance sector at 20.3%, and the agriculture sector at 0.42% of the total GVA.

From 2008 to 2018, the finance sector had the highest annual growth rate in Ekurhuleni at 2.95%, followed by the construction sector at 2.83%. The electricity sector shrank at -0.42%, while the mining sector had the lowest average annual decline of -0.56%. Overall growth existed for all industries in 2018, with an annual growth rate of 0.92%.

8.4.10 Average annual household income

The average household income in Ekurhuleni is R24,000, which is about the same as the average income in Gauteng and South Africa. Approximately 18% of the population has income, 4% earn less than R4,800, and 5% earn between R5,000 and R10,000. Regarding household goods, about 93% of households own a cell phone, which is typically costly but seems to be a priority. There is a television in 82% of households, but only 37% of households own a car. According to the General Household Survey conducted by the CoGTA in 2020, 30.8% of households receive a social grant.

8.4.11 Human settlement

Although the CoE delivered 14 781 houses between 2011 and 2016, there is still a high demand for housing. Due to the rapid growth in the CoE population, there has been an increase in the demand for housing, leading to creative and diversified approaches to the delivery of housing. Ekurhuleni is working with private and public housing delivery partners to accelerate delivery and encourage inclusionary housing within private sector-driven developments. The CoE, with its partners, has packaged the release of private sector development opportunities within the Integrated Rural Development Programme and flagship projects on municipal land. This has required strengthened function in inter-departmental coordination and the capacitation and support of the city's social housing institutions to attract additional investment in the delivery of affordable rentals.

The demand environment has also necessitated the CoE to take stringent measures to enforce spatial governance while working towards creating solutions that will address demand and spatial justice in the city. Land management has become a central component of planning as measures to control land invasions and new informal structures are mushrooming. Concerted efforts have been made to improve service delivery within informal settlements and promote the effective management of municipal-owned rental properties.

APPENDIX B

IMPACT ASSESSMENT METHODOLOGY

9.0 APPENDIX B: SOCIAL IMPACT ASSESSMENT METHODOLOGY

9.1 Introduction

All project impacts have been evaluated using a semi-quantitative risk assessment methodology (i.e., a screening-level assessment following the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This system derives an environmental impact level based on the magnitude, duration, scale, probability, and significance of the impacts, based on a clear understanding of pre- and post-mitigation measures being implemented.

The significance of the identified impacts will be determined using the approach outlined below (terminology from the Department of Environmental Affairs Guideline document on Environmental Impact Assessment Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, the occurrence and severity. The occurrence and severity of impacts are further subdivided, as shown in Table 4.

Table 4: Aspects for assessing the potential significance of impacts

Occurrence		Severity	
Probability of occurrence[7]	Duration of occurrence[8]	Scale/extent of the impact[9]	Magnitude (severity) of impact[10]

9.2 Scoring the specific aspects

Firstly, the impact aspects must be scored. Table 5 presents the ranking scales for each aspect of the impact.

Table 5: Scoring system for evaluating impacts

The probability of occurrence	The duration of occurrence	The scale of the impact	The magnitude of the impact
5 - Definite/do not know	5 - Permanent	5 - International	10 - Very high/do not know
4 - Highly probable	4 - Long-term (longer than 10 years, with the impact ceasing after the closure of the project)	4 - National	8 - High
3 - Medium probability	3 - Medium-term (4-10 years)	3 - Regional	6 - Moderate
2 - Low probability	2 - Short-term (1-3 years)	2 - Local	4 - Low

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[7] Probability of occurrence is a description of the probability of the impact occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will occur).

[8] Duration refers to the length of time over which a social impact may occur, e.g. immediate/transient, short-term (one to three years), medium-term (four to 10 years), long-term (greater than 10 years with impact ceasing after the closure of the project), or permanent.

[9] Scale/Geographic extent refers to the area that could be affected by the impact. It is classified as onsite, local (typically adjacent landowners, land users, and communities), district and regional (including towns and settlements in the larger project area that may be affected), national, or international. The type and nature of different projects may have a different scale or geographic context.

[10] Magnitude is a measure of the degree of change in measurement or analysis (e.g., pasture area, the impact on social infrastructures such as schools, clinics, and churches, or the number of people potentially affected). It is classified as none/negligible, low, moderate, or high. The categorisation of the impact magnitude may be based on a set of criteria (e.g. health risk levels, socio-economic impact, social dynamics, and professional judgement) pertinent to each of the impacts.

The probability of occurrence	The duration of occurrence	The scale of the impact	The magnitude of the impact
1 - Improbable	1 – Immediate (less than a year)	1 - Site only	2 - Minor

9.3 Determine the significance

Once these factors are scored for each impact, the significant point is determined using the following formula:

SP (significance points) = probability x (duration + scale+ magnitude)

The lowest possible SP is 3, with the highest value at 100.

9.4 Rate the significance

The SP must then be rated. The ratings range between low, moderate to high significance. Table 6 indicates how the SPs are rated. Positive impacts are not rated, as is the case for adverse impacts.

Table 6: impact rating

SP >75	Indicates a high environmental significance	An impact that could influence the decision about whether to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit is sufficiently important to require management, which could influence the decision to continue the project unless mitigated.
SP <30	Indicates low environmental significance	Impacts with little discernible effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

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DETAILS OF THE SPECIALIST

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Professional Registration Number:	N/A
Project:	Kelvin Power Station Decommissioning and Demolition Project

Declaration of Independence by Specialist

I, **David de Waal**, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

David de Waal

Appendix G8: Surface Water Assessment

REPORT

Kelvin A-Station Power Plant Decommissioning and Demolition

Surface Water Assessment

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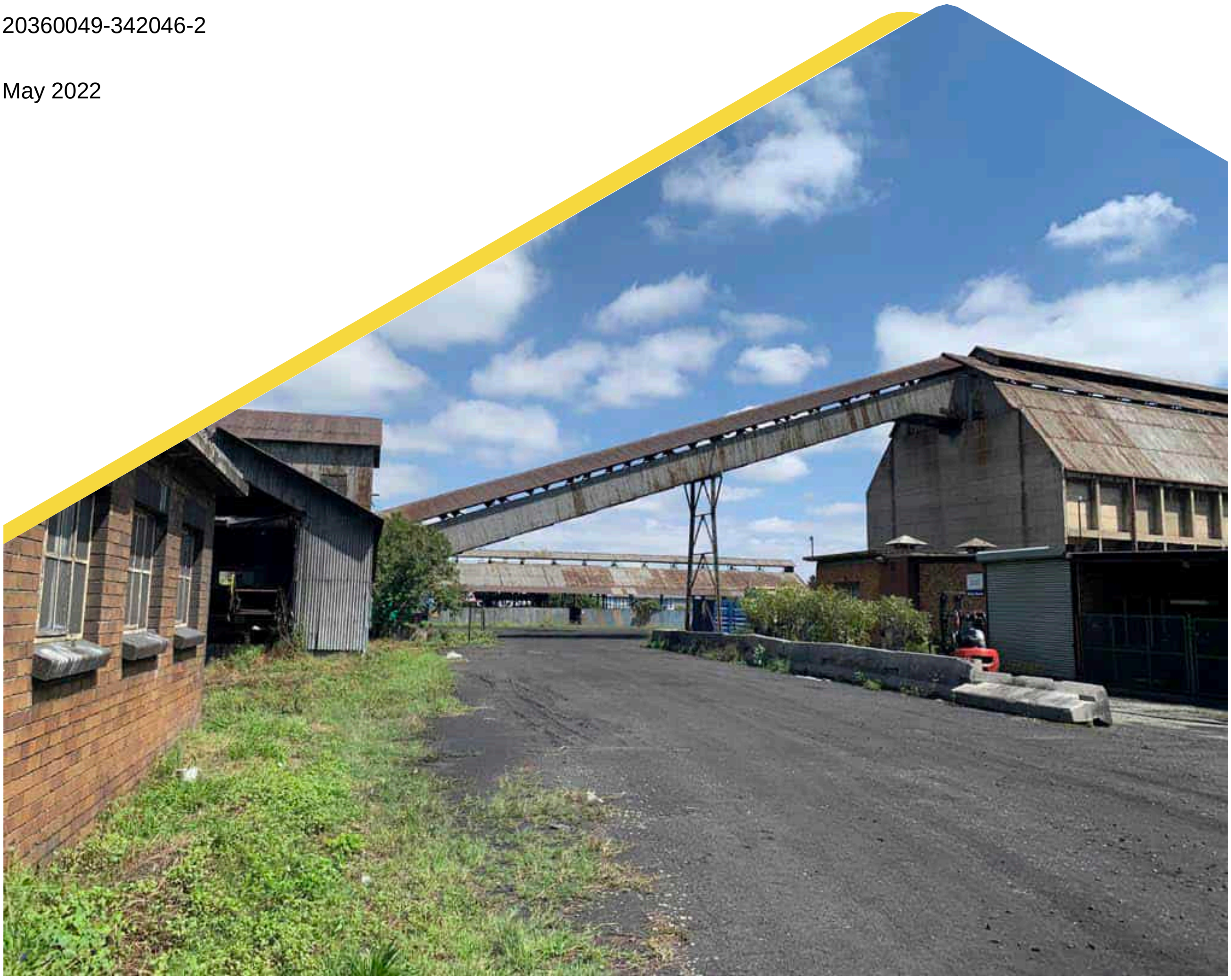
May 2022



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Executive Summary

Background

Kelvin Power Station (Kelvin) has two separate coal-fired power stations, A-station and B-station. A-station will be decommissioned after 60-years of operation. It was operational until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into potentially a cleaner technology power plant.

Kelvin Power Station is located in the Ekhurhuleni Metropolitan Municipality in the Province of Gauteng on the property Zuurfontein 331IR, Erf Re 82 zoned for an electrical power station.

Climate

The average daily maximum temperatures for the area show that the average midday temperatures for Kempton Park in the Ekhurhuleni Metropolitan Municipality range from 16.8°C in June to 26°C in January. The highest rainfall is during the months of October to April, with an average annual rainfall at Station 0476399W located at OR Tambo International Airport is 753 mm, and an approximate Mean Annual Evaporation (MAE) of 1742.82 mm.

Surface Water Assessment

The Kelvin site is situated on the boundary of two quaternary catchments, A21C and A21A, with 97% of the site in quaternary catchment A21C, the Jukskei River catchment. An unnamed tributary drains north-west for approximately 1.1km to confluence with the Modderfonteinspruit from the catchment of the ash dams where effluent is discharged. The Modderfontinspruit confluences with the Jukskei River which drains in a north westerly direction and confluences with the Crocodile River approximately 35 km downstream. The station is situated within an industrial area, however it is also close to a number of residential areas. In addition, there are large areas of Alexandra, located downstream, where it is understood that informal use of water from the Jukskei River occurs.

A-station is located in an area where there are no water resources that would be directly affected by runoff from the area that is to be decommissioned. Drainage from this section is currently via stormwater drains that drain directly to Main Channel which ultimately discharges to Modderfonteinspruit.

Kelvin has implemented a surface water monitoring programme that includes daily monitoring of the effluent and weekly monitoring at the effluent discharge point into the unnamed tributary as well as at points up and downstream of this in the Modderfonteinspruit. The 95th percentile data from weekly sampling for 2020/ 2021 indicate that the pH is compliant for all samples, and electrical conductivity, chloride, sodium, magnesium, calcium, nitrate and fluoride are elevated.

Impact Assessment

Overall, the surface water impact assessment has indicated the following potential surface water impacts that will require mitigation.

Decommissioning and removal of infrastructure may lead to release of additional contaminants, specifically those described in respect of the waste classification study undertaken during 2018. This may lead to changes to the chemical make-up of the stormwater run-off with higher concentrations of metals, hydrocarbons and salts from workshops, storage areas, A-stockpile and other dirty areas being decommissioned.

Considering the locality of Kelvin A-station within the two quaternary catchments, A21C and A21A, and specifically A21C, the impact significance on the Modderfonteinspruit and the Jukskei River has been rated as **low** and will require limited mitigation to reduce any residual risk.

Mitigation

In summary the following mitigation is proposed:

- Maintain, and develop if needed, adequate berms and stormwater collection facilities to capture sediment before it enters the existing stormwater system and the Modderfonteinspruit.
- Remove and dispose of soils within areas that have been subjected to high concentrations of contaminants over the years with as little exposure to rainfall as possible to limit contaminated run-off, after assessing level of contaminants and potential for reuse elsewhere.
- Maintain Main Channel and clear any sediment should it be noted, ensuring that the sediment is removed and responsibly disposed to a licenced waste disposal site if it is found to be contaminated.
- Continue the surface water monitoring programme, however, undertake a full spectrum of metals analyses and hydrocarbons at sampling points K1 and K2 before decommissioning starts, and monthly during decommissioning.

Should mitigation be implemented as proposed, then the impact significance should be **low**, and the cumulative and residual impacts will be **negligible**.

Acronyms/ Abbreviations

DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GAA	Golder Associates Africa (Pty) Ltd
Ha	hectares
IWUL	Integrated Water Use Licence
MAE	Mean Annual Evaporation
Mamsl	Metres above mean sea level
MAP	Mean Annual Precipitation
NIWIS	National Integrated Water Information System
WMA	Water Management Area

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1.0 INTRODUCTION

Kelvin Power Station (Kelvin) has two separate coal-fired power stations, A-station and B-station. A-station will be decommissioned after 60-years of operation. It was operational until 2012 when it was placed under care and maintenance. Kelvin Power has made the decision to decommission and demolish the A-station after which this section of the site will be redeveloped into a cleaner technology power plant.

Golder Associates Africa (Pty)(Golder) Ltd, a member of WSP, has been appointed to compile a basic assessment to inform the regulatory processes.

1.1 Projective objective

This project therefore covers the application for environmental authorisation by mean of a basic assessment process for the decommissioning of A-Station. This report describes the current status of the surface water resources, relevant legislation and potential impacts of the proposed decommissioning and demolition.

2.0 BACKGROUND

2.1 Project Locality

Kelvin Power Station is located in the Ekhurhuleni Metropolitan Municipality in the Province of Gauteng on the property Zuurfontein 331IR, Erf Re 82 zoned for an electrical power station.

2.2 Project Description

2.2.1 Decommissioning Process summary

The battery limits of the A-station power plant, earmarked for decommissioning and demolition include the following aspects highlighted as a purple shape in Figure 1:

- The A-station boiler, turbine house and two associated stacks,
- Three cooling towers,
- Workshops and storage facilities,
- External Stockpile A,
- Dry coal storage,
- Old switch yard or high voltage yard; and
- Train wagon tippler or rail tippler.

The current project scope does not include the decommissioning of any waste management facilities as those currently on site are still in use by the B-station power plant.

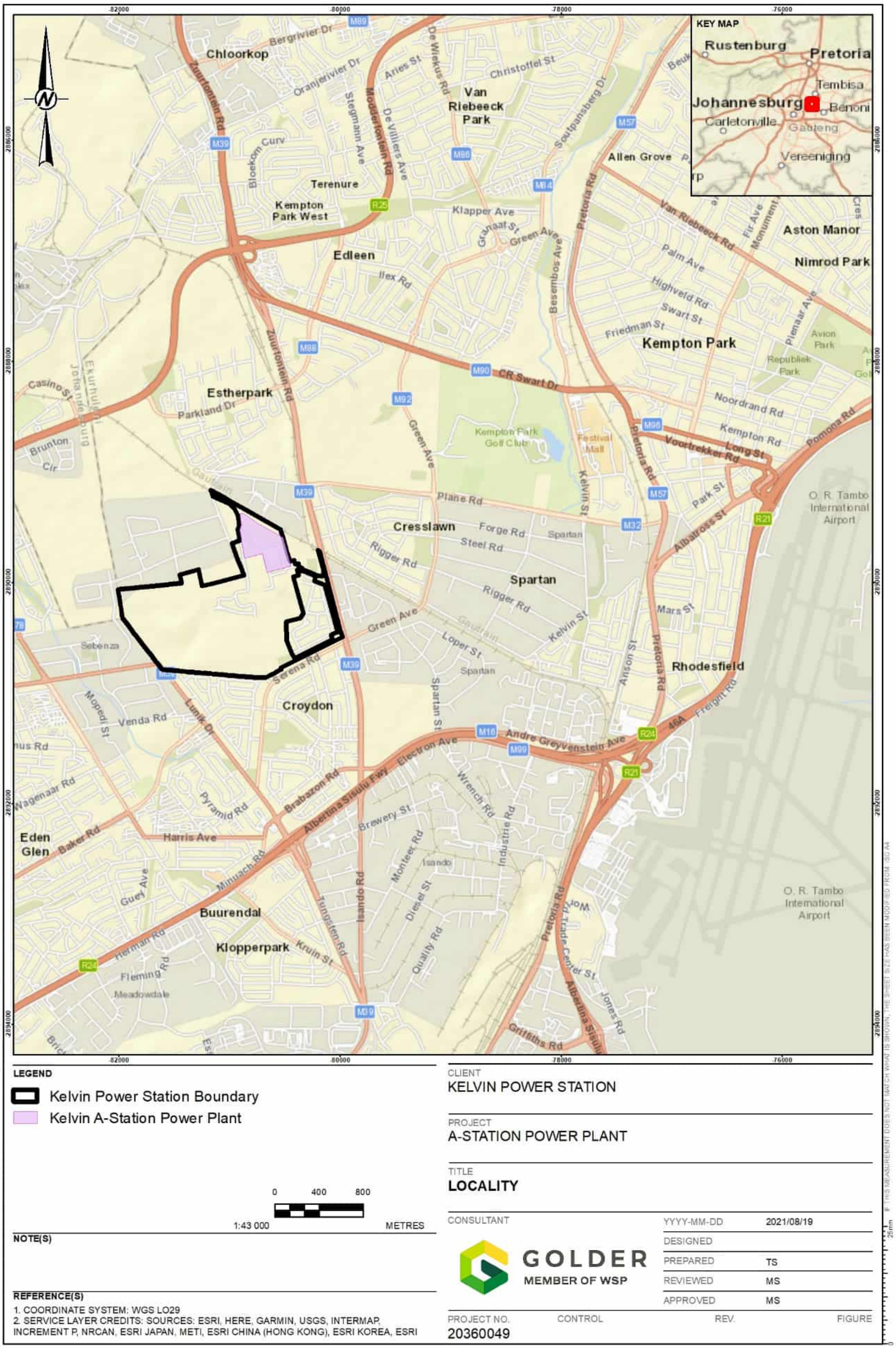


Figure 1: Kelvin Power Station locality showing area of decommissioning

2.2.2 Contaminated areas and Contaminants of Concern (CoC)

It is understood that the entire A-station area is contaminated, however, in most cases the contaminants of concern (CoC) have been classified as non-hazardous (Golder, 2018). Results taken from the report for Station A are included in Table 1, Table 2 and Table 3.

- The total concentrations of arsenic and lead from fugitive waste at Station-A fugitive exceeded TCT0 level,
- The total concentrations of manganese and nickel from fugitive waste at Station-A exceeded TCT0 level,
- The total concentrations of barium and copper from fugitive waste at Station-A including cooling towers at Station A exceeded TCT0 level,
- Concentrations of Polycyclic Aromatic Hydrocarbons (PAH) were well within the limits, and
- The concentration of total dissolved solids including manganese within fugitive waste from fugitive waste at station A including cooling towers at Station-A exceeded LCT0 level.

The fugitive waste material from station, and around station A cooling towers is classified as Type 3 waste (TC>TCT0 and LC>LCT0) which means that they would need to be disposed of to a Class C landfill or a GLB+ landfill.

Table 1: Water Classification Assessment (Golder, 2018)

Constituent of Concern	TCT0	TCT1	TCT2	Fugitive-Station A-Comp 1	Fugitive-Station A-Cooling Tower-Comp 1	Fugitive-Station A-Cooling Tower-Comp 2
				mg/kg concentration of element		
Aluminium	ng			11400	2488	4406
Arsenic	5.8	500	2000	7	5.1	4.7
Boron	150	15000	60000	<0.25	<0.25	<0.25
Barium	62.5	6250	25000	286	129	148
Beryllium	ng			2.1	1.2	1.1
Calcium				19610	9456	8757
Cadmium	7.5	260	1040	<0.1	<0.1	<0.1
Cobalt	50	5000	20000	15.1	6.1	9
Chromium	46000	800000	N/A	266.8	22.7	96.3
Copper	16	19500	78000	62	17	16
Iron	ng			72400	9866	12400
Mercury	0.93	160	640	<0.1	<0.1	<0.1
Potassium	ng			468	223	271
Magnesium				3524	1440	2348
Manganese	1000	25000	100000	2055	152	232
Molybdenum	40	1000	4000	9.8	1.3	1.6
Sodium	ng			1041	104	139
Nickel	91	10600	42400	113	25.2	67.1
Phosphorus	ng			973	262	397
Lead	20	1900	7600	51	15	15
Antimony	10	75	300	7	<1	1
Selenium	10	50	200	2	<1	<1
Tin	ng			4	<1	<1
Strontium				325	108	149
Titanium				707	197	262

Constituent of Concern	TCT0	TCT1	TCT2	Fugitive-Station A-Comp 1	Fugitive-Station A-Cooling Tower-Comp 1	Fugitive-Station A-Cooling Tower-Comp 2
				mg/kg concentration of element		
Thallium				1	<1	<1
Vanadium	150	2680	10720	39	20	22
Zinc	240	160000	640000	193	28	34
Zirconium	ng			16	10	10

Notes: *ng – no guidelines; Total concentrations above TCT0 highlighted in grey, total concentrations above TCT1 highlighted in yellow and total concentrations above TCT2 highlighted in red.*

Table 2: Total concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in waste streams from Kelvin Power Station

Constituents of Concern	TCT0	TCT1	TCT2	Fugitive-Station A-Comp 1	Fugitive-Station B-Comp 2	Fugitive-Station A-Cooling Tower-Comp 2
				mg/kg concentration of element		
Acenaphthene	ng			0.10	<0.01	0.20
Acenaphthylene				<0.01	<0.01	0.10
Anthracene				0.17	0.05	0.35
Benzo(a)anthracene				0.28	0.10	0.83
Benzo(a)pyrene	ng	1.7	6.8	0.47	0.26	0.46
Benzo(b)fluoranthene	ng			0.58	0.24	1.13
Benzo(bk)fluoranthene				0.81	0.34	1.57
Benzo(ghi)perylene				0.70	0.24	0.92
Benzo(k)fluoranthene				0.23	0.09	0.44
2-Chloronaphthalene				<0.01	<0.01	<0.01
Chrysene				0.38	0.17	0.80
Dibenzo(ah)anthracene				0.09	0.02	0.17
Fluoranthene				0.38	0.17	0.68
Fluorene				0.13	0.08	0.43
Indeno(123cd)pyrene				0.17	0.06	0.33
2-Methylnaphthalene				1.33	0.85	4.02
Naphthalene				0.79	0.56	2.31
Phenanthrene				0.90	0.54	2.25
Pyrene				0.11	0.20	0.82
PAH Total	ng	50	200	7.60	3.97	17.80

Table 3: Leachable concentrations of CoCs in ALSP (deionised water) extract of waste stream sampled at Kelvin Power Station

Constituents of Concern	LCT0	LCT1	LCT2	LCT3	Fugitive-Station A-Comp 1	Fugitive-Station A-Cooling Tower-Comp 1	Fugitive-Station A-Cooling Tower-Comp 2
					mg/kg concentration of element		
Aluminium	ng				0.65	0.29	0.41
Arsenic	0.01	0.5	1	4	<0.003	<0.003	<0.003
Boron	0.5	25	50	200	0.35	0.05	0.08
Barium	0.7	35	70	280	0.42	0.70	0.70
Beryllium	ng				<0.0005	<0.0005	0.0006

Constituents of Concern	LCT0	LCT1	LCT2	LCT3	Fugitive-Station A-Comp 1	Fugitive-Station A-Cooling Tower-Comp 1	Fugitive-Station A-Cooling Tower-Comp 2
Bismuth					<0.005	<0.005	<0.005
Calcium					372	279	271
Cadmium	0.003	0.15	0.3	1.2	<0.0005	<0.0005	<0.0005
Cobalt	0.5	25	50	200	0.01	0.03	0.03
Chromium	0.1	5	10	40	0.005	<0.0015	0.003
Copper	2	100	200	800	0.009	<0.007	<0.007
Iron	ng				0.021	0.22	0.09
Mercury	0.006	0.3	0.6	2.4	<0.001	<0.001	<0.001
Potassium	ng				13.6	3.5	4.1
Lithium					0.11	0.01	0.02
Magnesium					24.8	19.9	20.4
Manganese	0.5	25	50	200	1.66	1.45	1.46
Molybdenum	0.07	3.5	7	28	<0.002	<0.002	<0.002
Sodium	ng						
Nickel	0.07	3.5	7	28	0.044	0.044	0.051
Phosphorous	ng				0.242	0.018	0.04
Lead	0.01	0.5	1	4	<0.005	<0.005	<0.005
Antimony	0.02	1	2	8	<0.002	<0.002	<0.002
Selenium	0.01	0.5	1	4	<0.003	<0.003	<0.003
Tin	ng				<0.005	<0.005	<0.005
Strontium					2.66	1.53	1.51
Titanium					<0.005	<0.005	<0.005
Vanadium	0.2	10	20	80	0.0067	<0.0015	0.0022
Zinc	5	250	500	2000	0.79	0.146	0.23
Zirconium	ng				<0.005	<0.005	<0.005
pH	ng				5.36	5.3	5.28
Chloride	300	15000	30000	120000	18.2	2.8	2.9
Sulphate	250	12500	25000	100000	199.5	66.9	73.8
Nitrate	11	550	1100	4400	23.3	1.2	0.4
Fluoride	1.5	75	150	600	0.8	<0.3	0.3
Total Dissolved Solids	1000	12500	25000	100000	1439	1112	949

Notes*:* *ng – no guidelines; Leachable concentrations above LCT0 highlighted in **grey**, leachable concentrations above LCT1 highlighted in **yellow**, leachable concentrations above LCT2 highlighted in **orange** and leachable concentrations above LCT3 highlighted in **red**.*

3.0 CATCHMENT DESRIPTION

Kelvin Power Station falls within the Upper Crocodile Catchment of the Limpopo Water Management Area.

3.1 Climate

The Köppen-Geiger climate classification for South Africa (1980 – 2016) (Beck et al., 2018) indicates that this area is classified as a Cwb: Temperate, dry winter, warm summer.

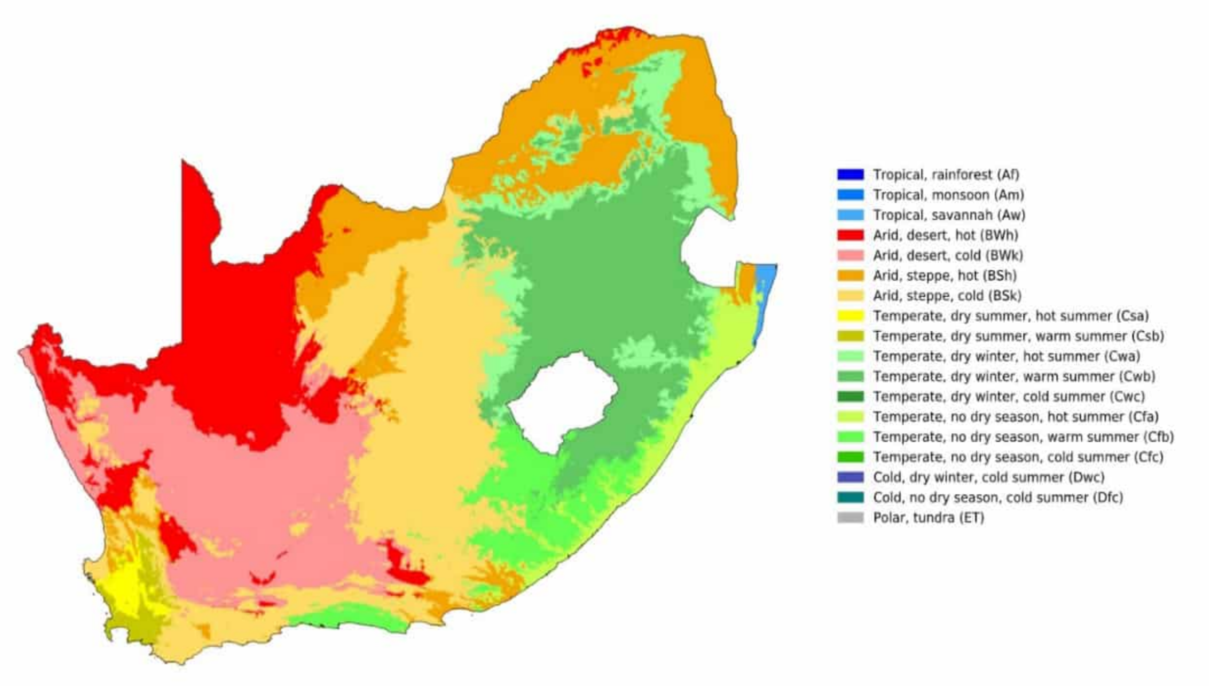


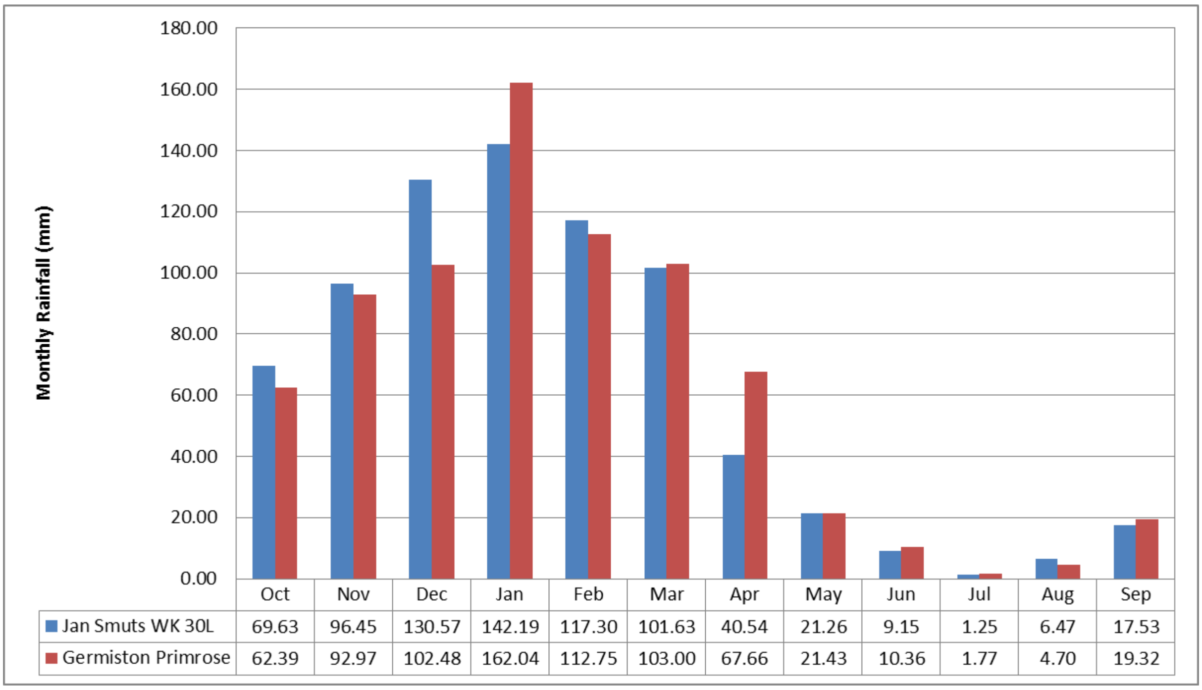
Figure 2: Koppen-Geiger Climate classification for South Africa (Beck et al., 2018)

3.1.1 Temperature

The average daily maximum temperatures for the area show that the average midday temperatures for Kempton Park in the Ekhurhuleni Metropolitan Municipality range from 16.8°C in June to 26°C in January. The region is the coldest during July when the mercury drops to 0.9°C on average during the night.

3.1.2 Rainfall

The rainfall data for Kelvin Power Station is informed by two nearby weather stations namely, Jan Smuts WK 30L, (0476399W) located at the OR Tambo International Airport, approximately 5km south east of the site, and Germiston Primrose, approximately 7km south of the site. The highest rainfall is during the months of October to April, with an average annual rainfall at Station 0476399W is 753mm.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
🟦 Jan Smuts WK 30L	69.63	96.45	130.57	142.19	117.30	101.63	40.54	21.26	9.15	1.25	6.47	17.53
🟥 Germiston Primrose	62.39	92.97	102.48	162.04	112.75	103.00	67.66	21.43	10.36	1.77	4.70	19.32

Figure 3: Average monthly rainfall in the area of Kelvin Power Station

3.1.3 Evaporation

Monthly evaporation data was available from the Department of Water and Sanitation (DWS) station A2E009, located approximately 5km south-east of the project site at the OR Tambo International Airport. This station has an approximate Mean Annual Evaporation (MAE) of 1742.82 mm (S-Pan) over a period of 1957-1984. Monthly mean, minimum and maximum evaporation depths are shown in Figure 4, also illustrating that the highest evaporation occurs in the summer months of September to March.

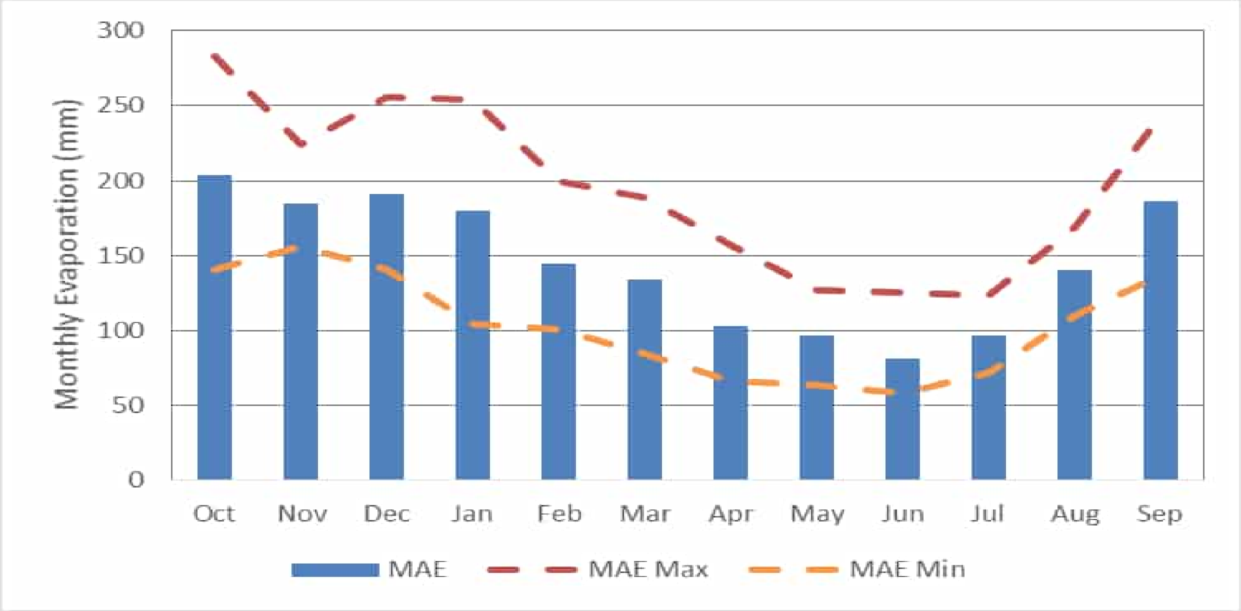


Figure 4: Monthly mean, minimum and maximum evaporation for station A2E009

3.2 Hydrological description

As described above, the Kelvin site is situated on the boundary of two quaternary catchments, A21C and A21A, with 97% of the site in quaternary catchment A21C, the Jukskei River catchment (Figure 5).

An unnamed tributary drains north-west for approximately 1.1km to confluence with the Modderfonteinspruit from the catchment of the ash dams where effluent is discharged. The Modderfontinspruit confluences with the Jukskei River which drains in a north-westerly direction and confluences with the Crocodile River approximately 35 km downstream.

The 3% of the site that falls within catchment A21A drains north-east into a non-perennial tributary that drains to the Rietvleispruit that drains to the Rietvlei Dam.

Catchment A21C is 75 961 ha and the part of the Kelvin site contributing to this catchment is 154.7 ha (or 0.2%) and Catchment A21A is 48 189 ha and the portion of the Kelvin site contributing to this catchment is 5.4 ha (or 0.01%).

The site is at an elevation of between 1620 and 1680 mamsl with a gentle slope of approximately 0.03 (3% or 3 meters of elevation for every 100m).

Figure 5: Kelvin in relation to the main water resources in the area

3.3 Water Resource Protection

Government Gazette Number 652 for the Water Resource Classes and Resource Quality Objectives for Mokolo, Matlabas, Crocodile (West) and Marico Catchment (18 October 2019) describes the outputs from the classification process and the Resource Quality Objectives (RQO).

The site falls within Integrated Unit of Analysis, IUA 1: Upper Crocodile/ Hennops/ Hartebeespoort, upstream of Hartebeespoort Dam and Resource Units 1.1 (Upper Hennops and Rietvlei Rivers to inflow of Rietvlei Dam, and dolomite aquifer systems) and 1.7 (Jukskei, Klein Jukskei and Modderfonteinspruit) (Figure 6). This IUA has been classified as a Class III river. In respect of the classification of rivers, this means that it is a river that is highly used and configuration of ecological categories of that water resource are highly altered from the pre-development condition.

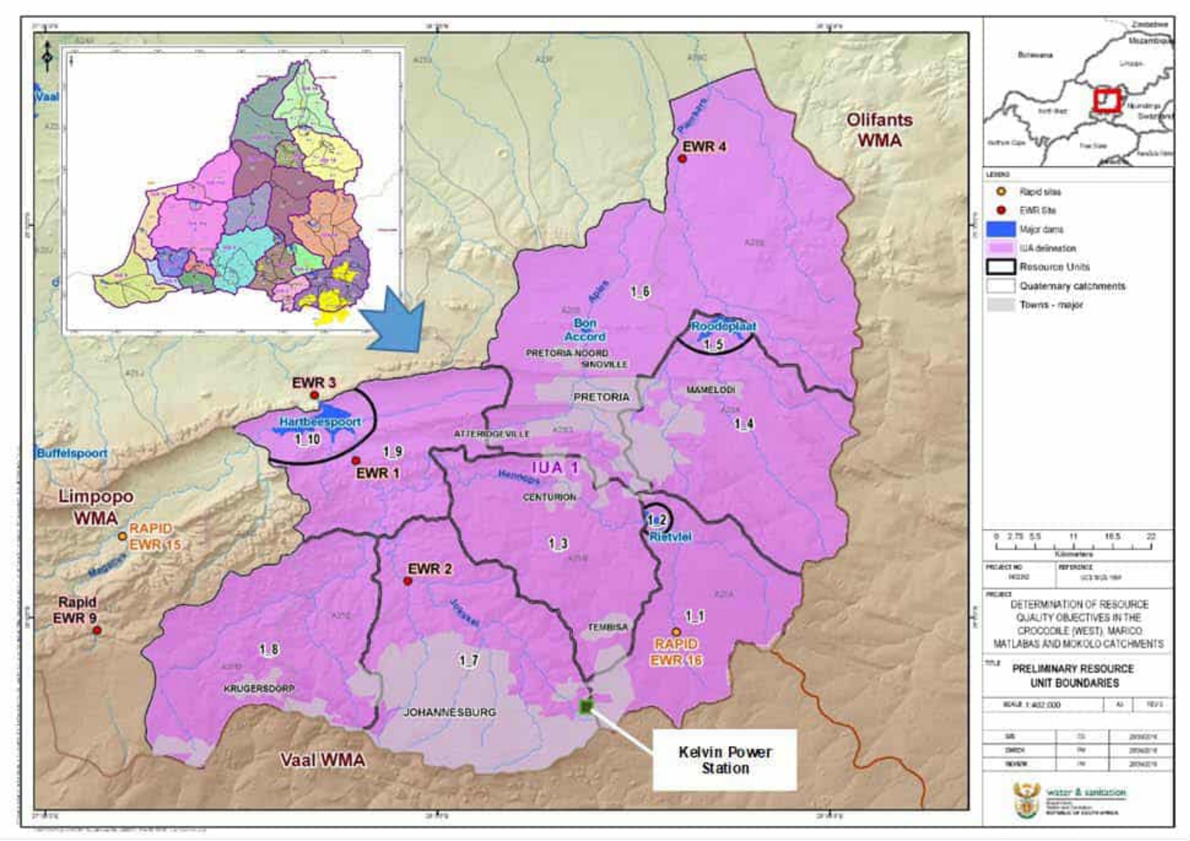


Figure 6: Integrated Unit of Analysis 1: Upper Crocodile/ Hennops/ Hartebeespoort and delineated Resource Units (DWS, 2017)

Table 4: Description of the resource units in which Kelvin is located

Quat	Class	Hydro node/ Resource Unit	EI	ES	PES	REC	Natural MAR (mcm/a)
A21A	III	Rietspruit (source) to Rietvlei Dam (CROC_EWR16)	Low	Low	C	C	4.79
A21C		Modderfonteinspruit to confluence with Jukskei River	Mod	Mod	E	D	34.4

Note: Ecological Importance (EI); Ecological Sensitivity (ES); Present Ecological State (PES); Recommended Ecological Category (REC); MAR: Mean Annual Runoff

A summary of the Resource Quality Objectives set for Resource Unit 1.1 and Resource Unit 1.7 are included in APPENDIX B.

3.4 Surface Water Assessment

3.4.1 Water users

The station is situated within an industrial area, however it is also close to a number of residential areas. In addition, there are large areas of Alexandra, located downstream, where it is understood that informal use of water from the Jukskei River occurs.

3.4.2 Stormwater management

Due to the age of Kelvin, storm water management systems at the operation are considered inadequate when measured by present day standards and comprise three parts: Main Channel, Secondary Channel, Effluent Channel and overland flow (Figure 7). It is important to note that no clean/ dirty water system is in place to facilitate the separation of clean and dirty runoff. It should however be noted that the operation is located in an urbanised / industrial area and that no water on or surrounding the site can be considered clean, and all storm water generated on site is considered to be affected.

A-station is located in an area where there are no water resources that would be directly affected by runoff from the area that is to be decommissioned. Drainage from this section is currently via stormwater drains that drain directly to Main channel. Main Channel flows to a diversion weir that diverts high flows (greater than the 1:2 year recurrence interval storm peak flow rate) into a bypass channel, which discharges into the Effluent Channel. The low flows (effluent plus average and small storm runoff) are routed through the Desilting Dams for settling and oil removal. Outflow from the Desilting Dams is discharged into the Effluent Channel. The Effluent Channel discharges through the outlet monitoring and measuring flume directly into the unnamed tributary that drains to the Modderfonteinspruit. The Effluent Channel flows through a by-pass structure upstream of the flume, which can facilitate the discharge of flow into the Return Water Dam as make-up water to the ashing system.

Figure 7: Storm water channels

3.4.3 Water Quality Assessment

Considering the waste classification results summarised in Section 2.2.2, in addition to total dissolved solids, hydrocarbons, and pH, the constituents of concern that should be monitored are arsenic, copper, barium, manganese, nickel and lead, all of which can have an impact on human health.

Kelvin has a surface water monitoring programme that includes daily monitoring of the effluent and weekly monitoring at the effluent discharge point into the unnamed tributary, as well as at points up and downstream of this in the Modderfonteinspruit (Table 5).

Table 5: Surface water monitoring sites

Monitoring ID	Description	Latitude	Longitude
Eff	Effluent discharge point below ash dam RWD	26° 7'18.38"S	28°10'58.11"E
Eff_plus	Just upstream of the confluence with Modderfonteinspruit	26° 7'8.71"S	28°10'28.35"E
K1	Modderfonteinspruit upstream of effluent discharge	26° 7'9.43"S	28°10'25.66"E
K2	Modderfonteinspruit downstream of effluent discharge, as well as a drainage line emanating from the industrial area north of Kelvin ash dams	26° 6'33.79"S	28°10'9.03"E

Statistical data for results from weekly sampling for 2020/ 2021 are set out in Table 6. The 95th percentile data indicates that the pH is compliant for all samples, and electrical conductivity, chloride, sodium, magnesium, calcium, nitrate and fluoride are elevated.

Figure 8: Surface water monitoring sites

Table 6: Statistics of weekly water quality data for 2020/2021

		pH	Electrical Conductivity (µS/cm)	Sulphate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Nitrate (mg/L)	Fluoride (mg/L)	Suspended Solids (mg/L)
	Limit	**5.0 – 9.5**	**1115.0**	**200.0**	**103.4**	**49.5**	**61.6**	**100.0**	**6.0**	**0.3**	**40.0**
Eff	Minimum	7.7	450.0	67.0	48.0	0.2	14.0	71.0	4.9	0.1	1.0
	Average	8.4	1297.2	98.7	148.0	41.1	96.5	190.4	10.7	0.9	13.8
	Maximum	9.2	1724.0	113.0	200.0	132.0	232.0	249.0	26.2	2.9	166.0
	95th percentile	8.9	**1625.0**	108.0	**185.0**	**53.8**	**150.6**	**234.4**	**17.9**	**2.0**	31.7
KS1	Minimum	7.6	397.0	54.0	28.0	6.4	32.0	42.0	2.6	0.1	0.0
	Average	8.3	1222.2	94.6	127.6	36.3	115.1	169.7	9.3	1.0	13.3
	Maximum	9.4	1810.0	117.0	186.0	78.0	207.0	280.0	22.0	3.0	139.0
	95th percentile	9.0	**1610.2**	109.6	**178.4**	**53.0**	**175.0**	**226.0**	**17.3**	**2.1**	**48.5**
KS2	Minimum	7.7	346.0	46.0	24.0	2.6	49.5	40.0	2.6	0.1	0.0
	Average	8.2	1354.5	93.0	126.9	34.6	119.5	166.0	8.9	1.0	13.2
	Maximum	9.6	11959.0	110.0	199.0	81.8	210.0	267.0	21.8	2.8	113.0
	95th percentile	8.7	**1616.2**	107.0	**171.6**	**51.3**	**174.4**	**225.2**	**15.6**	**2.4**	**46.1**

4.0 IMPACT ASSESSMMENT

4.1 Major areas of concern for surface water impacts

The major areas of concern relating to the surface water resources during decommissioning of the A-station are the release of additional chemicals via the stormwater channels.

4.2 Impact assessment methodology

An impact is essentially any change (positive or negative) to a resource or receptor brought about by the presence of the project component or by the execution of a project related activity. The purpose of an impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and natural resources according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise, reduce, or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation. The assessment of impacts proceeds through an iterative process considering four key elements:

- Prediction of the magnitude of impacts (the consequences of the project on the natural and social environment),
- Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources of human receptors into account,
- Development of mitigation measures to avoid, reduce or manage the impacts; and
- Assessment of residual significant impacts after the application of mitigation measures.

The evaluation of baseline data gathered during desktop and field studies provides information for the process of evaluating and describing how the project could affect the biophysical and socio-economic environment. A clearly defined methodology is used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. For this, the project must be considered in the context of the area and the people that will be affected.

4.2.1 Significance rating

The significance of the identified impacts on the various environmental components were determined using the approach outlined below. This incorporates two aspects for assessing the potential significance of impacts (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998), namely occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of Occurrence	Duration of Occurrence	Magnitude (Severity) of Impact	Scale / Extent of Impact

To assess each of these factors for each impact, the following four ranking scales were used (Table 7).

Table 7: Impact ranking scales

Magnitude	Duration
10- Very high/ unknown	5- Permanent
8- High	4- Long term (>10 years)
6- Moderate	3- Medium-term (5 – 10 years)

Magnitude	Duration
4- Low	2- Short-term (0-3 years, impact ceases after the decommissioning and rehabilitation activities)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Definitions

Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate, or high.

Scale/ Geographic extent refers to the area that could be affected by the impact and is classified as site, local (within the quaternary catchment), regional, national, or international.

Duration refers to the length of time over which an environmental impact may occur i.e., immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and

Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

Once these factors have been ranked for each impact, the significance of the two aspects, occurrence and severity, will be assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

Table 8: Significance of impact based on points allocation

Points	Significance	Description
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30-60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management, and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

4.3 Decommissioning impacts

4.3.1 Increased contaminated run-off during the construction phase

Decommissioning and removal of infrastructure may lead to the release of additional contaminants, specifically those described in Section 2.2.2. This may lead to changes to the chemical make-up of the stormwater run-off with higher concentrations of metals, hydrocarbons and salts from workshops, storage areas, A-stockpile and other dirty areas being decommissioned.

Clearing of the site will leave areas exposed. Rainfall data has indicated that the period for rainfall is from October to April with the highest rainfall being during December, January, and February. As the rainfall events are often associated with heavy downpours, erosion of exposed areas is likely. Sediment run-off, potentially contaminated before removal and disposal to an approved site, can therefore be expected during rainfall events.

Considering the locality of the Kelvin A-station within the two quaternary catchments, A21C and A21A, and specifically A21C, the scale of the impacts to the Modderfonteinspruit and the Jukskei River has been rated as local. The duration is likely to be short-term, with the site clearing taking a few months at most. Considering that the contaminants of concern (Section 2.2.2) will have mostly been removed prior to demolition, with only residual contaminants left behind, the magnitude of change has been rated as low. The contamination probability is rated as medium, so that the impact significance is rated as **low**, and will require limited mitigation to reduce any risk.

4.3.1.1 Mitigation

In summary the following mitigation is proposed:

- Maintain, and develop if needed, adequate berms and stormwater collection facilities to capture sediment before it enters the existing stormwater system and the Modderfonteinspruit.
- Remove and dispose of soils within areas that have been subjected to high concentrations of contaminants over the years with as little exposure to rainfall as possible to limit contaminated run-off, after assessing level of contaminants and potential for reuse elsewhere.
- Maintain Main Channel and clear any sediment should it be noted, ensuring that the sediment is removed and responsibly disposed to a licenced waste disposal site if it is found to be contaminated.
- Continue the surface water monitoring programme, however, undertake the following additional sampling:
  - Before decommissioning starts, and monthly during decommissioning, undertake a full spectrum of metals analyses and hydrocarbons at sampling points K1 and K2.

Should the measures described above be implemented during the demolition phase, then the impact significance will be negligible.

Table 9: Summary of activities and associated surface water impacts

ACTIVITY	POTENTIAL IMPACT	ASPECT AFFECTED	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation
Removal of Station-A infrastructure	Disturbance of soil during infrastructure removal may release chemicals leading to run-off (and erosion) from disturbed areas to the existing stormwater system containing increased concentrations of total dissolved solids and metals and additional sediment.	Downstream water resources and potential human health	4	2	2	3	24	Low	4	2	2	2	16	Low

5.0 ENVIRONMENTAL MANAGEMENT PROGRAMME: SURFACE WATER

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed project in respect of surface water and should be used for managing, mitigating, and monitoring of the environmental impacts associated the decommissioning and demolition of A-station.

5.1 Objectives

The objectives for the surface water component should include:

- Managing the cleared areas to limit sedimentation to the existing stormwater system and downstream water resources.
- Maintaining vehicles and machinery and clearing any spills timeously, to limit contaminated run-off from the site during the decommissioning and demolition activities.
- Maintaining the existing stormwater management system that is currently linked to A-Station to prevent sediments entering the system.
- Practicing good housekeeping in all areas, including, the disposal of contaminated soils and infrastructure to licenced waste disposal sites for the specific class of waste, to limit the volume of contaminated run-off to downstream water resources.

5.2 Environmental Management and Mitigation Measures Identified

A summary of mitigation for each of the potential impacts identified are described in Table 10. These include consideration of the following aspects:

- For negative impacts (either/or):
  - Avoid,
  - Minimize,
  - Rehabilitate/ Repair, and/ or
  - Compensate.
- For positive impacts:
  - Enhance.

5.3 Potential Cumulative Impacts Identified

The current situation is that the Jukskei catchment is already highly developed with water resources bearing the brunt of urban (formal and informal) and industrial contamination. Considering the existing impacts to the Modderfonteinspruit and Jukskei River, quaternary catchment (A21C), and the desilting dam with oil booms already in place, the cumulative impact of contamination (hydrocarbons, metals and sediments) to surface water resources is not expected to adversely affect the surface water resources any further. With good management practices during decommissioning no further impacts are expected in the water resources.

5.4 Residual Risk

Residual impacts from the decommissioning will be low, as long as good management practices are maintained.

Table 10: Proposed mitigation for surface water impacts identified

ACTIVITY	POTENTIAL IMPACT	Negative impacts				Positive
		Avoid	Minimize	Rehabilitate/ Repair	Compensate	Enhance
Removal of A-station infrastructure.	Disturbance of soil during infrastructure removal may release chemicals leading to run-off (and erosion) from disturbed areas to the existing stormwater system containing increased concentrations of total dissolved solids and metals and additional sediment. Soil contamination from hydrocarbon and chemical spills.	Avoid clearing during heavy rainfall periods if possible (December, January, and February); try to do clearing during winter so that run-off will be limited. Only clear working areas and within the targeted footprint.	Procedures on land clearance, soils handling and rehabilitation plan to be adhered to, including removal of contaminated material to a licenced waste disposal site. Ensure spill kits are on site with staff adequately trained to use them, if needed.	Drainage channels and sedimentation ponds (even temporary) must be maintained and developed if necessary.	None expected for the project.	Continue the surface water monitoring programme, however, undertake the following additional sampling: before decommissioning starts, and monthly during decommissioning, undertake a full spectrum of metals analyses and hydrocarbons at sampling points K1 and K2.

5.5 Recommended monitoring programme

5.5.1 Surface water monitoring points

The surface water monitoring programme must be continued as per the site's Integrated Water Use Licence (IWUL); however, the following additional sampling should be undertaken at points K1 and K2 (Table 11):

- Before decommissioning starts, and monthly during decommissioning, undertake a full spectrum of metals analyses and hydrocarbons at sampling points K1 and K2 to assess the impacts from the decommissioning, and inform additional mitigation that may need to be implemented to limit downstream impacts.

Table 11: Monthly monitoring sites

Monitoring ID	Description	Latitude	Longitude
K1	Modderfonteinspruit upstream of effluent discharge	26° 7'9.43"S	28°10'25.66"E
K2	Modderfonteinspruit downstream of effluent discharge, as well as a drainage line emanating from the industrial area north of Kelvin ash dams	26° 6'33.79"S	28°10'9.03"E

6.0 CONCLUSIONS

Overall, the surface water impact assessment has indicated the following potential surface water impacts that will require mitigation.

Decommissioning and removal of infrastructure may lead to release of additional contaminants, specifically those described in respect of the waste classification study undertaken by Golder during 2018. This may lead to changes to the chemical make-up of the stormwater run-off with higher concentrations of metals, hydrocarbons and salts from workshops, storage areas, A-stockpile and other dirty areas being decommissioned.

Considering the locality of Kelvin Station-A within the two quaternary catchments, A21C and A21A, and specifically A21C, the impact significance on the Modderfonteinspruit and the Jukskei River has been rated as **low** and will require limited mitigation in the form of good practices to reduce the risk.

In summary the following mitigation is proposed:

- Maintain, and develop if needed, adequate berms and stormwater collection facilities to capture sediment before it enters the existing stormwater system and the Modderfonteinspruit.
- Remove and dispose of soils within areas that have been subjected to high concentrations of contaminants over the years with as little exposure to rainfall as possible to limit contaminated run-off, after assessing level of contaminants and potential for reuse elsewhere.
- Maintain Main Channel and clear any sediment should it be noted, ensuring that the sediment is removed and responsibly disposed to a licenced waste disposal site if it is found to be contaminated.
- Continue the surface water monitoring programme, however, undertake a full spectrum of metals analyses and hydrocarbons at sampling points K1 and K2 before decommissioning starts, and monthly during decommissioning.

Should mitigation be implemented as proposed, then the impact significance should be reduced to **low**, and the cumulative and residual impacts will be **negligible**.

7.0 REFERENCE

Golder Associates Africa (2018) Kelvin Power Station: Waste Classification and Assessment. Report Number: 1790793/317616/1

Department of Water and Sanitation, South Africa. June 2017. Determination of Resource Quality Objectives in the Mokolo, Matlabas, Crocodile West and Marico Catchments in the Limpopo North West Water Management Area (WMA01): Resource Quality Objectives and Numerical Limits Report. Final. Report No: RDM/WMA01/00/CON/RQO/0516

Signature Page

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APPENDIX A

Document Limitations

APPENDIX B

Resource Quality Objectives for RU 1.1 and RU 1.7

Summary of RQOs for RU1.1 and RU 1.7 (DWS, 2017)

Component	Sub-component	Resource Quality Objective (RQO)	Indicator	Numerical Limit					
				RU 1.7			RU 1.1		
					Maintenance Low flows (m3/s)	Drought flows (m3/s)		Maintenance Low flows (m3/s)	Drought flows (m3/s)
Quantity	Low flows	EWR maintenance low and drought flows: Hennops River at A2H090 in A21A NMAR = 11.66x10^6m3 REC=C category The maintenance low flows and drought flows must be attained to support the aquatic ecosystem and the downstream users.	Base Flows - specifically required after confluence of Rietvlei and Hennops Rivers Maintenance flows and drought flows Monitoring of Hennops River with surveys of biota at A2H090)	Oct	0.041	0.007	Oct	0.725	0.725
				Nov	0.054	0.007	Nov	0.775	0.775
				Dec	0.056	0.01	Dec	0.77	0.77
				Jan	0.078	0.017	Jan	0.814	0.814
				Feb	0.1	0.015	Feb	0.936	0.936
				Mar	0.087	0.017	Mar	0.845	0.845
				Apr	0.072	0.014	Apr	0.839	0.839
				May	0.065	0.013	May	0.795	0.795
				Jun	0.064	0.017	Jun	0.815	0.815
				Jul	0.059	0.016	Jul	0.785	0.785
				Aug	0.054	0.013	Aug	0.774	0.774
				Sep	0.048	0.007	Sep	0.762	0.762
Quality	Nutrients	Instream concentration of nutrients must be improved to sustain aquatic ecosystem health and ensure the prescribed ecological category is met. Application of the concentration limits must be undertaken in conjunction with a nutrient load balance for the catchment.	Orthophosphate (PO4-) as Phosphorus	≤ 0.060 milligrams/litre (mg/l) (50th percentile)			≤ 0.5 milligrams/litre (mg/l) (50th percentile) (interim numeric limit) ≤ 0.125 milligrams/litre (mg/l) (50th percentile) (long term numeric limit)		
			Dissolved Inorganic Nitrogen (DIN) as Nitrogen	≤1.25 milligrams/litre (mg/l) (50th percentile)					
			Nitrate (NO3-) & Nitrite (NO2-) as Nitrogen	≤ 1.0 milligrams/litre (50th percentile)			≤ 1.0 milligrams/litre (50th percentile)		
	Salts	Instream salinity must be maintained or improved upon to support the aquatic ecosystem and the water quality requirements of the water users.	Electrical conductivity (EC)	≤ 55 milliSiemens/metre (mS/m) (95th percentile) Hennops above confluence with Rietvlei			≤ 65 milliSiemens/metre (mS/m) (95th percentile)		
				≤ 70 milliSiemens/metre (mS/m) (95th percentile) below confluence					

Component	Sub-component	Resource Quality Objective (RQO)	Indicator	Numerical Limit	
				RU 1.7	RU 1.1
			Sulphate (SO4)	≤ 80 milligrams/litre (mg/l) (95th percentile)	≤ 70 milligrams/litre (mg/l) (95th percentile)
			Sodium (Na)	≤ 70 milligrams/litre (mg/l) (95th percentile)	≤ 70 milligrams/litre (mg/l) (95th percentile)
			Chloride	-	≤ 60 milligrams/litre (mg/l) (95th percentile)
	Pathogens	The presence of pathogens should pose a low risk to human health.	Escherichia coli (E. coli)	130 counts/100 millilitres (ml) (95th percentile)	130 counts/100 millilitres (95th percentile)
	System Variables	pH must be maintained at present state.	pH range	6.5 (5th percentile) and 9.0 (95th percentile)	6.5 (5th percentile) and 9.0 (95th percentile)
		A baseline assessment to determine the present state instream turbidity is required.	Turbidity	A 10% variation from background concentration is allowed.	A 10% variation from background concentration is allowed.
		Dissolved oxygen levels must be improved to support the aquatic ecosystem.	Dissolved oxygen	6-7 milligrams/litre (mg/l)	≥ 6 milligrams/litre (mg/l)
	Toxics	The concentrations of toxins should not be toxic to aquatic organisms and a threat to human health.	Ammonia as N	≤ 0.0725 milligrams/litre (mg/l) (95th percentile)	≤ 0.1 milligrams/litre (mg/l) (95th percentile)
			Aluminium (Al)	≤ 0.105 milligrams/litre (mg/l) (95th percentile)	≤ 0.15 milligrams/litre (mg/l) (95th percentile)
			Manganese (Mn)	≤ 0.15 milligrams/litre (mg/l) (95th percentile)	≤ 0.15 milligrams/litre (mg/l) (95th percentile)
			Iron (Fe)	≤ 0.1 milligrams/litre (mg/l) (95th percentile)	≤ 0.3 milligrams/litre (mg/l) (95th percentile)
			Lead (Pb) hard	≤ 0.0095 milligrams/litre (mg/l) (95th percentile)	≤0.013 milligrams/litre (mg/l) (95th percentile)
			Copper (Cu) hard	≤ 0.0073 milligrams/litre (mg/l) (95th percentile)	≤0.0075 milligrams/litre (mg/l) (95th percentile)
			Nickel (Ni)	≤ 0.07 milligrams/litre (mg/l) (95th percentile)	≤0.07 milligrams/litre (mg/l) (95th percentile)
			Atrazine	≤0.078 milligrams/litre (mg/l)	≤0.078 milligrams/litre (mg/l)
			Mancozeb	≤0.009 milligrams/litre (mg/l)	0.009 milligrams/litre (mg/l)

Component	Sub-component	Resource Quality Objective (RQO)	Indicator	Numerical Limit	
				RU 1.7	RU 1.1
			Glyphosate	≤0.7 milligrams/litre (mg/l)	0.7 milligrams/litre (mg/l)
			Endosulfan	≤0.13 micrograms/litre (ug/l)	0.13 micrograms/litre (ug/l)
			Oil and grease	2.5 mg/l	
			Hormone driven Pharmaceuticals	17ß-oestradiol: ≤ 0.001 mglℓ	
Habitat	Instream	Sufficient velocity depth for flow sensitive species must be attained.	Index of Habitat Integrity, Rapid Habitat Assessment Method and Model Method and Model (RHAMM)	Instream Habitat Integrity ecological category = C ≥ 62%	Instream Habitat Integrity EC = D ≥ 42%
	Riparian habitat	Alien invasive control should be implemented. Riparian vegetation should be maintained at a C ecological category.	Index of Habitat Integrity, Vegetation Response Assessment Index	VEGRAI ecological category = C ≥ 62% Riparian IHI = C ≥ 62%	VEGRAI EC = C ≥ 62%
Biota	Fish	Fish community should be maintained at a C ecological category. Flow velocity linked to seasonal requirements needed for BMAR., AURA and CPRE	Fish Response Assessment Index (FRAI). Seasonality must be noted.	Fish ecology category = C FRAI ≥ 62% Fish survey determining diversity and quantity should be conducted during the wet and dry seasons. No less than 20min survey effort must be conducted for fish sampling. The FRAI should be conducted to monitor against the prescribed C ecological category. REMP site: Tweefontein (A21A-01171)	Fish ecology category = D FRAI ≥ 42%
	Aquatic macroinvertebrates	Macroinvertebrate assemblage must be maintained within a moderately modified condition or improved upon.	Macroinvertebrate Response Assessment Index and the South African Scoring System Version 5 (SASS5).	MIRAI C ecological category ≥ 62% SASS ≥ 80 ASPT ≥ 4.8	MIRAI ecological category = D ≥ 42% SASS ≥ 50 ASPT ≥ 3.8 (EWR2, A2JUKS-DIENR)
	Diatoms				Diatom EC ≥ 42% A2JUKS-DIENR
	Semi-aquatic biota	The suitability of this stretch of river to serve as a habitat and migration corridor for aquatic bird and mammal populations must be maintained through proper habitat management.	Aquatic birds/Indicator mammal species	Determine representative bird species (types and population numbers to serve as indicators). There is a need to set a numerical limit for density of animals/birds based on the available/collected data.	

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DETAILS OF THE SPECIALIST

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Project:	Kelvin Power Station Decommissioning and Demolition Project

Declaration of Independence by Specialist

I, Lee Boyd, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

[Lee Boyd]

Appendix G9: Waste Inventory and Management Plan

REPORT

Waste Inventory and Management Plan for the Decommissioning and Demolition of the Kelvin Power A-Station Power Plant, Ekurhuleni, Gauteng

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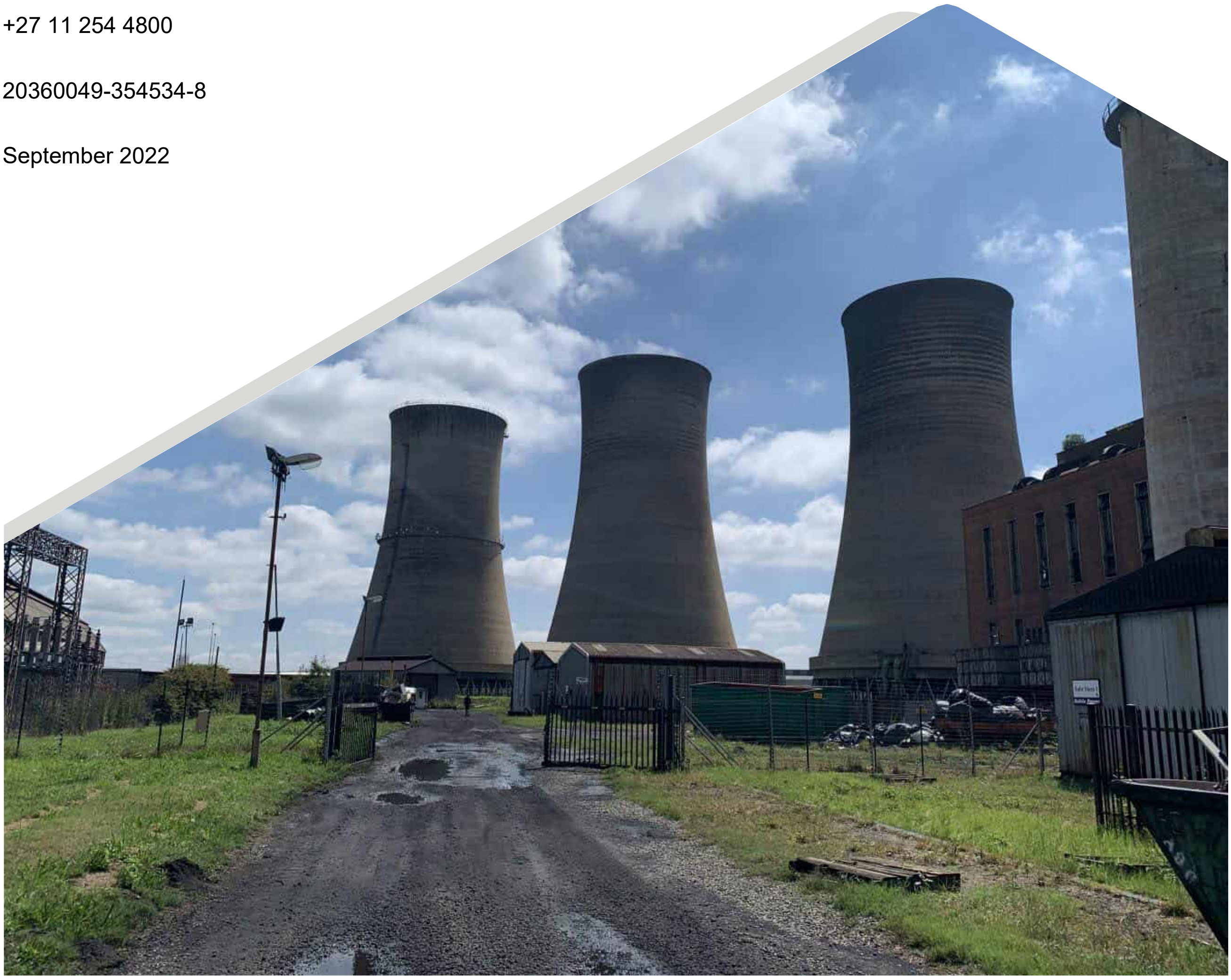

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EXECUTIVE SUMMARY

The purpose of this document is to provide:

- A Waste Inventory for the materials expected to be generated as a result of the proposed decommissioning of the Kelvin Power A-Station Power Plant infrastructure located in the City of Ekurhuleni, Gauteng;
- Options for the management of the expected waste streams at each phase of the decommissioning process; and
- A plan for the safe, legal and environmentally sound management of each expected waste stream.

This document provides a preliminary and high-level Waste Inventory for all the materials expected to be generated as a result of the decommissioning, demolition and site clean-up phases of the A-Station Power Plant infrastructure and sets out management plan methodologies appropriate to the inventoried materials being managed, in compliance with waste related legislation and best practice.

At a high-level overview, waste will be managed during the various phases of decommissioning as follows:

- **Decommissioning Phase**: The waste that arises from this phase will be largely as a result dismantling of various items prior to removal offsite. Any residual process related wastes will be disposed of at an appropriately licensed hazardous facility such as the Holfontein Landfill site, operated by EnviroServ.
- **Demolition Phase**: The demolition plan is an on-going development with contractor consultation. Where possible, asbestos removal will take place ahead of demolition. The demolition Waste Inventory has assessed building structural elements, e.g. sheeting, structural steel and concrete structures, slated for demolition.

  Once the buildings are decontaminated and demolished, the steel can be sold off as scrap metal. Any demolished concrete from low level walls will be used on site for infilling or disposed at the licensed Simmer and Jack General Waste Landfill, belonging to the City of Johannesburg, for use as capping material.

  Site Clean Up Phase: Once all the equipment and buildings which are designated for removal have been removed, the site will be remediated according to a Remediation Plan. Once the site footprint becomes available, soils will require further analysis to quantify contamination and to conceptualise remediation methodology.

  Analysis of remediated soils may demonstrate that such remediation is not feasible and this may result in transfer of contaminated soils, in part or in full, to appropriate disposal facilities. Soils which are analysed as being remediable by reasonable on-site techniques will be remediated and re-used on site if they test as safe for reuse, alternatively they will be disposed as general waste or another appropriately licenced landfill site.

The inventory of materials provided in this document is considered a live document, and will be updated as decommissioning progresses.

LIST OF ACRONYMS

BA	Basic Assessment
CoC	Constituents of Concern
DFFE	Department of Forestry, Fisheries and Environment
DWS	Department of Water and Sanitation
ECA	Environmental Conservation Act, 1989 (Act 73 of 1989)
GHS	Globally Harmonised System
NEMA	National Environmental Management Act
NEMWA	National Environmental Management Waste Act, 2008 (Act 59 of 2008)
NEMWAA	National Environmental Management Waste Amendment Act, 2014 (Act 26 of 2014)
NWIR	National Waste Information Regulations, GN R. 625 of 13 August 2012
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
SANS	South African National Standards
SAWIS	South African Waste Information System
SDS	Safety Data Sheet
WCMRs	Waste Classification and Management Regulations, GN R.634 of 23 August 2013
WMP	Waste Management Plan

DEFINITIONS (FROM NEMWA AND REGULATIONS THEREUNDER, UNLESS OTHERWISE INDICATED)

Term	Definition
Building and demolition waste	Waste, excluding hazardous waste, produced during the construction, alteration, repair or demolition of any structure, and includes rubble, earth, rock and wood displaced during that construction, alteration, repair or demolition, which include: (a) discarded concrete, bricks, tiles and ceramics (b) discarded wood, glass and plastic (c) discarded metals (d) discarded soil, stones and dredging spoil (e) Other discarded building and demolition wastes
Domestic waste	Waste excluding hazardous waste, that emanates from premises that are used wholly or mainly for residential, educational, health care, sport or recreation purposes, which include garden and park waste, municipal waste and food waste.
General waste	Waste that does not pose an immediate hazard or threat to health or to the environment, and includes— (a) domestic waste; (b) building and demolition waste; (c) business waste; (d) inert waste; or (e) any waste classified as non-hazardous waste in terms of the regulations made under section 69, and includes non-hazardous substances, materials or objects within business, domestic, inert, building and demolition wastes
Hazardous waste	Waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles.
Inert waste	Waste that (a) does not undergo any significant physical, chemical or biological transformation after disposal; (b) does not burn, react physically or chemically biodegrade or otherwise adversely affect any other matter or environment with which it may come into contact; and (c) does not impact negatively on the environment, because of its pollutant content and because the toxicity of its leachate is insignificant; and which include: - discarded concrete, bricks, tiles and ceramics - discarded glass - discarded soil, stones and dredging spoil
Recovery	The controlled extraction or retrieval of any substance, material or object from waste to produce a product.
Recycle	A process where waste is reclaimed for further use, which process involves the separation of waste from a waste stream for further use and the processing of that separated material as a product or raw material.
Re-use	To utilise the whole, a portion of or a specific part of any substance, material or object from the waste stream for a similar or different purpose without changing the form or properties of such substance, material or object.
Temporary storage	Continuous storage of waste, excluding a once off storage of waste for a period not exceeding 90 days.

Term	Definition
Treatment	Any method, technique or process that is designed to: change the physical, biological or chemical character or composition of a waste; or remove, separate, concentrate or recover a hazardous to toxic component of a waste; or destroy or reduce the toxicity of a waste, in order to minimise the impact of the waste on the environment prior to further use or disposal.
Waste	(a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to the NEMWAA (Act 26 of 2014: National Environmental Management: Waste Amendment Act, 02 June 2014); or (b) any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette, but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste - (i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered; (ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered; (iii) where the Minister has, in terms of section 74, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or (iv) where the Minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.
Remediation	"Remediation" means the management of a contaminated site to prevent, minimise, or mitigate harm to human health or the environment.
Decommissioning	In relation to waste treatment, waste transfer or waste disposal facilities (only), means the planning for and management and remediation of the closure of a facility that is in operation or that no longer operates.

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1.0 INTRODUCTION AND BACKGROUND

Kelvin Power Station, hereafter referred to as Kelvin Power, is a coal-fired power station, operated by Kelvin Power (Pty) Ltd (Kelvin) and is situated in the City of Ekurhuleni in the Gauteng Province. The site is located west of the Zuurfontein Road and is approximately 5 km north-west of the O.R. Tambo International Airport (Figure 1). The total extent of the plant is 226.18 ha and is located on the farm Zuurfontein 33 IR, in a wider area classified as mixed industrial and residential.

Kelvin Power is an independent power station and does not operate under South Africa's state-owned electricity utility. The power station was constructed and operated by the City of Johannesburg until 2001 when it was privatised.

Kelvin Power has two separate power stations, namely the A-Station and the B-Station. The A-Station was commissioned first and started generating commercial power on 27 March 1957. The technology used in the A-Station has become very outdated and the last unit was placed on extended care and maintenance in November 2012. The newer B-Station is still operational. The associated infrastructure for each of the stations include a common High Voltage Yard (now replaced by the new Sebenza sub-station), a control room and workshop facilities.

A decision was made to decommission and demolish the A-Station, excluding shared infrastructure with the B-Station, making the site available for future industrial redevelopment.

This waste inventory and management plan was drafted as part of the Basic Assessment process and must be read in conjunction with the draft Basic Assessment Report (BAR) and Environmental Management Programme (EMPr), in support of the application for Environmental Authorisation.

2.0 OBJECTIVES

The document provides:

- A preliminary waste inventory for the materials expected to be generated during the decommissioning and demolition of the A-Station Power Plant infrastructure.
- Options for the management of the expected waste streams during the decommissioning and demolition phases.
- A plan for the safe, legal and environmentally sound management of each expected waste stream.

3.0 SITE DESCRIPTION

Kelvin Power is situated adjacent (west) to the Zuurfontein Road (M39) and is approximately 5 km north-west of the O.R. Tambo International Airport (Figure 1|). The total extent of the plant is 226.18 ha and is located on the farm Zuurfontein 33 IR, in an area classified as mixed industrial and residential.

The A-Station infrastructure is located in the northern section of the Kelvin Power site (Figure 2).

The infrastructure associated with the A-Station occupies an area of approximately 13.75 ha and includes the following infrastructure as illustrated in Figure 2:

- A-Station building, including stacks.
- A-Station Cooling towers (3).
- Workshops.
- A-Station coal stockpile.

- A-Station Coal dry-store.
- A-Station Overland Ash Conveyor (removed).
- A-Station Wagon Tipplers.

4.0 PHASES OF THE PROJECT

Kelvin Power intends on approaching the decommissioning and demolition of the A-Station infrastructure in three distinctive phases i.e., decommissioning, demolition and site clean-up.

During the decommissioning phase, usable assets such as machinery and equipment will be identified, dismantled and stored for either reuse at the B-Station or will be sold. It is anticipated that these items will be cleaned and decontaminated before removal from the A-Station site, if required.

Demolition will progress in a controlled manner, as determined by an appointed demolition contractor. Laydown areas, to be demarcated in consultation with the demolition contractor and Environmental Control Officer (ECO), will be utilised for the storage of waste skips, recyclables, inert concrete for crushing, offices and vehicle parking.

Hydrocarbon contamination and soil saturated by wastes or waste which cannot be suitably cleaned by routine high pressure cleaning will be identified visually and isolated for full removal and disposal. Site clean-up will be followed by confirmation through soil sampling and analysis.

5.0 APPROACH

As a result of the decommissioning of the plant, a variety of wastes will be generated. Kelvin Power requires a high-level inventory of these prescriptive plans, in order to responsibly manage these wastes at each phase of the decommissioning and demolition processes, to improve efficiency and reduce costs where possible, while remaining legally compliant.

Waste generation types and volumes will need to be determined and confirmed at a high level of accuracy after the appointment of the demolition contractor and as decommissioning and demolition progresses, and the waste inventory must be updated accordingly on a continuous basis.

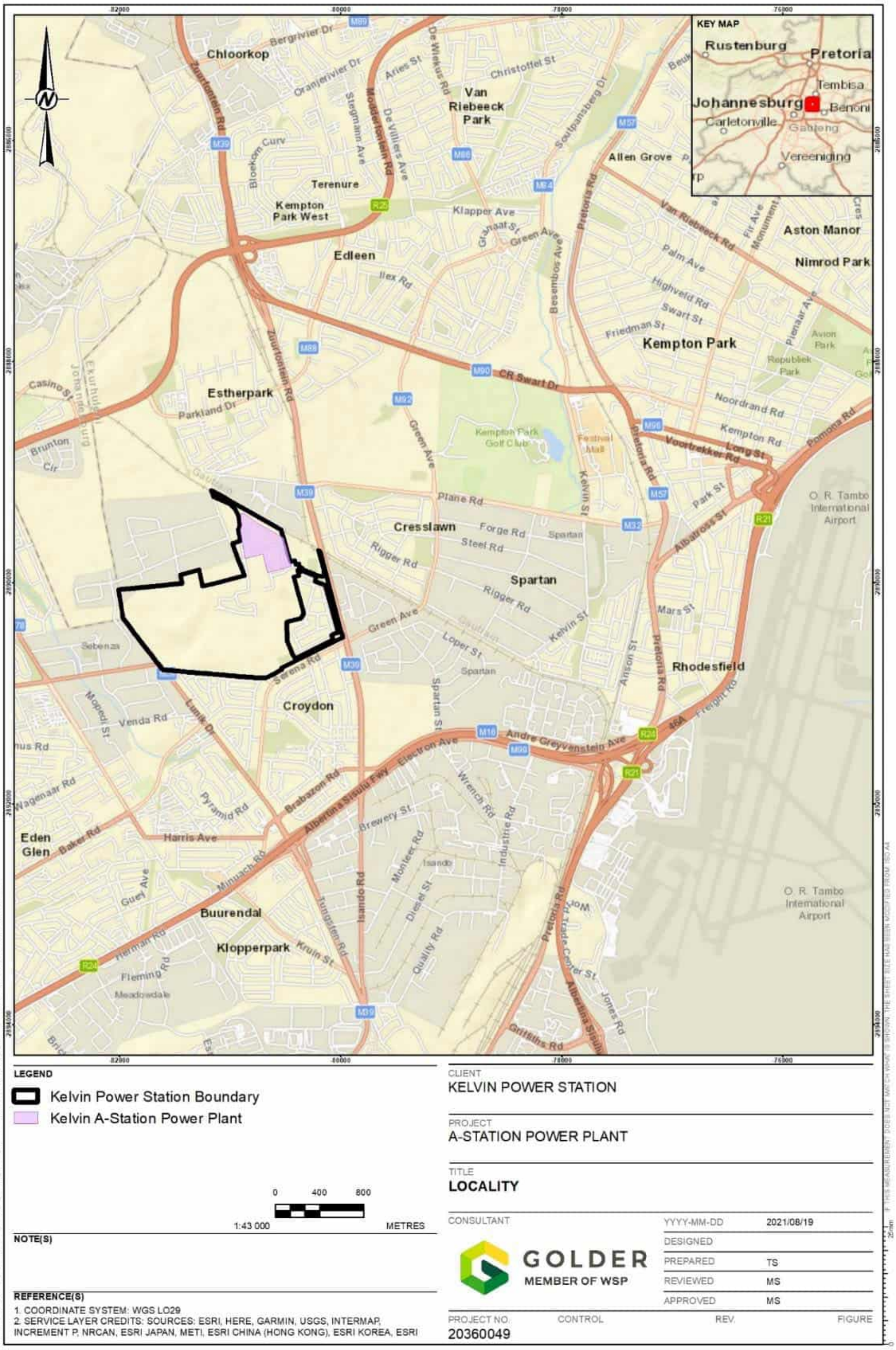

Figure 1 : Regional locality of the Kelvin Power Station and A-Station project area.

Figure 2 : Locality of the A-Station within the Kelvin Power site

6.0 LEGAL REQUIREMENTS

The purpose of this section is to focus on key legal requirements in respect of this Waste Inventory and Management Plan.

6.1 National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA) (as amended)

The National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA), as amended, commenced on 01 July 2009 and the previous procedures for the permitting of waste sites in terms of Section 20 of the Environment Conservation Act, 1989 (Act 73 of 1989) were replaced by various provisions in the NEMWA.

The NEMWA reforms the law regulating waste management in order to protect health and the environment. It provides measures for the prevention of pollution and ecological degradation.

In terms of this Act, all listed waste management activities must be licensed and the licensing procedure must be integrated with an environmental impact assessment process. Activities which trigger thresholds for licensing are listed in GN R. 921, which replaced GN R. 718, on 29 November 2013 (as amended). These activities are divided into Category A (activities requiring a Basic Assessment), Category B (activities requiring a full Scoping and Environmental Impact Reporting (S&EIR)) and Category C (activities requiring registration and adherence to specific standards). The BA and full S&EIR processes to be followed are prescribed in the Environmental Impact Assessment (EIA) Regulations, 2014, published under GN R. 982 in December 2014 (as amended).

The licensing authority for activities involving hazardous waste is the national Department of Forestry, Fisheries and the Environment (DFFE). For non-hazardous wastes, the relevant provincial environmental authority, which is the Gauteng Department of Agriculture and Rural Development (GDARD), is the competent authority.

The prosed demolition and decommissioning of the A-Station Power Plant infrastructure does not require an application for a Waste Management Licence (WML).

6.2 National Waste Information Regulations (GN R. 625 of 13 August 2012)

The National Waste Information Regulations (GN R. 625 of August 2012) (NWIR) regulate the collection of data and information to fulfil the objectives of the South African Waste Information System (SAWIS) as set out in section 61 of the NEMWA. NWIR applies to anyone conducting an activity listed under Annexure 1 of these regulations, of which Kelvin Power is deemed to have conducted the following:

a) Generators of hazardous waste in excess of 20 kg per day; and

b) Treatment of waste using any form of treatment at a facility that has a capacity to process in excess of 10 tons of general waste or 500 kg of hazardous waste per day, excluding effluent, wastewater or sewerage.

Kelvin Power is registered on the SAWIS system; any new waste arising from the decommissioning of the site will also be reported to the SAWIS. The waste types for reporting are coded according to Annexure 3 (for general) and Annexure 4 (for hazardous wastes) of these regulations.

The expected waste streams from the decommissioning of the A-Station infrastructure have been listed in Section 8.0 of this report and SAWIS codes for each waste are included.

6.3 Waste Classification and Management Regulations (GN R. 634 of 23 August 2013)

The Waste Classification and Management Regulations (WCMRs) were promulgated in August 2013 (GN R.634 of 2013) and replace the role of the Minimum Requirements (second edition 1998).

These Regulations stipulate that "*all generators of waste must ensure that the waste is classified in terms of SANS 10234 (latest edition of the South African National Standard Globally Harmonized System of Classification and Labelling of Chemicals (GHS)) within 180 days of generation".* Furthermore, the Regulations also require accurate accounting records of volumes of waste generated as well as volumes managed at waste management facilities. The regulations provide that waste generators must keep accurate and up to date records of the management of waste they generate which records must reflect:

- The classification of wastes;
- Quantity of each type of waste generated expressed in tons per month; and
- The quantities of each type of waste that has either been re-used, recycled, recovered, treated or disposed of.

The WCMRs also regulate the classification and management of waste, establishes a mechanism for listing activities and prescribes requirements for disposal, timeframes and duties specific to outcomes.

According to Regulation 5, generators of hazardous waste must prepare a Safety Data Sheet (SDS) for each hazardous waste stream in accordance with SANS 10234, unless the waste is pre-classified in the WCMR's. Hazardous wastes that are pre-classified in the WCMR's require a SDS for the product which the waste originates from. This SDS usually accompanies the product. SDSs are regulated by the Occupational Health and Safety Act, 1993 (Act 85 of 1993) (OHSA).

Waste may not be diluted solely to reduce the concentration of hazardous substances. Any waste storage container or impoundment must be labelled. Waste may only be stored for a maximum of 18 months and records must be kept.

According to the Regulations, waste treatment should not be undertaken if it:

- Reduces the potential for reuse, recycling or recovery; and
- Is not controlled or does not result in a permanent solution.

Pre-classified hazardous wastes as per Chapter 7, Annexure 1, part 2(b) are as follows:

- Asbestos waste;
- PCB or PCB containing waste (>50 ppm);
- Expired, Spoilt or Unusable hazardous products;
- General waste, excluding domestic waste, which contains hazardous wastes or chemicals;
- Mixed hazardous chemical wastes from laboratories; and
- Health Care Risk Waste (HCRW).

Record Keeping

Waste generators must keep accurate and up to date records of the management of the waste they generate, which records must reflect:

- The classification of the wastes;
- The quantity of each waste generated, expressed in tons or cubic meters per month;
- The quantities of each waste that has either been re-used, recycled, recovered, treated or disposed of; and
- By whom the waste was managed, disposed or transported.

These records must be:

- Retained for a period of at least five (5) years; and
- Made available to the Department upon request.

Waste Manifest System requirements

Every holder of waste that has been classified as hazardous in terms of Regulation 4(2) or a waste that is listed in item (2)(b) of Annexure 1 to these Regulations, must be in possession of a waste manifest document containing the relevant information specified in Annexure 2 to these Regulations. The following information from the waste generator must be reflected in a waste manifest document:

i) Unique consignment identification number;

ii) If applicable, the SAWIS Registration number in terms of the NWIR, 2012;

iii) Generator's contact details (contact person, physical & postal address, phone, fax, email);

iv) Physical address of the site where the waste was generated (if different from (iii));

v) Contact number in case of an incident or after hours;

vi) Origin / source of the waste (process or activity);

vii) Classification of the waste and Safety Data Sheet;

viii) Quantity of waste by volume (m3) or weight (tons);

ix) Date of collection / dispatch;

x) Intended receiver (waste manager); and

xi) Declaration (content of the consignment is fully and accurately described, classified, packed, marked and labelled, and in all respects in proper condition for transportation in accordance with the applicable laws and regulations).

The waste transporter must supply the following information:

i) Name of transporter;

ii) Address and telephone number of transporter; and

iii) Declaration acknowledging receipt of the waste.

6.4 SANS 10234 – Globally Harmonised System

The SANS 10234 (2008): Globally Harmonised System of Classification and Labelling of Chemicals (GHS) sets out a standard to which Kelvin Power must adhere for wastes which must be classified and accordingly labelled. The GHS covers all hazardous chemicals.

SANS 10234 is the South African Standard, based on the Globally Harmonised System, thus material categories are listed in the GHS for use by SANS 10234.The GHS codes for Physical, Health and Environmental hazards of each waste material have been listed in the Waste Inventory. The wastes should be labelled with these codes.

6.5 National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R. 635 of 2013)

These Norms and Standards prescribe the requirements for the assessment of waste prior to disposal to landfill. It requires the identification of chemical substances present in the waste, through the analysis of Total Concentrations (TC) and Leachable Concentrations (LC). The specific type of waste for disposal to landfill must be determined by comparing the TC and LC of the elements and chemical substances in the waste with the limits (TCT & LCT) specified in Section 6 of the Norms and Standards. There are threshold levels 0, 1, 2 & 3; where 0 means that the element/chemical is at concentrations as low as or lower than the base line or detectable levels. Level 1 is derived from the lowest value in standards for soil and water that does not affect human health. Levels 2 and 3 are multiples of level 1.

Based on the TCT and LCT limits from Section 6; the type of waste is determined in Section 7 as follows:

Type 0: LC > LCT3 or TC >TCT2

Type 1: LCT2 <LC < LCT3 or TCT1 < TC < TCT2

Type 2: LCT1 <LC < LCT2 and TC ≤ TCT1

Type 3: LCT0 <LC < LCT1 and TC ≤ TCT1

Type 4: LC ≤ LCT0 and TC ≤ TCT0

This does not apply to waste streams which have been pre-classified in the WCMRs, however wastes which do require assessment, must be analysed within 3 years from the commencement of this act, i.e. 2016.

Section 12 of the WCMRs indicate that all wastes that have been classified in terms of the Minimum Requirements must be re-classified in terms of the new regulations within three years from the date of commencement of the Regulations (August 2016).

In the context of the Kelvin Power plant being decommissioned, the following waste streams will need to be assessed prior to transport and disposal off-site:

- Boiler Ash (if any remainder is found on site);
- Coal veneer;
- Dried sludge at the base of the cooling towers;
- Residue around the valves at the cooling towers; and
- Contaminated soil.

6.6 National Norms and Standards for Disposal of Waste to Landfill (GN R. 636 of 2013)

These Norms and Standards determine the requirements for the disposal of waste to landfill. It gives a new landfill classification with associated containment barrier design requirements, as replacement for the Minimum Requirements (2nd Edition, 1998, DWAF).

Section 3 describes the new classes of landfill from A – D, with Class A having the most stringent barrier system and Class D having the least stringent barrier. Section 4 of these Norms and Standards then links these landfill classes to the waste types as set out in GN R. 635. Waste types are linked to landfill classes as follows:

Table 1: Waste Type Disposal Criteria

Waste Type	Landfill Disposal Requirements
Type 0	Disposal to landfill is NOT allowed. This waste must be treated and re-assessed.
Type 1	May only be disposed to a Class A landfill. This is equivalent to the h:H and H:H from the Minimum Requirements
Type 2	May only be disposed to a Class B landfill. Similar to a G:L:B+ from the Minimum Requirements.
Type 3	May only be disposed to a Class C landfill. This is also similar to a G:L:B+
Type 4	May only be disposed to a Class D landfill. Similar to a G:L:B- from the Minimum Requirements

6.7 City of Ekurhuleni Metropolitan Municipality Integrated Waste Management By-Laws

The purpose of the City of Ekurhuleni Metropolitan Municipality integrated waste management by-laws, dated 25 March 2021, is to provide for integrated waste management and matters incidental thereto; to give effect to the environmental right in section 24 of the Constitution, by regulating the collection, storage, disposal, and other waste management activities within the jurisdictional area of City of Ekurhuleni; to provide, in conjunction with any other applicable law, an effective legal and administrative framework, within which the Municipality can manage and regulate waste management activities; to ensure that waste is avoided, or otherwise minimised, reused, recycled, and recovered, and that the remainder thereof is treated and disposed of in an environmental sound manner; to promote and ensure an effective delivery of waste service; and to ensure universal access to the municipal waste services.

Section 16 states that every person who is a generator or holder of waste must:

(1) investigate, assess, and evaluate the impact that their activities, the process, or a situation have on the environment;

(2) inform and educate employees about the environmental risks of their work and the way their tasks must be performed to avoid causing damage to the environment;

(3) cease, modify or control any act, process, situation or activity which causes damage to the environment;

(4) contain or prevent the movement of pollutants or other causes of damage to the environment;

(5) eliminate or mitigate any source of damage to the environment, or the effects of the damage to the environment

Section 17 requires any person conducting an activity listed in annexure 1 of the National Waste Information Regulations 2012 shall conform with the National Waste Information Regulation.

Section 18 requires any person responsible for the disposal of waste must comply with the Waste Classification Management Regulations of 2013.

Section 38, dealing with collection and disposal of hazardous or health-care risk waste, states that:

(1) Only an accredited service provider may transport hazardous and health-care risk waste, and must do so in accordance with the conditions of an accreditation permit issued to him or her under Chapter 11, as well as the requirements of any relevant SANS codes in respect of the type of vehicle, the markings and manner of construction of such vehicle, procedures for safety and cleanliness, and documentation relating to the source, transportation, and disposal of such waste, and subject to the requirements of any other legislation.
(2) A person accredited to collect and dispose of hazardous or health-care risk waste, must inform the Municipality at intervals stipulated in the accreditation permit issued in terms of this By-Law, of each removal of hazardous or health-care risk waste, the date of such removal, the quantity of the waste removed, the composition of the waste removed, and the waste disposal facility at which the waste has been disposed of.
(3) Any person carrying on an activity which generates hazardous or health-care risk waste must ensure that such waste is disposed of or treated at an appropriately- licensed waste disposal facility or waste treatment facility. If such facility is a waste incineration facility, then further steps shall be taken to ensure that such facility has the requisite licence in terms of the National Environmental Management: Air Quality Act 39 of 2004.
(4) The Municipality may, by notice in writing, instruct a waste generator who generates special hazardous waste or health care waste to remove the waste, or cause the waste to be removed by an accredited or licensed provider, either to a waste disposal site or to an incinerator.

Section 47, dealing with transportation of waste, states that:

(1) No person may:

(a) transport waste within the area of jurisdiction of the Municipality, unless he or she is accredited in terms of Chapter 11 of this By-Law, excluding the transportation of domestic waste by the owner or occupier for the purposes of placing the waste in approved waste receptacles for goods to be recycled, or at approved the mini disposal sites;

(b) operate a vehicle for the conveyance of waste upon a public road, unless the vehicle has a body of an adequate size and construction for the type of waste being transported;

(c) fail to maintain a vehicle used for the conveyance of waste in a clean, sanitary, and roadworthy condition at all times;

(d) fail to cover loose waste on an open vehicle with a tarpaulin or suitable net;

(e) cause or permit any waste being transported in or through the Municipality's jurisdiction to become detached, or to leak or fall from a vehicle transporting it, except at a waste disposal facility;

(f) transport waste in a manner that would cause nuisance or environmental pollution.

(2) Subject to the provisions of subsection (1), all transportation of waste must comply with the National Road Traffic Act 93 of 1996.

(3) Any person engaged in the transportation of waste shall take all reasonable measures to prevent any spillage of waste or littering from a vehicle used to transport waste, and where waste is spilled, immediately clean-up the spilled waste.

Section 48, dealing with the disposal of waste, states that waste within the jurisdictional area of the Municipality, including recycled or treated matter, may only be disposed of by an accredited service provider, at a waste disposal facility licensed or permitted to accept such waste.

7.0 DOCUMENTATION REVIEW

The following documentation were consulted during the preparation of this Waste Inventory and Management Plan.

7.1 Asbestos Maintenance Register

Kelvin Power has compiled an asbestos maintenance register to identify areas where exposed asbestos could be found at the site (Kelvin Power, 2021). The register states the discovery date, location (A-Station or B-Station), floor, description of area, condition of asbestos, safety measures currently in place at asbestos exposed area, date of repair, details of repair, responsible persons. The asbestos maintenance register is not an asbestos survey or a complete asbestos register.

The asbestos maintenance register is not an in-depth inspection of all lagging and cladding materials at the Kelvin Power areas. The demolition of the A-Station infrastructure will require approved asbestos contractors to handle the asbestos material and full compliance with the Asbestos Regulations will be required for the handling, storage, transport and disposal of asbestos containing waste. A-Station infrastructure slated for demolition will need to be given special consideration for removal of asbestos ahead of demolition.

A more advanced asbestos survey will be required for buildings and infrastructure that will undergo dismantling or demolition to provide an analysis of percentage Chrysotile content and assessment of total amount, binding and risk category for each event of detected asbestos. Locations of asbestos containing materials need to be clearly marked and indicated on a location plan prior to demolition. The removal of asbestos requires special procedures for all types of asbestos which need to be elaborated by the asbestos removal specialist to conform to International Standards and may impact the demolition schedule.

Kelvin Power needs to maintain an Asbestos Register to ensure that all identified asbestos-containing materials are recorded, and disposal is tracked.

7.2 Kelvin Power Closure Costing

Kelvin Power regularly updates its restoration and decommissioning costs for the scenarios related to the “Realistic case” and the “Lower case”.

The realistic case involves complete site demolition/dismantling/rehabilitation with disturbed footprints rehabilitated for the next land use, that would most likely not be power generation. The lower-case entails that the next land use is most likely again power generation, with sell-off and transfer of the existing infrastructure at the end of operations (Golder, 2021).

The decommissioning and restoration (closure) costs in terms of the above two scenarios are required to inform corporate financial reporting and planning but also provided valuable insight to the estimated quantities of demolition waste that could be generated during the demolition of the A-Station infrastructure and was used in the preparation of this Waste Inventory and Management Plan.

7.3 Contaminated Land Assessment

A contaminated land assessment (CLA) (Golder , 2022) was conducted in support of the environmental authorisation process for the decommissioning and demolition of the A-Station Power Plant.

The objective of the CLA is to develop the scope of work for the assessment of contaminated land and infrastructure to be undertaken during the demolition phase as footprints becomes available.

In addition, the report also provides guidance on clean-up actions that should be undertaken during the demolition phase and provides valuable information on waste types that could be generated as a result of the decommissioning and demolition activities.

7.4 Waste Classification and Assessment

A waste classification and assessment, in line with provisions of the Waste Act (Act 59 of 2008) and Waste Classification and Management Regulations (GN R.634 of 2013) of the following waste streams from the Kelvin Power operations were conducted in 2018 (Golder, 2018):

- Fly ash;
- Ash Dam A;
- Ash Dam B;
- Mix fugitive waste (coal and ash mix);
- De-silting dams; and
- Ash water return dam (RWD).

The analytical data indicated that all these waste streams, except the RWD which is not applicable to the current project, are general (non-hazardous) waste.

The waste assessment showed that all waste material sampled across the above mentioned facilities are classified as Type 3 waste (TC ≤ TCT1 and LC ≥ LCT0 but ≤ LCT1) and will require disposal at a facility with Class C barrier or G:L:B+ facility according to the Minimum Requirements.

8.0 WASTE INVENTORY

Table 2 below provides a high-level waste inventory of the predicted waste streams from all phases of the project.

Table 2: Preliminary Waste Inventory

Waste Type	Source	Assumptions	Phase	GHS		
				Physical Hazards	Health Hazards	Envi Haz
General Waste						
General Waste	Domestic waste will be produced by the on-site contractors during the project. This waste will be collected in waste bins provided by the demolition contractor.	1kg of domestic waste per person per week.	Decommissioning, demolition, remediation	H242, H272		H40
Plastic						
Cardboard						
Wastepaper						
Garden refuse	Kikuyu grass and alien species growing on-site will be removed during site remediation.		Demolition and remediation	H242		
Weeds and invasive plants						
Concrete rubble	Demolition of buildings, this waste will be stored on the concrete foundations of each building before removal or in a designated storage area.	Decontaminated before demolition. Volumes calculated from high level quantities in the Closure Costing Report.	Demolition			
Building structural steel						
Building cladding						
Scrap metal	During the dismantling of the infrastructure, certain metal parts and fittings will become damaged to a point where they cannot be sold for reuse.		Demolition			
Steel piping	During the dismantling of the infrastructure, certain metal pipes will		Demolition			

Waste Type	Source	Assumptions	Phase	GHS		
				Physical Hazards	Health Hazards	Envi Haz
	become damaged to a point where they cannot be sold for reuse.					
Conveyor belt	Some conveyor belts or pieces thereof could be found during demolition.			H242		
Dust suppression chemical (Dust-a-Side) spillage	At dust suppression chemical storage tanks.		Decommissioning			
Hazardous Waste						
Transformer oils (PCBs > 50 mg/kg)	Draining oil from transformers before sell-off.	Average of 100l oil per transformer	Decommissioning	H226, H272	H301, H320, H332	H40
Use oils and greases	From storage areas of new and used oils and chemicals.	It is assumed that a small volume (2 or 3 drums) may be recovered	Decommissioning	H226, H272	H301, H320, H332	H40
Boiler Ash	Removed during the clean out and decontamination of boilers and associated infrastructure.	Assumed hazardous. To be sampled and analysed. If not hazardous, to be handled as general waste.	Decommissioning		H305, H320, H333	H40
Fluorescent tubes	From the dismantling of lighting fittings while gutting buildings for sell-off.	All fluorescent tubes / bulbs will become waste.	Decommissioning		H301, H304, H317, H340, H370, H351	H41
Contaminated soil	Soil contamination hotspots have been identified, in the Contaminated Land Assessment	Test work to be conducted in accordance with the recommendations of the CLA (Golder , 2022).	Site clean-up			

Waste Type	Source	Assumptions	Phase	GHS		
				Physical Hazards	Health Hazards	Envi Haz
	(Golder, 2021) where					
Coal residual / veneer	Areas identified in the CLA (Golder , 2022)			H228	H320, H333	H40
Asbestos waste	Further asbestos survey required prior to demolition.	Asbestos should be removed ahead of demolition by a registered asbestos contractor.	Demolition		H301, H313, H318, H331, H350	
Medical waste	Generated by ad-hoc treatment of minor injuries on-site at first-aid station First aid box will be kept.	Worst case: 100g/person/month.	Decommissioning, demolition, site clean-up		H302, H312	H40
Substation and transformer ballasts	Substation / transformers located along eastern side of the A-Station building (Golder , 2022)	Low volumes are expected.	Demolition			
Redundant chemical containers (caustic and phosphates)	Area outside the Projects and Planning office.	Low volumes are expected.	Decommissioning	H290	H301, H312, H318, H332, H371	H40
Dried sludge	At the bases of the cooling towers	Assumed to hazardous until analysed and assessed.	Demolition			
Residue around valves of the cooling towers.	Valves of the cooling towers.	There is a thick layer of residue around the valve boxes of the cooling towers. Its characteristics is unknown.	Decommissioning			
Hydrocarbon contaminated gravel/soil.	Mechanical workshop (Golder , 2022).					
eWaste						

Waste Type	Source	Assumptions	Phase	GHS		
				Physical Hazards	Health Hazards	Envi Haz
Electrical parts	Wiring, switches and electrical fittings from redundant buildings.	Wiring can be separated from fittings and sold. Fittings can be sold or disposed as scrap to recyclers.	Decommissioning / demolition			
Hazardous Components of eWaste	Hazardous components of broken or damaged eWaste generated during sell-off	Any e-Waste which has Hazardous components is classified as Hazardous until it is separated from those components.	Decommissioning / demolition	H204, H241	H301, H312, H318, H332, H371	H40
General Components of eWaste	Non-hazardous components of broken or damaged eWaste generated during sell-off	Ratio of safe to Hazardous components is 10:1	Sell-Off		H313	
Effluent						
Domestic wastewater	Existing ablution facilities on the site used by employees and contractors will generate greywater and blackwater	The existing ablution facilities will not be demolished. Portable ablution facilities to be used if additional capacity is required.	All		H303	H40

9.0 WASTE MANAGEMENT FACILITIES

9.1 Disposal Sites

9.1.1 Simmer and Jack

The Simmer and Jack Waste Disposal Site (Simmer and Jack) G: L: B^- belonging to the City of Johannesburg has been permitted in terms of the of the ECA in March 1996 (B33/2/0322/494/P223).

Simmer and Jack, or any other appropriately licensed facility, may be used for the disposal of all waste types, excluding those listed in Annexure 1 of the Waste Management Licence and excluding those where specific control has been established in terms of the Nuclear Energy Act, 1996 (Act 131 of 1993).

Simmer and Jack is the closest general waste disposal facility and is 15.3 km from Kelvin Power.

9.1.2 Holfontein

Holfontein is a Class A (hazardous) disposal facility, belonging to EnviroServ. This facility is at a distance of 45.3km from Kelvin Power.

Holfontein received an amended permit in terms of the NEMWA in March 2010, with reference number 16/2/7/C212/Y121/P3. This permit allows EnviroServ to treat and dispose of any hazardous wastes up to Level 1 (Excluding level 0 and any radioactive wastes).

10.0 WASTE MANAGEMENT OPTIONS

This section of the report provides waste management options for the wastes listed in the inventory in Section 8.0.

10.1 Hazardous Sludge or Residue

The sludge and residues are assumed to be hazardous, pending an assessment in terms of GN R. 635. Kelvin Power has the following option available for the management of this waste:

- Disposal of non-inerted sludge or residue may take place at Holfontein Class A landfill. A licensed hazardous waste transporter must be used, and safe disposal certificates must be retained.

10.2 General Waste and Garden Refuse

It is expected that 1kg per week of general waste could be generated per person on-site for the purpose of dismantling and removing the A-Station infrastructure. This waste is expected to contain many recyclables such as plastic, paper and cardboard.

Garden waste from the clearing of the kikuyu grass and alien invasive species is expected. Some of these plants will be category 1, 2 and 3 invasives, mostly occurring in the open areas of the site. These plants propagate easily and thus cannot be left on open ground.

General waste should be collected in the existing waste separation bins on site and managed by the existing waste management contractor until there is no more waste being generated on-site.

Alternatively, Kelvin Power may outsource general waste management to the on-site contractors who will be dismantling, demolishing or remediating the site. This should then form part of the written contract with this service provider in order to ensure compliance.

In order to prevent the propagation of alien invasive plants, Kelvin Power should ensure that the removed plant matter is contained or destroyed appropriately. The plant material may be dried and burned in a furnace, or could be turned into mulch and composted at a registered composting facility. Kelvin Power should hire a well-established garden waste contractor to ensure the safe management of this waste.

10.3 E-Waste

During the dismantling of the plant, numerous electronic and electrical devices will be removed from the site. Electronic items are those which contain circuit boards, resistors and capacitors, while electricals are mostly associated with wiring and fittings such as plugs and lights. eWaste can be separated into hazardous and non-hazardous components. These components are integrated into the same equipment, until separated by an eWaste management company. The volume of eWaste has not yet been quantified. Some of the devices constituting eWaste at the A-Station could include:

- Switchboards and distribution boards;
- Electrical control room installations;
- Electrical cabling; and
- Fittings, such as light fittings.

The following options are available for the management of eWaste:

- **Recycling:** Kelvin Power should send all eWaste to an eWaste recycling company in order to recover any value out of it where possible. The recycling company will be able to extract valuable materials, separate the hazardous from non-hazardous components for separate disposal and reduce the cost to Kelvin Power for the management of this waste.
- **Disposal:** Without the services of an eWaste management company, Kelvin Power will have to dispose of all eWaste as hazardous, due to the hazardous components found in it. Holfontein would be the closest option.

10.4 Fluorescent tubes

Fluorescent tubes will arise from the dismantling of the light fittings in the buildings which are to be demolished. While these may still be working at the time of dismantling, it is anticipated that most of the lighting tubes will be damaged or broken in the dismantling process.

Waste fluorescent tubes are crushed and stored in 200 litre drums, and it has been assumed that roughly 100 tubes can be stored in each drum; therefore, it is estimated that Kelvin Power will produce 5 - 10 drums of crushed fluorescent tubes as a result of decommissioning.

The fluorescent tubes must be handled with care before being crushed and placed in sealed drums, to avoid breaking the tubes, as this will expose workers to glass shards and harmful fumes. Fluorescent tubes will be managed as follows:

- **Storage**: The tubes should be taken to a designated storage area on site, where the tubes are crushed into a sealed drum, using a specialised fluorescent tube crusher. Drums should be sealed when full and properly labelled with SDS.
- **Disposal**: The tubes should be transported by a hazardous waste contractor to Holfontein, where it will be treated and disposed.

10.5 Conveyor belts

During the dismantling of the plant, there could be conveyor belting that is old, broken and damaged. These conveyor belts are predominantly made out of rubber. The following options are available for the management of conveyor belts:

- **Treatment:** Kelvin Power should ensure that these rubber products are decontaminated, so that they do not have to be disposed of as hazardous waste;
- **Reuse:** Kelvin Power should send as much of this waste back to a conveyor belt manufacturer for reuse in the manufacture of new conveyor belts. Furthermore, the demolition contractor should reuse some of the conveyor belts to cover roads / paving to prevent damage;
- **Recycling** of rubber products is possible, depending on the type, quantity and agreement with a local rubber recycling company. Kelvin Power should seek a rubber recycler to collect, transport and recycle the rubber conveyor belts that are not taken back by a conveyor belt manufacturer; and
- **Disposal** can be done at a general landfill such as Simmer and Jack landfill site, provided that decontamination has been thoroughly completed.

10.6 Chemicals

The chemicals that have been during the contaminated land assessment include: caustic and phosphates. While these chemicals are no longer used at the A-Station, there may still be spent chemicals which have not yet been removed from the site. The chemical containers must be managed as follows:

- Disposal: All containers of chemicals should be properly labelled with SDS. Spent chemicals and the associated containers should be safely managed as hazardous wastes. A licensed hazardous waste management contractor should be appointed for the collection, transport and treatment/disposal of such wastes.

10.7 Used Oil and Grease

Used oil and grease will be managed as follows:

- **Recycling:** to be collected by a ROSE Foundation licensed collector and delivered to a licensed processor to ensure proper recycling.
- **Disposal:** to be disposed to Holfontein.

10.8 Transformer Oil and Contaminated Materials

The transformers at the A-Station site contain old transformer oil, some of which could contain more than 50mg/kg of polychlorinated biphenyls (PCBs). Each transformer is estimated to hold an average of 100 litres of cooling oil. Since these oils could have been diluted to a point where PCB is below 50mg/kg during oil replacement, the oil will be managed as used oil (Section 10.7) if possible. Should this oil not be acceptable for recycling, it will be disposed at Holfontein.

10.9 Structural steel and cladding

Owing to the very large demand for recycled construction materials in South Africa almost 100% recycling of structural steel and cladding is expected, through resale to contractors. Recovery of structural steel to steel fabricators is expected to be high, if not 100%, with residuals being transferred after purchase to steel mills for recycling. Miscellaneous steel may be sold directly to steel mills.

10.10 Demolished Concrete

Concrete rubble and separated reinforcement steel will be generated from removed internals of retained buildings and from demolished buildings, including the cooling towers. Crushing and steel separation will occur on site. Approximately 25 tons of concrete and brick rubble is expected to be recycled as inert fill on site to level the substantial amount of excavation associated with below surface infrastructure. The residual material is generally acceptable as landfill cover material. Steel may be sold to mills for recycling.

10.11 Demolition Waste

The demolition waste will consist mainly of concrete rubble.

Demolition waste has been newly redefined in Schedule 3 of the National Environmental Management Waste Amendment Act, 2014 (Act 26 of 2014) (NEMWAA). These definitions are as follows:

Hazardous Construction Wastes include:

- Wastes from bituminous mixtures, coal tar and tarred products
- Discarded metals
- Waste soil, stones and dredging spoil
- Wastes from insulation materials and asbestos containing construction materials
- Wastes from gypsum-based construction material
- Wastes from other construction and demolition

Building & demolition waste means non-hazardous construction wastes, which includes:

- Discarded concrete, bricks, tiles and ceramics
- Discarded wood, glass and plastic
- Discarded metals
- Discarded soil, stones and dredging spoil
- Other discarded building and demolition wastes

Inert waste, means waste that:

- Does not undergo any significant physical, chemical or biological transformation after disposal,
- Does not burn, react physically or chemically biodegrade or otherwise adversely affect any other matter or environment with which it may come into contact, and
- Does not impact negatively on the environment, because of its pollutant content and because the toxicity of its leachate is insignificant.

Inert Wastes include:

- Discarded concrete, bricks, tiles and ceramics
- Discarded glass
- Discarded soil, stones and dredging spoil

It is expected that all concrete rubble will fall within the inert waste definition. During the demolition of buildings and structures, the rubble and scrap steel will be stored on the concrete foundations of the buildings before it is removed for use or disposal.

According to GN R. 921 Category A, number 9; a WML is required for: The disposal of inert waste to land in excess of 25 tons but less than 25 000 tons, excluding the disposal of such waste for the purpose of levelling and building which has been authorised by or under other legislation.

By decontaminating the buildings before they are demolished, Kelvin Power will produce less hazardous construction waste, and more inert wastes. Inert building rubble from the demolition phase will be used for infilling purposes as part of remediation. Less than 25 tons must be used over the entire site, otherwise a WML may be required, pending further discussion with the DFFE. Any excess inert building rubble should be disposed to the Simmer and Jack landfill for use as cover / capping material.

10.12 Asbestos

Asbestos should be removed ahead of demolition by a registered asbestos contractor. During the removal of cement which contains asbestos, duty of care and safety of all workers in the vicinity of the asbestos should be ensured by the registered contractor.

The asbestos waste should be stored in sealed and labelled containers to avoid human contact. Any exposed asbestos should be kept wet to avoid the dispersion of particles. It should then be disposed in the sealed containers in a properly licensed Class A landfill, such as Holfontein.

10.13 Scrap metal

Scrap metal will consist of structural steel and cladding from building demolition, and residual scrap metal and piping from the dismantling of the infrastructure. Electrical cabling and wiring and metal casings, brackets and cable trays associated with electrical wiring installation can be included. Piping is assumed to be either completely above ground or accessible for complete removal with feasible excavation. Scrap metal could include:

- Building cladding;
- Structural steel beams;
- Steel framing and miscellaneous fabricated steel components, e.g., brackets or cable trays;
- Reinforcing bars from reinforced concrete;
- Steel pipes from around the site;
- Electrical cable and wiring and associated metal casings, brackets and cable trays; and
- Damaged machinery or fittings which cannot be reused.

Management options include:

- **Treatment:** Some of these items may be contaminated and will require pressure cleaning. In some cases, such as with steel piping, it will not be possible to fully decontaminate the material.
- **Recycling**: Scrap steel which is contaminated may still be recycled in a steel mill as the contamination will be removed in the various stages of the steel mill process. Kelvin Power should make any prospective scrap steel buyer aware of the potential contamination so as to fulfil Kelvin Power's duty of care. Electrical cable and wiring should be recycled with an experienced recycler who will manage the insulation component where metal is separated in the recycling process. The recycler may make the process more sustainable if there is potential for reuse of some of the material.

It is envisaged that all steel will be sold as scrap, despite contamination, due to its intrinsic value and the ability of steel mills to manage the contamination. However, if contaminated scrap steel is not sold off as scrap, it should be disposed as hazardous waste, due to the potential contamination and the precautionary principle.

10.14 Contaminated Soils

Potential Soil contamination hotspots have been identified in the Golder Contaminated Land Assessment (Golder , 2022) where exposed soil is found within the A-Station project site.

Contaminated soils will be managed during the remediation phase. This soil will contain coal and other process residues, as well as small amounts of hydrocarbon contamination. Management options include:

- **In Situ Remediation**: in cases where the contaminated soil is found to be of low concentrations of contaminants, it may be feasible to remediate the soil in situ using an appropriate method of bioremediation.
- **Disposal:** Removed from site and disposal at an appropriately licensed hazardous disposal facility:
    - **Holfontein**, without remediation.

10.15 Coal Residual

Coal was used on site as the main raw material for electricity generation. Coal residual may be disposed at either the Simmer and Jack or Holfontein landfill sites, pending the outcome of the waste assessment.

10.16 Domestic Wastewater

Due to the presence of staff and labourers during each phase of the decommissioning, Kelvin Power will be required to provide ablution facilities. Any existing ablution facility which is not going to be demolished can be utilised for this purpose. The water from these existing facilities will be sent through existing sewage pipes to the municipal sewage treatment works. Alternatively, portable toilet facilities should be provided.

10.17 Medical Waste

Medical waste will be generated on an ad hoc basis by first aid services on-site for staff and demolition workers. Kelvin Power will ensure that this waste is stored in sealed containers and is removed from the site by a medical waste contractor. A waste manifest document must be retained for this waste.

11.0 ON-SITE SUPPORT FACILITY REQUIREMENTS

Requirements have been identified in each of three phases for on-site storage and handling.

11.1 Decommissioning phase

Ahead of demolition during the sell-off phase, Kelvin Power will complete collection and removal of the loose materials, the options for final destination of which have been elaborated in previous sections of this report. These materials are effectively residual operational wastes and include the following:

- Coal and coal ash.
- Residual domestic waste from operations.
- Redundant chemical containers.
- Scrap waste (equipment).
- eWaste and fluorescent tubes (removed from buildings to be demolished).
- Wood and garden waste.
- Conveyor belt and other rubber.
- Transformer oil (requiring removal from transformers ahead of transport).

All of the above residual operational wastes will be managed in accordance with their characteristics, whether non-hazardous or hazardous.

The decommissioning phase will entail removal of the following from the entire site outside of building footprints and within building footprints slated for demolition:

- Electricity generation equipment.
- Piping and fittings of all dimensions and materials.
- Electrical wiring, cabling, fittings, cable trays, control panels.

Mechanical equipment, piping and electrical materials removed for resale will be sorted and packaged within the building footprint for transport. Teams of personnel and subcontractors will address the wastes and materials for removal individually with wastes and materials collected and packaged at each building. Collection from transport will be from the buildings.

11.2 Asbestos

The current asbestos maintenance register does not provide sufficient input for demolition planning. Further surveys will define the specific quantities, types and risk levels of asbestos present in each building, as well as provide removal methodologies referenced to International Standards. Any asbestos in buildings slated for demolition will be removed according to detailed procedures appropriate to the specific type, risk assessment and installation constraints of each asbestos location (by type), within each building. Buildings will be closed to other activities and removal will be monitored according to health and safety requirements of each asbestos removal sub-operation, according to material-specific methodologies. Asbestos will be packaged at each building and collected for transport from buildings directly.

11.3 Demolition phase

At start of demolition, minor quantities of materials remaining from electrical system materials and equipment will be collected, packaged and removed from all buildings slated for demolition. In most instances, structural material will be washed to a standard appropriate to consider the material ready for recycling. In instances where contamination cannot be removed by washing, materials will be slated for separate demolition, collection, packaging and transport as hazardous waste.

Buildings slated for demolition will be ready at the start of this stage for structural dis-assembly, having been gutted, inclusive of asbestos removal. Buildings that contain concrete structures will have been similarly prepared.

Structural steel and miscellaneous steel framing will subsequently be dismantled and stacked within each building footprint. The final stage will be demolition of brick walls and concrete structures within the building footprint. The resultant rubble materials will remain stockpiled on the building base slabs ready for transport.

11.4 Remediation phase

Once the project footprint, post demolition and site clean-up, becomes available, a contaminated land assessment and rehabilitation study needs to be conducted by a registered soil scientist or contaminated land specialist dependent on the future plan for the use of that parcel of land. The depth of the study will depend on the observations made during demolition. It is currently indicated that the future land use will remain industrial and therefore a high-level assessment will be sufficient to confirm that the demolition and clean up was completed to an acceptable level. Similarly, a more in-depth study and risk assessment will be required if the exposed footprint shows high levels of contamination (Golder , 2022).

11.5 Security

The site will be lit at night and the perimeter as well.

Documentation on the utilisation of personnel and resources on a daily basis is to be retained to provide health and safety control and assurance for personnel employed at the site.

11.6 Signage

A notice board will be erected at the site entrance, stating the name, address, and telephone number of the Operator, the hours of operation, emergency telephone numbers, the Responsible Person and the class of waste site. The notice board information should be displayed in two official languages. Suitable signs must also be erected on site, to direct drivers and to control speed. Signage is to be maintained and updated by the Operator.

Waste storage areas must display danger signs to warn employees of potential hazardous substances. Danger signs to be displayed include:

- Explosive;
- Flammable Gas/Liquid/Solid;
- Poison and infectious substances;
- Radioactive;
- Corrosive;
- Oxidizers and organic peroxides;
- Authorised entry only;
- No smoking.

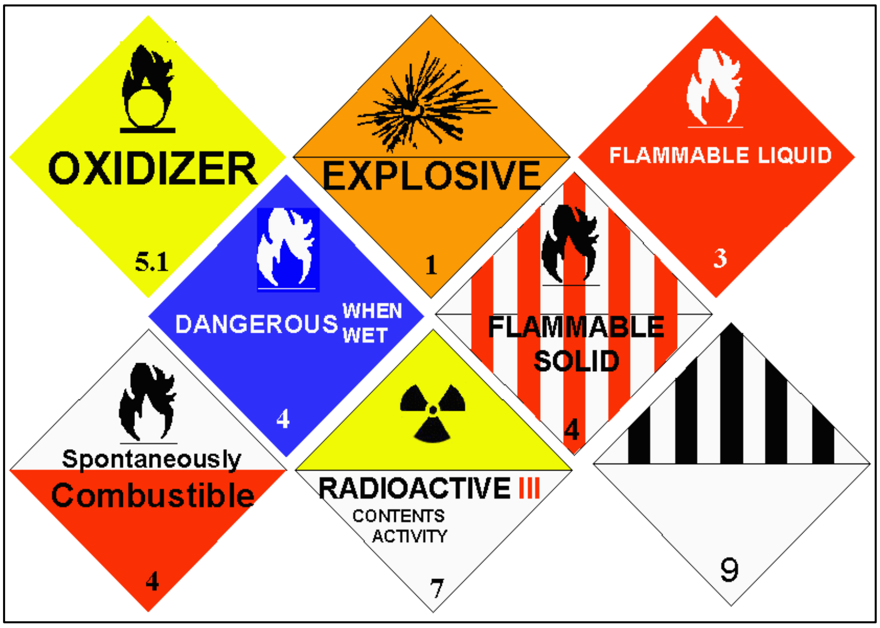

Figure 3: Hazardous Substance Signage

11.7 Waste manifests

GN R. 634 mandates the use of waste manifest documents by generators and transporters. These procedures are important to all stakeholders to manage short, medium and long term risk associated with hazardous waste material management especially.

Transport shall be by approved / licenced contractors relative to the properties of the materials being transported. The transporter shall be required to use vehicles, on-loading and off-loading equipment, PPE and methodologies appropriate to the material being transported and handled. The transporter shall provide chain of custody documentation for all shipments including a mandatory sign-off from the receiver of all materials with effective reference made to specific material documentation as provided. The receiver of materials shall be advised of handling and disposal requirements and shall acknowledge their understanding at time of delivery.

12.0 MONITORING PROGRAMME

12.1 Inspections and Maintenance

- All hazardous substance storage areas must be inspected weekly by a Supervisor to monitor leaks or spills, and the supervisor must sign the inspection register.
- A responsible person must be assigned responsibility for the spill kit. This person must check on a regular basis that the kit is complete, as per the inventory form checklist inside the spill kit.
- Suspected leaks or spills must be reported immediately and contained or treated to prevent damage.

12.2 Audits

- It is recommended that regular internal environmental audits are done to determine compliance against best practice, regulation, permits and licences.
- External, independent audits should be arranged on an annual or bi-annual basis as required.

12.3 Reviews

Practices and methodologies for remediation and handling of wastes and their documentation shall be reviewed as follows:

- When there is a change of method and/or technology that may affect the accuracy of documentation;
- When there has been a significant event to which the existing documentation was relevant; and
- As a result of relevant analysis results or audit findings.

The waste inventory should also be updated as decommissioning progresses.

13.0 CONCLUSION

The inventory as presented in this document is a fair representation of waste streams expected to be generated during the decommissioning of the A-Station infrastructure.

Waste categorisation and classification were performed in accordance with the relevant legislation to the extent possible considering that some of the waste streams will only be generated as decommissioning commences.

Waste management options presented in this report are aligned with legal requirements in respect of initial storage, treatment, transport and ultimate disposal.

The contents of this report will be refined as appropriate during the execution of the decommissioning and remediation plan as more data becomes available.

Signature Page

WSP Group Africa (Pty) Ltd

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MS/ASc/ms

https://golderassociates.sharepoint.com/sites/133264/project files/6 deliverables/final/specialist studies/waste inventory and mng plan/20360049_rep_wimp_final_21nov2022.docx

APPENDIX A

Document Limitations

DOCUMENT LIMITATIONS

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Appendix G10: Closure Costing

REPORT

Review and Update of the Decommissioning and Restoration Costs for Kelvin Power Station, as at December 2021

Kelvin Power (Pty) Ltd

Submitted to:

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November 2021

Distribution List

1 x electronic copy Kelvin Power

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Executive Summary

Kelvin Power (Pty) Ltd (Kelvin Power) is an independent power producer operating the Kelvin Power Station (Kelvin), a coal fired power station which is located approximately 5 km from the Kempton Park central business district and approximately 20 km from Johannesburg. The total extent of the plant is 226.18 ha and is located on the farm Zuurfontein 33 IR, in an area classified as mixed industrial and residential. Kelvin currently supplies electricity to City Power (Johannesburg electricity utility), with the supply contract expiring in 2023.

Presently, there is uncertainty regarding the continuation of the Kelvin operation upon termination of the above contract. It is not clear whether the power station would be decommissioned, whether it would continue to produce power in its current form over the short- to medium term and/or whether it would be upgraded to continue producing electricity over the long term.

Kelvin appointed Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Environmental (Pty) Ltd (WSP), to review and update its restoration and decommissioning costs for the scenarios related to the “Realistic case” and the “Lower case”. These scenarios attempt to reflect the uncertainty related to the power station’s future going forward. It is noted that an environmental regulatory process is currently underway for the decommissioning and demolition of the A-station Power Plant. However, it was confirmed with Mr Khuluse during the site visit that the 2021 cost update will still be based on the latest (2018) assumptions and scenarios, until the EA for the demolition of the A-station has been received.

The realistic case involves complete site demolition/dismantling/rehabilitation with disturbed footprints rehabilitated for the next land use, that would most likely not be power generation. The lower-case entails that the next land use is most likely again power generation, with sell-off and transfer of the existing infrastructure at the end of operations.

The decommissioning and restoration (closure) costs in terms of the above two scenarios are required to inform corporate financial reporting and planning.

A site visit to Kelvin was conducted on 12 October 2021, followed by a review of the available technical information to inform the decommissioning and restoration closure cost determinations.

This report reflects the computed realistic case and lower-case costs as present-day costs for Kelvin, as at December 2021. These costs are exclusive of VAT.

The decommissioning and restoration costs were determined for the following:

- **Realistic case**: Complete site demolition/dismantling/rehabilitation with disturbed footprints rehabilitated for the next land use that would not be power generation.

  Allowance has been made for a portion of the dismantling and clean-up work primarily related to Power Station A to be conducted by Kelvin as part of operations. This includes the demolition of superfluous infrastructure not essential to power generation and the rehabilitation of the resultant footprint areas. Non-essential infrastructure associated with the stockpile areas for both power stations would also be removed as an operational cost prior to decommissioning. Material arising from the clean-up of the stockpile areas would be incorporated with Ash Dam A during operations, and the resultant footprint area rehabilitated as an operational cost. The historical clinker dump was removed, and the cleaned-up site was sold to City Power for the establishment of the Sebenza substation.

For this scenario it is assumed that the Ash Dam B material would be used for brick making/construction and/or other industrial purposes, and that the resultant footprint area rehabilitated during operations. This scenario also assumed that there is insufficient space to re-shape Ash Dam A, and that this action would result in excessive dust generation/nuisance conditions given the adjacent built-up/urban environment. Furthermore, this case assumed that once ash deposition on Ash Dam A has ceased and the groundwater plume beneath the ash dam has been treated, the existing side slope vegetation would therefore be sufficient to prevent erosion from occurring, ensuring a long-term sustainable landform. Thus, only the upper surface would be shaped, levelled and vegetated at closure.

A third-party contactor would be commissioned to conduct the major demolition/dismantling work of the remainder of Power Station A, as well as Power Station B. Given the sheer volume of demolition waste likely to be generated, it has been assumed that this waste has to be disposed off-site, as the ash dams would not be available for this purpose, nor is there space on the site for a properly constructed waste disposal facility. As it is unlikely that any municipal waste disposal facilities in the area would have sufficient remaining airspace for this purpose, it was assumed that the benign (non-contaminating) crushed demolition waste would be in demand for construction purposes (aggregate, road maintenance, construction fill, etc.) within the surrounding urban areas. In this regard it has been assumed that such a site or sites would be available within 5 km from the power station for reuse of the generated demolition waste.

- **Lower case**: Next land use is most likely power generation again, with sell-off and transfer of the existing infrastructure at the end of operations.

  For this scenario it was assumed that all power generation and ancillary infrastructure, including buildings that will be made good for future reuse would remain as is, and would be transferred to the next operator for beneficial use. Contaminated soils from underneath coal stockpile areas would be removed at closure and incorporated into Ash Dam A to assist with the final profiling of the dam towards closure. The cleaned footprint areas would be ripped, levelled and re-vegetated.

Furthermore, it is assumed that both Ash Dams A and B would still be present at closure and that neither ash dams would be re-shaped due to the reasons stated above. The upper surfaces of both ash dams would be shaped, levelled and vegetated at closure.

The computed decommissioning and restoration costs for the above scenarios are presented as follows:

- *Decommissioning costs*: Costs pertaining to the removal of plant and infrastructure and the rehabilitation/restoration of the surface following demolition. Decommissioning costs include footprint rehabilitation (backfilling, topsoiling, profiling, vegetation establishment) of the power plant and related operational areas, offices, etc.
- *Restoration costs:* Costs pertaining to the rehabilitation/restoration of areas impacted on by the operation during the life of the operation, outside of infrastructure footprints. Restoration costs would involve groundwater remediation, surface water remediation, rehabilitation of ash dams, pollution control dams, contaminated land, etc.

Methodology

The costs are reported in accordance with accepted international accounting practices to inform ongoing corporate financial accounting and reporting. Although the determination of closure costs for the above power stations are not required in terms of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GN R.1147), this mining specific legislation provides a well-developed costing framework that can also be adapted for industrial and power generation facilities and has been employed in determining the decommissioning and rehabilitation costs for Kelvin.

Accordingly, the costs as determined are reflected in terms of the following aspects:

- Infrastructural areas (including power station A and B complexes, supporting infrastructure and services, workshops and stores)
- Operational areas and dams (including coal stockpile areas, Ash Dams A and B and water system including dams and ponds)
- General surface restoration
- Surface water reinstatement
- Post-closure aspects
- Additional allowances

Closure costs

The decommissioning and restoration costs as at December 2021 for the realistic and lower-case scenarios (excluding 15% VAT) is given below. It is noted that costs are reported with no offset for salvage.

Closure components		**Unscheduled Closure (2021)**			
		Realistic case		**Lower case**	
		Decommissioning costs	**Restoration costs**	**Decommissioning costs**	**Restoration costs**
1	Infrastructural aspects	R 208 154 167	R 0	R 1 014 508	R 3 316 015
2	Operational aspects	R 0	R 0	R 0	R 10 680 534
3	General surface rehabilitation	R 2 910 093	R 697 752	R 418 106	R 2 113 010
4	Surface water reinstatement	R 78 025	R 0	R 70 744	R 128 100
	Sub-Total 1	**R 211 142 284**	**R 697 752**	**R 1 503 357**	**R 16 237 659**
5	**Post-Closure Aspects**				
5,1	Surface water monitoring	R 0	R 0	R 0	R 0
5,2	Groundwater monitoring	R 0	R 1 430 572	R 0	R 0
5,3	Rehabilitation monitoring	R 43 445	R 4 022	R 3 541	R 91 926
5,4	Care and maintenance	R 246 544	R 59 100	R 20 097	R 1 350 758
5,5	Water treatment costs	R 0	R 71 900 000	R 0	R 0
	Sub-Total 2	**R 289 990**	**R 73 393 694**	**R 23 638**	**R 1 442 683**
6	**Additional Allowances**				
6,1	Preliminary and general	R 31 671 343	R 104 663	R 225 504	R 2 435 649
6,2	Contingencies	R 21 114 228	R 69 775	R 150 336	R 1 623 766
6,3	Additional studies	R 0	R 0	R 0	R 0
	Sub-Total 3	**R 52 785 571**	**R 174 438**	**R 375 839**	**R 4 059 415**
	Grand Total Excl. VAT. (Sub-total 1 + 2 + 3)	**R 264 217 845**	**R 74 265 885**	**R 1 902 835**	**R 21 739 757**
		R 362 126 322			

Conclusions

It is noted that no detailed layout drawing was provided to Golder for the purposes of the determination of the decommissioning and restoration costs. Quantities for the costing were largely based the following:

- Observations made during the site visit conducted on 12 October 2021
- Measurements from the most recent Google Earth aerial imagery
- Comparable other power stations for which Golder have recently conducted closure costings
- Unit rates from Golder’s data base and/or in consultation with demolition and restoration practitioners

Notwithstanding the above limitations, the computed decommissioning and restoration costs for Kelvin provide a good indication of the likely range of costs as at December 2021.

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FIGURES

APPENDICES

1.0 INTRODUCTION

Kelvin Power (Pty) Ltd (Kelvin Power) is an independent power producer operating the Kelvin Power Station (Kelvin), a coal fired power station which is located approximately 5 km from the Kempton Park central business district and approximately 20 km from Johannesburg (Figure 1). The total extent of the plant is 226.18 ha and is located on the farm Zuurfontein 33 IR, in an area classified as mixed industrial and residential. Kelvin currently supplies electricity to City Power (Johannesburg electricity utility), with the supply contract expiring in 2023.

Presently, there is uncertainty regarding the continuation of the Kelvin operation upon termination of the above contract. It is not clear whether the power station would be decommissioned, whether it would continue to produce power in its current form over the short- to medium term and/or whether it would be upgraded to continue producing electricity over the long term.

Kelvin appointed Golder Associates Africa (Pty) Ltd (Golder), a member of WSP Environmental (Pty) Ltd (WSP), to review and update its restoration and decommissioning costs for the scenarios related to the “Realistic case” and the “Lower case”. These scenarios attempt to reflect the uncertainty related to the power station’s future going forward. It is noted that an environmental regulatory process is currently underway for the decommissioning and demolition of the A-station Power Plant. However, it was confirmed with Mr Khuluse during the site visit that the 2021 cost update will still be based on the latest (2018) assumptions and scenarios, until the EA for the demolition of the A-station has been received.

The realistic case involves complete site demolition/dismantling/rehabilitation with disturbed footprints rehabilitated for the next land use, that would most likely not be power generation. The lower-case entails that the next land use is most likely again power generation, with sell-off and transfer of the existing infrastructure at the end of operations.

The decommissioning and restoration (closure) costs in terms of the above two scenarios are required to inform corporate financial reporting and planning.

A site visit to Kelvin was conducted on 12 October 2021, followed by a review of the available technical information to inform the decommissioning and restoration closure cost determinations.

This report reflects the computed realistic case and lower-case costs as present-day costs for Kelvin, as at December 2021. These costs are exclusive of VAT.

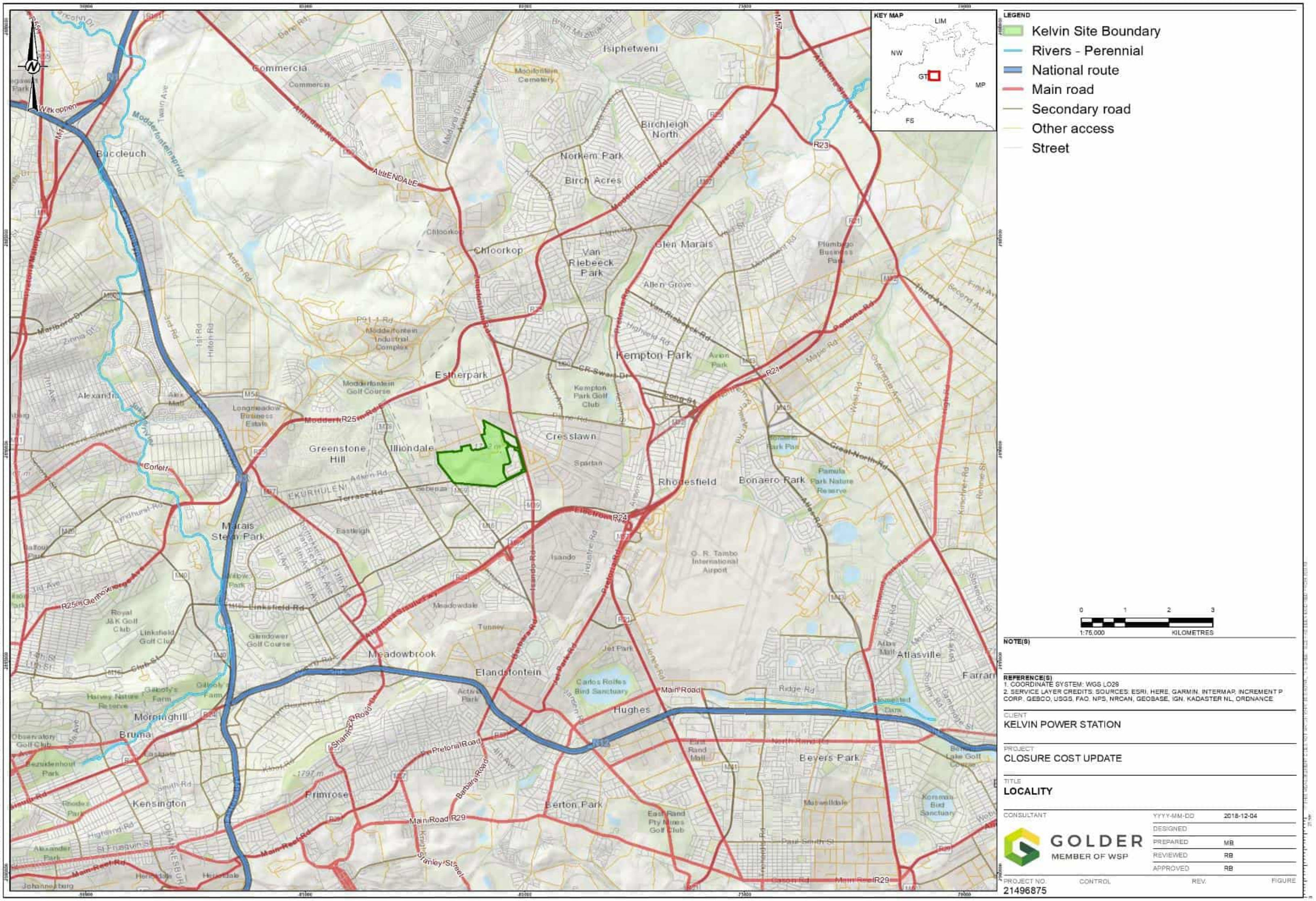

Figure 1: Locality map for Kelvin Power

2.0 APPROACH TO COST DETERMINATION

2.1 Decommissioning and restoration scenarios

The decommissioning and restoration of the Kelvin Power Station could be viewed from different perspectives with different cost outcomes. For these reasons a range of likely decommissioning and restoration scenarios were devised and costed. It was endeavoured for each of the scenarios to be as realistic possible, coupled to "real life" situations/outcomes and the fact that the power station is located within an urban environment.

The decommissioning and restoration costs were determined for the following:

- **Realistic case**: Complete site demolition/dismantling/rehabilitation with disturbed footprints rehabilitated for the next land use that would not be power generation.

  Allowance has been made for a portion of the dismantling and clean-up work primarily related to Power Station A to be conducted by Kelvin as part of operations. This includes the demolition of superfluous infrastructure not essential to power generation and the rehabilitation of the resultant footprint areas. Non-essential infrastructure associated with the stockpile areas for both power stations would also be removed as an operational cost prior to decommissioning. Material arising from the clean-up of the stockpile areas would be incorporated with Ash Dam A during operations, and the resultant footprint area rehabilitated as an operational cost. The historical Clinker dump was removed, and the cleaned-up site was sold to City Power for the establishment of the Sebenza substation.

  For this scenario it is assumed that the Ash Dam B material would be used for brick making/construction and/or other industrial purposes, and that the resultant footprint area rehabilitated during operations. This scenario also assumed that there is insufficient space to re-shape Ash Dam A, and that this action would result in excessive dust generation/nuisance conditions given the adjacent built-up/urban environment. Furthermore, this case assumed that once ash deposition on Ash Dam A has ceased and the groundwater plume beneath the ash dam has been treated, the existing side slope vegetation would therefore be sufficient to prevent erosion from occurring, ensuring a long-term sustainable landform. Thus, only the upper surface would be shaped, levelled and vegetated at closure.

  A third-party contactor would be commissioned to conduct the major demolition/dismantling work of the remainder of Power Station A, as well as Power Station B. Given the sheer volume of demolition waste likely to be generated, it has been assumed that this waste has to be disposed off-site, as the ash dams would not be available for this purpose, nor is there space on the site for a properly constructed waste disposal facility. As it is unlikely that any municipal waste disposal facilities in the area would have sufficient remaining airspace for this purpose, it was assumed that the benign (non-contaminating) crushed demolition waste would be in demand for construction purposes (aggregate, road maintenance, construction fill, etc.) within the surrounding urban areas. In this regard it has been assumed that such a site or sites would be available within 5 km from the power station for reuse of the generated demolition waste.

- **Lower case**: Next land use is most likely power generation again, with sell-off and transfer of the existing infrastructure at the end of operations.

  For this scenario it was assumed that all power generation and ancillary infrastructure, including buildings that will be made good for future reuse would remain as is, and would be transferred to the next operator for beneficial use. Contaminated soils from underneath coal stockpile areas would be removed at closure and incorporated into Ash Dam A to assist with the final profiling of the dam towards closure. The cleaned footprint areas would be ripped, levelled and re-vegetated.

Furthermore, it is assumed that both Ash Dams A and B would still be present at closure and that neither ash dams would be re-shaped due to the reasons stated above. The upper surfaces of both ash dams would be shaped, levelled and vegetated at closure.

The computed decommissioning and restoration costs for the above scenarios are presented as follows:

- *Decommissioning costs*: Costs pertaining to the removal of plant and infrastructure and the rehabilitation/restoration of the surface following demolition. Decommissioning costs include footprint rehabilitation (backfilling, topsoiling, profiling, vegetation establishment) of the power plant and related operational areas, offices, etc.
- *Restoration costs:* Costs pertaining to the rehabilitation/restoration of areas impacted on by the operation during the life of the operation, outside of infrastructure footprints. Restoration costs would involve groundwater remediation, surface water remediation, rehabilitation of ash dams, pollution control dams, contaminated land, etc.

2.2 Methodology

The methodology followed with the determination of the decommissioning and restoration (closure) costs is summarised as follows:

- Undertake a site visit together with representatives from Kelvin, on 12 October 2021 for the following purposes:
  - Conduct a project kick-off meeting to discuss and agree on the project execution approach as well as key technical aspects to be addressed
  - Review the existing site baseline conditions
  - Make and confirm the site observations to contextualise the expected/likely closure related implications for the respective power station components
  - Identify key information requirements to inform the closure cost update
- Devise closure scenarios and check against Kelvin Power Station whether these are realistic and what portion of the demolition and rehabilitation/restoration work could be performed by themselves
- Verify/update closure costing unit rates and benchmark these against industry rates in consultation with demolition contractors and rehabilitation practitioners, notably Jet Demolition
- Compute the decommissioning and restoration costs of the facility as per the realistic and lower-case closure scenarios, and reflecting these in dedicated spreadsheets structured according to the closure battery limits listed in section 5.0, and indicated on Figure 2
- Determine sum allowances for preliminaries and general items as well as contingencies as guided by generally accepted industry trends/norms
- Determine the site-specific requirements for post-closure monitoring and aftercare-related matters
- Conclude the cost determination by adding narratives to the individual cost items reflecting assumptions and/or other information elucidating the item
- Compile a closure costing report (this report) outlining the approach and methodology followed with the decommissioning and restoration costs determination, key assumptions made with the formulation of closure measures and summarising the computed closure costs

3.0 AVAILABLE INFORMATION

A detailed layout drawing of the power plant was not available for the decommissioning and restoration cost update. The calculated costs are therefore largely based on available aerial and Google imaginary, observations made during the site visit and inferences to recently compiled closure costs for other power stations.

In addition to the above, the documents and maps listed in Table 1 were used as supporting information.

Table 1: Available information

Report title	Author	Date
Contaminated land assessment for A-Station. Golder Report No. 20360049	Golder Associates	September 2021
Kelvin Power Station Quarterly Water Quality Report	Aquatico Scientific	November 2020
Review and Update of the Decommissioning and Restoration Costs for Kelvin Power Station, as at December 2018. Golder Report No. 18109862-324301-1	Golder Associates	January 2019
Water and Salt Balance for Kelvin Power. Golder report no. 18106369-320979-1	Golder Associates	September 2018
Kelvin Power Station Quarterly Water Quality Report	Aquatico Scientific	August 2018
Asbestos stripping report	Kelvin Power Station	July 2018
Quarterly Report: Biomonitoring and toxicity testing	Clean Stream Biological Services	June 2018
Waste Classification and Assessment. Report no. 1790793-317616-1	Golder Associates	March 2018
Kelvin Power Station Rehabilitation Strategy and Implementation Plan (RSIP). Golder report no. 1668701-313793-1	Golder Associates	July 2017
Integrated Water and Waste Management Plan: 2017 Update. Golder report no. 1668700-313643-1	Golder Associates	March 2017
Kelvin Power Station Groundwater Assessment	SRK Consulting a	March 2016
Monitoring Borehole Installation at Kelvin Power	SRK Consulting b	June 2016

4.0 POWER GENERATION DESCRIPTION

The site has been in operation for over 50 years. Historically, coal was brought to the site by train but is now delivered by truck. The coal is deposited on the coal stockpiles and then moved to the coal stores to minimise the moisture content of the coal during the wet season, and from here it is brought into the station boilers by conveyors. The coal is then used in the power generation process by heating boilers to create steam.

The ash from the burnt coal is transported to Ash Dam A as a slurry and deposited. Kelvin consists of two separate power plants, namely the A-station and the B-station. A-station and its three cooling towers was in operation for approximately 60 years, until 2012 when it was placed under extended care and maintenance. Station B and its five cooling towers are currently in operation and deposit ash onto Ash Dam A. Station B comprises seven boilers and seven turbines with a design capacity of 420 megawatt. Ash Dam B has been dormant for more than 20 years with ongoing removal of the ash by third party contractors for use in hazardous landfill facilities.

Other major infrastructure on the site includes office buildings, an 88 kV switch yard for distribution of the power generated, a concrete lined desilting dam which collects plant process water and storm water on the hard standing areas, and a concrete lined return water dam (RWD) for the capture and reuse of ash dam seepages and desilting dam water.

5.0 BATTERY LIMITS

This decommissioning and restoration costs for Kelvin covers the following facility components:

- Infrastructural areas including:
  - Power Station A and B complexes, including cooling towers and stacks
  - Workshops, store buildings and offices
  - Supporting infrastructure and services. Note that the 88 kV switchyard was excluded from the battery limits as this infrastructure belongs to City Power
- Operational areas and dams including:
  - Power Station A and B coal stockpile areas
  - Ash Dams A and B
  - Associated water system, including dams and ponds

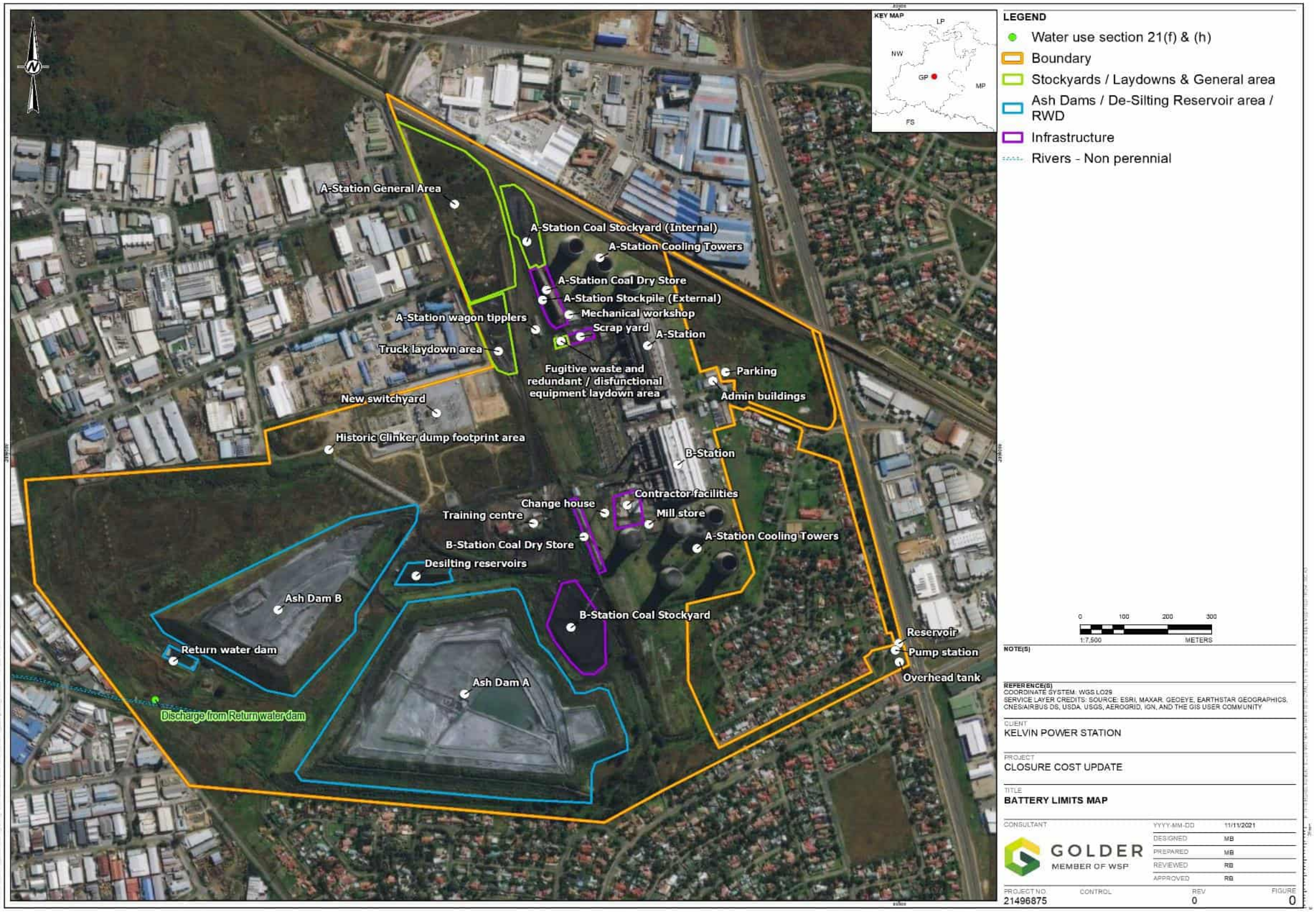

Figure 2: Battery limits for the 2021 closure cost determination

6.0 SITE OBSERVATIONS DURING 2021

The key site observations made during the dedicated site visit on 12 October 2021 are listed in Table 2.

Table 2: Site observations

Aspect	Observations / description	Photo reference
Ash Dam A	■ Ash Dam A is nearing the end of its life with the rate of rise increasing. Kelvin regulates the current height of the dam by frequently removing ash and placing it on Ash Dam B once a certain level of height has been reached ■ Supernatant water from Ash Dam A is routed via the concrete RDW to the ash mixing plant for reuse/recycling ■ A secondary channel is located along the eastern and southern toe lines of the ash dam that routes upslope stormwater and shallow seepage from the dam via the main channel to the discharge point ■ The toe drains around the ash dam routes water to the western part of the ash dam and then to the RWD ■ The outer slopes of the ash dam are more densely vegetated, although being with mostly alien vegetation. Furthermore, vegetation die-off on the upper two lifts has been observed during the site visit which will require follow-up maintenance during the rainy season (Figure 3) ■ SRK Consulting (2016a) indicated that Ash Dam A has the highest pollution risk and has sulphate concentrations ranging from 123-575 mg/l at the eight monitoring boreholes surrounding the ash dam	 **Figure 3: Ash Dam A**

Aspect	Observations / description	Photo reference
Ash Dam B	■ Third party contractors are removing ash from Ash Dam B for use in hazardous landfill facilities. If continuing, this would reduce the footprint of Ash Dam B and its eventual closure liability ■ The volume of ash material is estimated at 1.1 million tonnes of which +- 150 000 tonnes per year are being removed by third parties. Based on the current off-take volumes, it could be assumed that the dump would be depleted and removed within the next six years. Hence, it would be a fair assumption to assume that only footprint clean-up would be required ■ The method of how ash is being removed at present, a “pie crust” is left of which the inner slopes are shaped to stable gradients. Given this, stormwater runoff from the working phases and the shaped gradients would remain inside the created pie crust and not drain to the main channel ■ As the above is still relatively limited in footprint area, the accumulation of runoff within the pie crust is not such a magnitude that it could contribute to notable waste load, that would adversely affect the quality of the shallow groundwater ■ As the pie crust extents, attention to the above matter would be required as a semi Ash Dam A could be created with extended periods of saturation extending into the local shallow groundwater ■ Dust generation potential would significantly increase during the dry season and effort should be made to contain the dust with the disturbed pie crust area ■ Kraal manure trials have been conducted on the upper surface of the ash dam to confirm whether this can be used as a substitute for an evaporative soil cover which at this stage is not a feasible option due to the excessive import costs from local suppliers	 **Figure 4: Ash Dam B**

Aspect	Observations / description	Photo reference
Return water dams	■ During normal dry weather, supernatant water from the Ash Dam A as well as seepage collected in the trenches surrounding the dam, is routed to the RWD for reuse for ash slurrying ■ Given the design of the RWD, it is operated at a high level to give enough settling time for remaining suspended solids and to collect "clean" supernatant water for reuse. The Stormwater Management Plan confirmed that the capacity of the dam is adequate (Golder Associates, 2016b) against overtopping given that the overflow pipeline is adequately sized ■ Overflow from the RWD (that is not returned for reuse) and runoff in the secondary channel passes through the discharge point for release in a drainage line to the Modderfonteinspruit ■ The WUL authorises the release of approximately 2.6 million m^3/year from the site (from the secondary channel through the discharge point)	 **Figure 5: Return water dam**
Desilting dams	■ These dams are used for silt settling and to trap oil during emergency oil spillages. These dams are regularly desilted by contractors ■ Storm water generated at Station B is directed *via* a subterranean collection and pipeline network to a channel leading into the desilting dams ■ At Station A, both process and storm water runoff are usually collected via the same system and flow directly into the main channel. The main channel discharges into the desilting dam ■ Hydrocarbon spillage residues were evident on the water surface of the dams which poses a contamination risk to the Modderfonteinspruit	

Aspect	Observations / description	Photo reference
		Figure 6: De-silting dams
Infrastructure, waste and residues	- The oil tanks (Figure 7) located at A-station have been removed with final footprint rehabilitation still outstanding - The suspended coal conveyors (Figure 8) previously used for transferring coal to the A-station boilers have been removed due to the increasing risk of theft and other health and safety concerns - The A-station weighbridge has been demolished and replaced with the new weighbridge (Figure 9) located at the truck laydown entrance - The access road between the western extent of the B-station power plant and workshop area has been upgraded and paved (Figure 10) - Fugitive wastes (ash, coal veneer and rubble) occur alongside roads, railway lines and conveyors, etc., being sources of wash-off to the desilting dams or bypassing these dams to the discharge point - Given the history of the site as described above, effective separation of clean and dirty water would most likely not be achievable - Fugitive fine ash and coal dust are evident over most of the site which could be compounded during dry months - The surface of the entire area around the dry coal store and the roads are covered with a residue of coal and ash (Figure 11)	 **Figure 7: Oil tanks**  **Figure 8: A-Station coal conveyor**

Aspect	Observations / description	Photo reference
		 **Figure 9: New weighbridge at truck laydown area**  **Figure 10: New paved area around B-Station**  **Figure 11: A-station coal dry store**

7.0 ASSUMPTIONS AND QUALIFICATIONS

7.1 General

- The costs are reported in accordance with accepted international accounting practices to inform ongoing corporate financial accounting and reporting. Although the determination of closure costs for power stations is not required in terms of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GN R.1147), this mining specific legislation provides a well-developed costing framework and has therefore been employed in determining the decommissioning and rehabilitation costs for Kelvin
- The overall decommissioning and restoration costs (closure costs) for Kelvin would comprise a number of cost components. This closure costs only address surface rehabilitation, decommissioning of infrastructure and the final closure and control of the site, to achieve predetermined post operations land use with acceptable environmental and socio-economic effects. This equates to third party contractors establishing onsite and conducting the suite of closure related work, ranging from initial infrastructure demolition and surface rehabilitation to the monitoring/control and corrective action to ensure the desired rehabilitation/restoration related outcomes are achieved. Other components of the overall costs such as staffing of the site after decommissioning, the infrastructure and support services (e.g. power supply, etc.) for this staff as well as workforce matters such as separation packages, re-training /re-skilling, etc. were not considered with the closure costs determination
- Based on the above, dedicated contractors would be commissioned to conduct the demolition and related work on the power station site. This would inter alia require establishment costs for the demolition and rehabilitation/restoration contractors and hence, the allowance of preliminary and general (P&Gs) in the cost determination. Allowance has also been made for third-party contractors and consultants to conduct post closure care and maintenance work, as well as performance/compliance monitoring
- The closure costs determination has been conducted within the context of the envisaged next land use to be implemented after site closure. The costs only address the “physical” rehabilitation/restoration related work such as shaping and levelling, materials movement, revegetation, etc. to facilitate the successful implementation of the next land use, but do not include the costs of the actual establishment of the next land use, other than where such is considered part-and-parcel of the primary closure process and/or required to mitigate a residual impact after closure
- Although the facility and related surface infrastructure could have a salvage or resale value at closure, no cost off-sets due to these were considered as this would be in contrary to accepted international accounting practices, as well as the principles advocated by the DMR guideline
- Fixed ratios for P&Gs (15%) and contingencies (10%) have been applied

7.2 Site-specific

- The historical clinker dump area has been cleaned up and the area sold to City Power, with associated title deed transfer. Hence, the costs do not allow for any rehabilitation/restoration work over this area
- Depending on the scenario applicable, surface infrastructure would be dismantled/demolished and removed off-site. The disturbed footprint areas from where the infrastructure has been removed would be rehabilitated
- Allowance/cognisance has been made for Kelvin to remove and dispose of minor infrastructure as part of operations

- Vegetation has been established directly on the ash of the outer slopes of the existing ash dams. The decommissioning and restoration costs determination assumed that this practice would continue until the eventual closure of these dams
- Steel and concrete material quantities and volumes for the realistic case for the demolition of the specific plant components were inferred from the closure costs recently completed for other power stations in South Africa. The footprint areas of the Kelvin infrastructure components were compared with those of the power stations used as guidance, and the respective quantities/volumes determined on pro-rata basis
- The turbine houses, boiler rooms and chimney concrete structures were assumed to consist of medium reinforced concrete between 250 to 500 mm thickness
- It was assumed that the chimney stacks have a height of 50 m and diameter of 3 m, with 300 mm thick reinforced concrete walls. The cooling towers were assumed to be constructed of light reinforced concrete with a maximum thickness of 250 mm
- All steel structures were assumed to be constructed of light to medium structural steel, whereas equipment such as the boilers and turbines were assumed to be heavy structural steel
- The east wagon tippler indicated on the 2007 layout drawing is not visible on the latest Google Earth aerial photo and has therefore been excluded from the cost determination battery limits
- The inert reinforced concrete and the rubble from demolition would be reduced/crushed to suitable sizes to reduce airspace and/or to be applied for the infilling of cavities and openings from the demolition of the infrastructure
- Concrete footings and bases would be demolished to 1 m below the final surface topography. Cavities and openings of remaining underground infrastructure (below 1 m depth) would be in-filled with crushed concrete and/or similar from site demolition to facilitate surface rehabilitation/restoration, inadvertent surface subsidence and/or to prevent access
- It was assumed that concrete and brick building rubble from demolition that could not be applied for the above purpose, would also be crushed and transported to a nearby site within 5 km from the power station to be used for construction/fill purposes such as aggregate/road maintenance
- It was assumed that about 20% of the total surface area located inside of the main asphalt perimeter road is paved, and would require demolition at closure
- Steel infrastructure would be dismantled, decontaminated and salvaged
- The Sebenza substation, as well as the 88 kV switchyard and related infrastructure are deemed to be part of City Power distribution network. As these structures would remain in place and not the property of Kelvin, they have been excluded from the costs
- The onsite housing that historical belonged to Kelvin and subsequently converted into a private housing estate was excluded from the costs
- Ash dam footprints were measured on Google Earth. It was assumed that both ash dams at present have an average height of 15 m above the surrounding natural ground level and outer/side slopes of 34° (1:1.5)
- Hazardous waste quantities are expected to be limited, and would be transported to and disposed off-site at the Holfontein hazardous waste disposal facility

- The upper surface of the ash dam/s (as the case may be for the respective scenarios) would be shaped/profiled to be free-draining and vegetated
- Allowance has been made to shape rehabilitated areas to be free draining with contouring to combat erosion, as required
- For the realistic case, given the surrounding urban context, it has been assumed that the decommissioned and rehabilitated site would eventually be re-developed. Hence, the rehabilitation/restoration approach and associated measures are aligned with this assumption, however no provision for specific preparation of the site for this purpose has been made
- Allowance has been made for care and maintenance and rehabilitation monitoring for a five-year period after closure
- It has been assumed that effective rehabilitation/restoration of the ash dams, stockpile footprints and other potential sourced of groundwater contamination would alone not be sufficient to arrest and recede the contaminant groundwater plume that has already manifested/developed. Hence, allowance for groundwater remediation in the form of active treatment has been made over a 30-year period

7.3 Water treatment

Groundwater monitoring on the site was initiated in 2003, with the installation of six boreholes along the south and south western boundary of the site. In 2007, a further seven boreholes were drilled around the ash dams, historic clinker dump and coal stockpiles, with continued monitoring of these boreholes being conducted quarterly since 2010. During the November 2020 monitoring period, signs of adverse groundwater quality impacts, especially downgradient from the brick yard, Ash Dam B, historic clinker dump and southern coal stockpile has been detected. Sulphate was identified as the dominant contaminant associated with these four source areas and is likely to be generated through the oxidation of metal sulphides in the presence of water. Furthermore, the sulphate and nitrate content increased over the past year (Aquatico, 2020).

Based on the above, Kelvin is obliged to make full financial provision in the event that water treatment would be required, as stipulated under their water use licence conditions (Section 10.7 of WUL, 2011). Thus, allowance for water treatment costs has been included in the 2021 closure cost update based on the latest water quality data and predicted decant volumes expected at closure.

7.3.1 Model inputs and assumptions

The main input parameters, sources, and assumptions that Golder used to inform the water treatment costing model are provided in Table 3:

Table 3: Input parameters and assumptions

Parameters	Value	Unit	Source/Comment
Water quality data: Total dissolved solids over long term in scavenger boreholes	1 865 mg/l	mg/L	The current water quality used is BH-01 and is assumed to be indicative of the post closure water quality since it is reflective of the ash dam seepage plume quality. However, predicted water quality of the decant is therefore a data gap

Parameters	Value	Unit	Source/Comment
Water quality data – SO_4	913 mg/l		The water quality is based on BH-01 (November 2020 analysis)
Base Year	2021	Year	Selected as basis for evaluation
Treatment volumes for unscheduled closure	0,3	Mℓ/day	Ground water flow stated at 0,14 Mℓ/day, however, to reduce plume, it is assumed that 0,3 Mℓ/day would require treatment
Treatment period (from date of closure)	30	Years	A 50-year scenario was also developed for comparison purposes but omitted from the closure costs
Discount rate	9,91	Percentage	Selected as basis for evaluation
Inflation (CPI)	5,0	Percentage	Selected as basis for evaluation
Capital cost split	100	Percentage	Selected as basis for evaluation. Due to the small plant size, the capital cost will be used in one year
Capital replacement interval	20	Years	Selected as basis for evaluation
Capital Cost contingency	15	Percentage	Selected as basis for evaluation
Capital replacement factor (%) of original piping capital cost	50	Percentage	Selected as basis for evaluation
Capital replacement factor (%) of 1st replacement cycle of original plant capital cost	70	Percentage	Selected as basis for evaluation
Capital replacement factor (%) of 2nd replacement cycle of original plant capital cost	80	Percentage	Selected as basis for evaluation
Applicable ESKOM Megaflex Tariff	2021/ 2022	Year	

Parameters	Value	Unit	Source/Comment
Escalation factor for energy costs	12	Percentage	Will vary according to Eskom rate increases approved by NERSA, but expected to be above CPIX rate
Operating Cost contingency	10	Percentage	Selected as basis for evaluation
Exchange rate	14.60	R/$(US)	Rand:Dollar exchange rate https://www.xe.com/currencyconverter/

Table 4: Kelvin water qualities

Parameter	Units	Kelvin Power	WUL	RQOs
pH		7,5	6,5 – 8,5	5 – 9,5
TDS	mg/l	1 865		
Ca	mg/l	175	25	100
Mg	mg/l	185	15	61,6
Na	mg/l	182	25	
K	mg/l	38,7		
Cl	mg/l	114		103,4
SO_4	mg/l	913	200	200
NO_3	mg/l	< 0,459	6	6
F	mg/l	< 0,466		
Al	mg/l	< 0,005		
Fe	mg/l	0,032		
Mn	mg/l	0,199		
NH_4	mg/l	0,379		
PO_4	mg/l	< 0,014		

7.3.2 Discussion and conclusions

The Water Treatment Plant (WTP) base case process would not require a neutralization pre-treatment (PT) since both the Langelier index and the Puckorius scaling index do not indicate scaling due to the low concentrations of calcium and magnesium. The WTP consists of a membrane desalination process consisting of reverse osmosis (RO). Brine treatment is allowed for and it is assumed that brine storage ponds will not be permitted.

The water treatment costing model makes provision for the following components:

- WTP itself – total installed cost based on costing of other similar facilities
- An allowance for collection and distribution piping and pumping infrastructure typically associated with a WTP

- Brine and sludge processing –using typical percentage allowances based on other plants, which is significant as together it contributes approximately 50% of the total Capex

As basis for the present value of treatment costs, Golder used the concept design costs for similar treatment facilities. The RO option was selected as a base case for costing the WTP in the costing model since it is the only technology suitable for removing all the required pollutants from the water. Passive water treatments were not considered since the facility is located in an urban area and does not have the required footprint to accommodate these types of treatment technologies. Ratios for the brine and sludge treatment costs were derived from similar costing cases. Collection and discharge system costs were assumed based on the locations of different decant points. All the treatment costs have been adjusted for the flow rate capacity for the prescribed planned closure scenario.

The unscheduled closure treatment plant will be constructed once of as the decant does not increase over the analysed 30-year treatment period. It is assumed that due to the small decant volumes, the plant will be constructed in a modular fashion based on the predicted decant for the unscheduled closure.

The costing results for the prescribed decant rates stated above are summarized in Table 5 and Table 6 below, for a 30- and 50-year treatment period.

Table 5 : NPV Closure water treatment costs for Kelvin Power – 30 Years

	0,3 Mℓ/day Unscheduled	
Cost (R)	**CAPEX**	**30-year OPEX**
Real	R 50 200 000	R 143 700 000
Nominal	R 72 400 000	R 266 200 000
Discounted	R 33 700 000	R 60 500 000
NPV	R 71 900 000	

Table 6 : NPV Closure water treatment costs for Kelvin Power – 50 Years

	0,3 Mℓ/day Unscheduled	
Cost (R)	**CAPEX**	**50-year OPEX**
Real	R 71 800 000	R 239 500 000
Nominal	R145 400 000	R 513 600 000
Discounted	R 35 100 000	R 89 400 000
NPV	R 74 600 000	

7.3.3 Recommendations

The current water treatment costing was executed as an update on the 2021 closure costing and no alternative scenarios were considered. During the performance of the work the following gaps were observed:

- The geochemical inputs applied to determine the post-closure treatment costs are assimilated from various samples taking from the site. However, this information is for a single sample cycle only, and it is important that a more extensive statistical analysis of anticipated water quantities needs to be developed. Furthermore, geohydrological models should be updated to provide more reliable assessment of post-closure water recharge and excess water make that will require management and treatment. Water treatment costs are heavily influenced by the volume of excess water to be treated as well as concentrations of constituents such as the TDS, Ca, Mg, Na, NO_3 and SO_4. It is therefore necessary to ensure that these inputs are as accurate as possible, to ensure there is adequate provision for post-closure water treatment

- Various parameters are not currently measured, and assumptions were made in the development of this closure costing. These assumptions were accepted at the time as the best available information. However, there is a large number of assumptions made which can pose a risk
- Since the current scope was to update the existing costing, only active treatment in the form of reverse osmosis with associated ancillary treatment processes were assessed

8.0 UNIT RATES

The unit rates for general rehabilitation and closure measures and activities were obtained from Golder's existing database in consultation with demolition and earthworks contractors, as well as with rehabilitation practitioners. Golder undertakes a thorough review of its unit rate database twice per annum, as follows:

- Minor unit rates are adjusted with standard inflation with confirmation at least twice a year
- Key rates for the dismantling of infrastructure are benchmarked by a specialised demolition contractor, to ensure that it remains market-related and take account of the latest dismantling and demolition techniques. It is noted that as these technologies improve, these rates in real terms are trending downwards
- Earthworks rates are benchmarked against recent tenders available to Golder as well as benchmarking in discussion with earthwork contractors
- Aggregated rates dependent on base infrastructure or earthworks related rates are recalculated given the latest base rates

9.0 CLOSURE MEASURES FOR COST DETERMINATION

The allowances for the determination of the decommissioning and restoration costs are reflected below. The spreadsheets detailing the closure costs are included in APPENDIX B. The sub-sections indicated below are aligned to the spreadsheets and should be read in conjunction with these spreadsheets:

- Infrastructural areas including:
  - Power Station A and B complexes
  - General infrastructure noting that the high voltage switchyard is excluded from the costing battery limits
  - General surface rehabilitation associated with the above
- Operational areas and dams including:
  - Station A and B coal stockpiles areas
  - Ash Dams A and B
  - General surface rehabilitation associated with the above
- Surface water reinstatement namely:
  - Reinstatement of drainage lines
- Post closure aspects namely:

  - Surface and groundwater monitoring
  - Restoration monitoring
  - Care and maintenance
- Additional allowances for the following:
  - Preliminary and general
  - Contingencies

9.1 Infrastructural aspects

Closure cost component	Closure measures	
	Realistic case	**Lower case**
Power station A	- Infrastructure not used for power generation would have been removed as part of operational costs - Remainder of infrastructure to be demolished at closure, concrete to be crushed and disposed off-site - Demolish all heavy steel structures and transport to salvage yard - Rip footprint areas, level and re-vegetate	- Infrastructure to remain as is
Power station B	- Demolish infrastructure at closure, concrete to be crushed and disposed off-site - Demolish all heavy steel structures and transport to salvage yard - Rip footprint areas, level and re-vegetate	- Infrastructure to remain as is
General infrastructure	- Demolish infrastructure (including buildings, roads, railway) at closure, concrete to be crushed and dispose of-site - Asphalt to be stockpile on site for future re-use - Demolish rail tracks, sleepers and collect ballast for local stockpiling for re-use	- Infrastructure to remain as is
Switchyard	- Property of City Power therefore no liability	- Property of City Power therefore no liability
General surface rehabilitation / restoration	- General profiling of footprint areas where infrastructure has been removed, to be free-draining - Rip profiled areas to alleviate compaction - Establish vegetation	- General profiling of footprint areas where infrastructure has been removed, to be free-draining - Rip profiled areas to alleviate compaction - Establish vegetation

9.2 Operational areas

Closure cost component	Closure measures	
	Realistic case	**Lower case**
Station A coal stockpile	**Infrastructure:** ■ Remove infrastructure not used for power generation as part of operational cost, prior to decommissioning ■ Dismantle/demolish remainder of infrastructure at closure ■ Crush concrete and dispose off-site ■ Demolish steel shed-type structures and transport steel to salvage yard **Waste dumps:** ■ Material from stockpiles would have been incorporated with Ash Dam A as part of operational cost ■ Stockpile footprint area would also be rehabilitated during operations	**Infrastructure:** ■ Stockpile related infrastructure remain as is ■ Fugitive contamination would be cleaned-up at closure **Waste dumps:** ■ Material from stockpiles to be incorporated with Ash Dam A at closure ■ Contaminated soils to be removed from footprint area at closure, soils to be incorporated into Ash Dam A. The footprint would be ripped, levelled and re-vegetated
Station B coal stockpile	**Infrastructure:** ■ Non-essential infrastructure not used for power generation would be removed as part of operational cost, prior to decommissioning ■ Concrete would be crushed and disposed off-site **Waste residues:** ■ Contaminated soils and coal veneer removed from existing coal stockpile footprint area and soil/veneer mix incorporated with Ash Dam A ■ The cleaned footprint would be ripped, levelled and re-vegetated	**Infrastructure:** ■ Stockpile related infrastructure remains as is ■ Fugitive contamination would be cleaned-up at closure **Waste residues:** ■ Material from stockpile to be incorporated with Ash Dam A at closure ■ Contaminated soils to be removed from footprint area at closure, soils to be incorporated into Ash Dam A. The footprint would be ripped, levelled and re-vegetated

Closure cost component	**Closure measures**	
	Realistic case	**Lower case**
Clinker dump	**Waste dumps:** - Area has been cleaned and sold to City Power	**Waste dumps:** - Area has been cleaned and sold to City Power
Ash Dam A and de-silting dams	**De-silting dams:** - Remove 150 mm contaminated sediment material from de-silting dams and dispose on Ash Dam A - Demolish infrastructure (de-silting dams and pump station) at closure - Crush concrete and dispose off-site **Ash dam:** - Upper surface to be shaped, levelled and vegetated	**De-silting dams:** - Remove 150 mm contaminated sediment material from de-silting dams and dispose on Ash Dam A - Demolish infrastructure (de-silting dams and pump station) at closure - Crush concrete and dispose off-site **Ash dam:** - Upper surface to be shaped, levelled and vegetated
Ash Dam B and return water dam	**RWD:** - Infrastructure (Return water dam and pump station) would be removed as part of operational costs **Ash Dam:** - Material from Ash Dam B has been removed by third parties hence, only footprint clean-up would be required at closure (costed option)	**RWD:** - Remove 150 mm contaminated sediment material from RWD and dispose on Ash Dam A - Demolish infrastructure (RWD and pump station) at closure - Crush concrete and dispose off-site **Ash dam:** - Upper surface to be shaped, levelled and vegetated (not costed for)
General surface rehabilitation / restoration	- General profiling of footprint areas where infrastructure had been removed to be levelled - Rip profiled areas to alleviate compaction - Establish vegetation	- General profiling of footprint areas where infrastructure had been removed, to be levelled - Rip profiled areas to alleviate compaction - Establish vegetation

9.2.1 Post closure aspects

Closure cost component	Closure measures	
	Lower case	Realistic case
Surface water monitoring	■ Not applicable as there are no watercourses within the power plant site	■ Not applicable as there are no watercourses within the power plant site
Groundwater monitoring	■ Conduct post-closure groundwater monitoring at eight monitoring boreholes for each ash dam, for a period of five years post closure	■ Conduct post-closure groundwater monitoring at eight monitoring boreholes for each ash dam, for a period of five years post closure
Rehabilitation monitoring	■ Conduct rehabilitation monitoring of all rehabilitated areas for a period of five years after closure	■ Conduct rehabilitation monitoring of all rehabilitated areas for a period of five years after closure

Closure cost component	**Closure measures**	
	Lower case	**Realistic case**
Care and maintenance	■ Implement high intensity care and maintenance on rehabilitated ash dam for a period of five years after closure ■ Implement low intensity care and maintenance on other rehabilitated areas for a period of five years after closure	■ Implement high intensity care and maintenance on rehabilitated ash dams for a period of five years after closure ■ Implement low intensity care and maintenance on other rehabilitated areas for a period of five years after closure

9.3 Additional allowances

Closure cost component	**Closure measures**	
	Lower case	**Realistic case**
Preliminary and general	■ Additional allowance of 15% of the total for infrastructural and related aspects (sub-total 1 on summary costing table) has been made	■ Additional allowance of 15% of the total for infrastructural and related aspects (sub-total 1 on summary costing table) has been made
Contingencies	■ Additional allowance of 10% of the total for infrastructure and related aspects (sub-total 1 on summary costing table) has been made	■ Additional allowance of 10% of the total for infrastructure and related aspects (sub-total 1 on summary costing table) has been made

10.0 ASPECTS REQUIRING FUTHER ATTENTION

Most of the issues requiring consideration with the determination of the restoration and decommissioning costs have been identified and per “definition” accounted for in the costs. However, aspects that require further attention in order to refine/improve future updates of the costs have been identified. In addition, a number of short-term actions are recommended for implementation during the remaining operational life, to reduce the restoration and decommissioning (liability) of the power station at eventual closure.

The identified aspects requiring attention and those that could reduce costs over the remaining operational life of the power station are as follows:

- Compile detail engineering designs for ash dam upper surface rehabilitation. However, it must also be determined whether this approach would meet current regulatory requirements and cognisance taken of the fact that re-shaping and capping of the ash dams may be required. This has to be considered with follow-up cost reviews
- Confirm the off-site demand for benign crushed demolition waste to predict the uptake rate of the demolition waste more accurately. This information should be available for the next update of the closure costs, and thereafter regularly updated so that closure costs always take account of the inherent “risk” associated with changing market conditions for the off-site uptake of benign demolition waste
- Devise remedial action required with respect to groundwater contamination plumes, as well as isolated hot spots of hydrocarbons contamination at the workshop area
- Address those aspects that could be resolved without extensive preparatory work. Examples include immediately achievable actions such as the clean-up of fugitive spills alongside roads, conveyors, pipelines etc., as well as consolidating the various storage/disposal areas and rehabilitating resultant footprints
- Considering that Ash Dam B is being reworked, appropriately designed stormwater routing/conduits need to be devised and constructed as necessary. It is foreseen that as the reworking of the ash dump progresses, that ongoing adaptation to the devised measures would be required. Hence, this would be “work in progress” until the dam has been finally reworked. In addition, additional dust suppression would also be necessary
- As this decommissioning and restoration cost determination assumed that a dedicated cover would not be provided to Ash Dam A at closure, this approach requires confirmation as it is not strictly aligned to the requirements of the National Norms and Standards for the capping of industrial waste facilities. This would most likely require a dedicated waste assessment to determine the type/classification of the deposited waste with associated risk assessment. Given the outcomes of these, it could be motivated not to cover this dam. The absence of suitable soil (within a dense urban area) would also add to the motivation for not providing a capping. However, given the fact that the existing facility has not provided for a bottom liner could provide a motivation for capping
- Compile a detailed restoration plan for the site with a specific focus on higher requirement areas such as the ash dams; and commence with any restoration activities possible during the remaining operational life of the power plant
- The erosion measures at the discharge point have washed away because of the channel having inadequate capacity, these measures should be reconstructed. Design and construct gabion cross walls upstream of the discharge point to attenuate the water flow along the main channel. The main purposes of these cross walls are as follows:

  - Moderate flows along the channel (attenuation) with associated reduction of erosion potential
  - Capture sediment spikes during high flow conditions and in this way limit sediment mobilisation to the downstream Modderfonteinspruit which could have adverse aquatic health consequences

  It is recommended that at least two sets of cross walls be considered for implementation. In addition, the cross must be as wide as possible, straddling at least the full width of the main channel and not only the defined flow path

- Compile detailed general arrangement drawings/bill of quantities for the site, as up to date information would allow higher accuracy for future costs

11.0 CONCLUSIONS

It is noted that no detailed layout drawing was provided to Golder for the purposes of the closure cost update. Quantities for the closure cost determinations were largely based on observations made during the site visit conducted on 12 October 2021, or measured using the most recent Google Earth aerial imagery, or were otherwise based on or derived from comparable other power stations. Unit rates were obtained from Golder’s data base and/or in consultation with demolition and rehabilitation practitioners.

Notwithstanding the above limitations, the computed decommissioning and restoration costs for Kelvin provide a good indication of the likely range of costs as at December 2021.

Signature Page

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https://golderassociates.sharepoint.com/sites/153538/project files/6 deliverables/21496875_rep_kelvin power closure costs 2021_2mar22_final.docx

APPENDIX A

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APPENDIX B

Closure costing spreadsheets

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