APPENDIX J

ADDITIONAL INFORMATION

Appendix J1: The co-ordinates taken every 250 meters along the route for each alternative alignment.

Appendix J2: WULA

APPENDIX J1

THE CO-ORDINATES TAKEN EVERY 250 METERS ALONG THE ROUTE FOR EACH ALTERNATIVE ALIGNMENT.

Appendix J1: The co-ordinates taken every 250 meters along the route for each alternative alignment.

Ash Water Return Alternative Route 1 and 2 co-ordinates.				
	Ash Water Return Alternative Route 1		Ash Water Return Alternative Route 2	
	Lat	Long	Lat	Long
0	-26.27702	29.18709	-26.27976	29.8707
250	-26.27892	29.18789	-26.28115	29.19091
500	-26.28017	29.18957	-26.28056	29.18848
750	-26.28651	29.18779	-26.27994	29.15607
1000	-26.27988	29.18593	-26.27951	29.18369
1250	-26.2796	29.18303	-26.28046	29.18142
1500	-26.28062	29.18079	-26.28142	29.17915
1750	-26.28163	29.17856	-26.28243	29.17692
2000	-26.28269	29.17626	-26.28344	29.17469
2250	-26.28385	29.17426	-26.28518	29.17313
2500	-26.28564	29.17247	-26.28695	29.17159
2750	-26.2874	29.17119	-26.288	29.16946
3000	-26.2882	29.16886	-26.28877	29.1671
3250	-26.28897	29.16651	-26.28859	29.16478
3500	-26.28968	29.16451	-26.29069	29.16427
3750	-26.2912	29.16396	-26.29227	2916486
4000	-26.2916	29.16507	-26.2915	29.16651
4250	-26.29173	29.16735	-26.29222	29.16889
4500	-26.29247	29.16971	-26.29263	29.17032
4750	-26.29263	29.17032		

Slurry Transfer Alternative Route 1 and 2 co-ordinates.				
	Slurry Transfer Alternative Route 1		Slurry Transfer Alternative Route 2	
	Lat	Long	Lat	Long
0	-26.26804	29.18818	-26.26804	29.18818
250	-26.26789	29.18578	-26.26789	29.18578
500	-26.26842	29.18335	-26.26842	29.18335
750	-26.26901	29.18094	-26.26901	29.18094
1000	-26.27072	29.18116	-26.27072	29.18116
1250	-26.27214	29.183	-26.27214	29.183
1500	-26.27069	29.18491	-26.27069	29.18491
1750	-26.27239	29.1864	-26.27239	29.1864
2000	-26.27428	29.18775	-26.27428	29.18775
2250	-26.27633	29.18738	-26.27633	29.18733
2500	-26.27851	29.18733	-26.27851	29.18733
2750	-26.27959	29.18945	-26.27959	29.18945
3000	-26.28144	29.18969	-26.28088	29.19105
3250	-26.2821	29.19208	-26.28215	29.19226

3500	-26.28274	29.19448	-26.28279	29.19466
3750	-26.28338	29.19688	-26.28343	29.19706
4000	-26.28478	29.19865	-26.2492	29.19874
4250	-26.28696	29.19912	-26.28712	29.19916
4500	-26.28909	29.19983	-26.8922	29.19992
4750	-26.29056	29.20051	-26.29056	29.20051

APPENDIX J2

WULA

DIGBY WELLS
ENVIRONMENTAL

Date:	18 November2015	**Project Number:**	ESK2840
To:	DWS	**From:**	Carol Hooghiemstra
Authority Ref:			
RE:	WULA for the proposed Kriel - Matla Transfer Link project		

☐ **Mail / Express Post** (select one) ☑ **Enclosed**

☐ **Same Day Courier** ☐ **Picked Up**

☐ **Air Freight** ☑ **Hand Delivered**

☐ **Email** ☐ **FTP Site**

Quantity	Item	Description
3	IWULA	Reports
1	Electronic copy (CD)	Electronic copy of the Application

Please find attached the abovementioned documents for your perusal.

Please acknowledge receipt of documentation

Susan _____
Print name

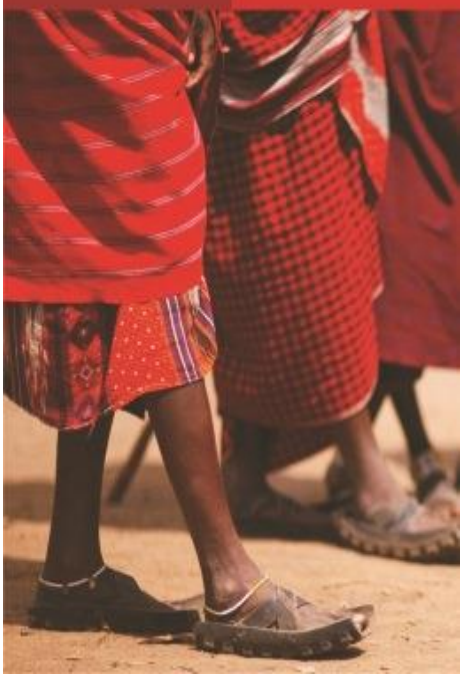
_____
Signature

SAC
Position

19/11/2015
Date

Dept. of Water Affairs
Private Bag X 10580
Bronkhorstspruit 1020
2015 -11- 19
REGISTRY
WMA OLIFANTS
Dept. van Waterwese

Please advise us if enclosures are not as described.



DIGBY WELLS
ENVIRONMENTAL

Water Use Licence Application for proposed Kriel-Matla Transfer Link Project

Water Use Licence Application

Project Number:

ESK2840

Prepared for:

Eskom Holdings SOC Limited

November 2015

Digby Wells and Associates (South Africa) (Pty) Ltd
(Subsidiary of Digby Wells & Associates (Pty) Ltd). Co. Reg. No. 2010/008577/07. Turnberry Office Park, 48 Grosvenor Road, Bryanston, 2191. Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

This document has been prepared by Digby Wells Environmental.

Report Type:	**Water Use Licence Application**
Project Name:	**Water Use Licence Application for proposed Kriel-Matla Transfer Link Project**
Project Code:	**ESK2840**

Name	Responsibility	Signature	Date
Riaan Swemmer	Report Writer/Project Manager		September 2015
Carol Hooghiemstra	Technical Reviewer		September 2015

SUPPLEMENTARY WATER USE INFORMATION

Specific water use information, as per Form 781 "*Supplementary Water Use Information*", is provided within this technical document. The table below provides as summary of the information required, as well as references to where the relevant information can be found in this document.

Watercourse Attributes		
Information Required	**Detail**	**Reference in Document**
Locality	Provide a description of the location of the watercourse at which the water use/s is to take place.	Section 5.1
	Provide a locality map/s indicating the relevant catchment, surrounding land use, towns, infrastructure etc.	Section 1.2
	Provide the catchment reference number.	Section 1.1
Description	Provide the name and/or description of the affected watercourse.	Section 5.1
	Provide a map with accompanying photographs (dated) indicating the segment and affected reach/es of the watercourse in which the water use/s is to take place and which indicates/delineates the regulated area.	Section 5.1
	Describe within context of the immediate catchment and segment, the historic as well as current state (Present Ecological State or PES) of the affected reach/es of the watercourse.	Chapter 5
	Describe the ecological importance and sensitivity (EIS) as well as the Socio-cultural Importance (SI) of the affected reach/es of the watercourse including the functions.	Chapter 5
	Discuss existing land and water use impacts (and threats) on the characteristics of the watercourse.	Section 5.1
	List and map sensitive environments in proximity of the project locality - sensitive environments include wetlands, nature reserves, protected areas, etc.	Section 5.3

Water Use Information		
Information Required	**Detail**	**Reference in Document**
Description and Methodology	Describe the activities associated with the water use/s.	Section 1.5
	Describe the project phases for each activity (i.e. planning, construction, operation and maintenance, decommissioning) including, but not limited to, the programme for and duration of the various phases.	Section 3.3
	Provide a site lay-out plan/s (master plan) indicating the various activities and existing and proposed infrastructure in relation to the 1:100 flood line and edge of the watercourse, etc. – a letter or certificate by a qualified surveyor must also be submitted that verifies the correctness of the site lay-out plans, in particular for wetlands.	Section 2.3
	Provide work method statements for the various water use activities.	Section 3.3.6
	Provide engineer design drawing(s) for construction activities within the watercourse.	Section 3.3.5
	Provide a description and a map/s indicating any Storm Water Management Practices (SWMPs) specifically addressing 'end of pipe' practices.	N/A
	Provide information on all existing lawful water uses [refer Section 27(1)(a)].	Section 7.1
	Provide information on investments already made and to be made by the water user in respect of the proposed water use/s [refer Section 27(1)(h)].	Section 7.8
	Indicate and motivate the probable duration of any undertaking for which the water use/s should be authorised [refer Section 27(1)(k)].	Section 7.12
Motivation	Provide information on the need/intention/objective of the water use/s.	Section 7.3
	Provide information on contributions to rectify the results of past racial and gender discrimination [refer Section 27(1)(b)]	Section 7.2
	Provide information to support efficient and beneficial use of	Section 7.3

	water in the public interest [refer Section 27(1)(c)].	
	Provide information on relevant catchment management strategies and local government planning frameworks that support the proposed water use [refer Section 27(1)(e)].	Section 7.5
	Provide information on the strategic importance of the water use to be authorised [refer Section 27(1)(i)].	Section 7.9
Impact Assessment and Management		
Impact Prediction and Assessment	Provide a prediction and assessment of the likely environmental and socio-economic impacts or effects associated with the water use/s for the different project phases:	Chapter 6
	On the watercourse and its characteristics as set out above [refer Section 27(1)(f)].	Chapter 6
	On other water users [refer Section 27(1)(f)].	Chapter 6
	On the broader public and property.	Chapter 6
	If the water use/s is not authorized.	Chapter 6
	Provide a description of the methodologies employed to undertake impact prediction and assessment as well as a motivation for these.	Chapter 6
Risk Assessment	Provide an assessment of the risks associated with the water use/s and related activities.	Section 6.6
Alternatives	Describe the alternatives considered to prevent negative impacts on the watercourse with regard to locality, procedures, materials, etc.	Section 2.3
Mitigation and Management Measures	Provide mitigation measures to prevent, reduce, remediate or compensate the pre-determined impacts; also provide emergency responses.	Chapter 6
	Provide a site map/s that marks the limits of disturbance to the watercourse and in particular indicates erosion and sediment controls.	N/A
	If the developer (applicant) of water use related infrastructure is not the end user/beneficiary and will not be responsible for long term maintenance of the infrastructure, provide a programme for hand over to the successor-in-title	N/A

	including a brief management/maintenance plan for infrastructure along with allocation of responsibilities.	
Changes to the Watercourse	Assess to what extent the impacts after mitigation will bring about changes in respect of the PES (and recommended ecological category, if this information is available at the stage of study) and functionality of the watercourse; as well as the socio-economic environment (including redress considerations as well impacts on other water users).	Chapter 5
Monitoring and Compliance	Provide a detailed monitoring programme and describe the auditing, compliance and reporting mechanisms to ensure execution of the mitigation measures and for informing DWAF of incidents – ensure that these measures are appropriate in relation to the impacts, mitigation measures, status of the watercourse, etc.	Section 6.7

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LIST OF ABBREVIATIONS

ASGISA	Accelerated and Shared Growth-South Africa
ASPT	Average Score Per Taxa
BBA	Boiler Bottom Ash
BPEO	Best Practical Environmental Option
DB	Distribution Box
DHP	Dust Handling Plant
Digby Wells	Digby Wells Environmental
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIS	Ecological Importance and Sensitivity
ELM	Emalahleni Local Municipality
GDP	Gross Domestic Produce
HGM	Hydro-geomorphic
ISP	Internal Strategic Perspective

KPS	Kriel Power Station
MBCP	Mpumalanga Biodiversity Conservation Plan
MPS	Matla Power Station
NDM	Nkangala District Municipality
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological Status
PFA	Pulverised Fuel Ash
SASS5	South African Scoring System 5
SMME	Small, Medium & Micro Enterprise
The Project	Kriel-Matla Transfer Link Project
VSD	Variable Speed Drive
WMA	Water Management Area
WULA	Water Use License Application

1 INTRODUCTION

Chapter 4 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA), legislates the use of water, identifies various water uses (Section 21 water uses) and facilitates the licensing of the Section 21 water uses through the process of a Water Use License Application (WULA). The Best Practical Environmental Option (BPEO) must be implemented when using water to ensure that there is a sustainable use of water and to prevent the deterioration of water quality and/or decrease in the quantity of the water resources as a result of any development.

Eskom Holdings SOC Limited (Eskom) appointed Digby Wells Environmental (Digby Wells) as an independent Environmental Assessment Practitioner (EAP) to undertake the required WULA to obtain environmental authorisation for the proposed "Kriel-Matla Transfer Link Project" (the Project) from the Department of Water and Sanitation (DWS).

As part of the Project, Eskom intends to construct and operate a series of ash and slurry transfer pipelines between the existing Kriel Power Station (KPS) ash dam complex and the Matla Power Station (MPS) ash dam complex, located near the town of Kriel, Mpumalanga Province. The current KPS ash dam complex is estimated to reach its full capacity by mid-2017 and a new ashing facility is required to accommodate ash storage for the remainder of the power station's operational life, which is expected to be until the year 2043. The new ADF will not be ready for ashing until 2020 as per project schedule due to delays associated with the Water Use Authorisation Process for the detailed Geotechnical Studies of the proposed site. To avoid a complete shut-down of the KPS, Eskom is considering implementing this Project as an interim measure to accommodate KPS's ashing requirements until such time as the new facility is operational.

The following water use(s) for the Project, in line with the NWA, are being applied for (all non-consumptive uses):

- Section 21 (c) – Impeding or diverting the flow of water in a watercourse; and
- Section 21 (i) – Altering the bed, banks, course or characteristics of a watercourse.

These uses relate to the fact that the envisaged pipelines will cross certain watercourses, as defined by the NWA. The NWA defines watercourses as "*a) a river or spring; b) a natural channel in which water flows regularly or intermittently; c) a wetland, lake or dam into which, or from which, water flows; and d) any collection of water which the Minister may, by Notice in the Gazette, declare to be a watercourse.*"

Therefore, the WULA for water uses identified in terms of Section 21 of the NWA will be submitted to the DWS. This application excludes existing water uses for either KPS or MPS based on the assumption that no changes are expected in the water balance to trigger an amendment of existing authorisations or result in new water uses that will have to be applied for.

This WULA provides details on the envisaged infrastructure, the motivation for the construction thereof (Section 27 motivation), a description of the baseline environment and anticipated impacts (and mitigation thereof) associated with the Project.

1.1 Regional Setting and Location of Activity

KPS and MPS are both situated within the Mpumalanga Province of South Africa between the towns of Bethal and Ogies on the R545 road (Plan 1). It is located approximately 8 km west of Kriel, 27 km south of Ogies and 34 km north-west of Bethal. The power stations are located within 3 km of one another (Plan 2). The closest human settlements (excluding nearby towns) to the proposed Project are Redstream Park and Thubelihle, which is situated approximately 10 km north and 9 km north east of the power stations, respectively. The power stations fall within the Emalahleni Local Municipality (ELM) and the Nkangala District Municipality (NDM).

Furthermore, the power stations lie within the Upper Olifants River primary catchment (Water Management Area (WMA) 04) and falls within both B11D and B11E quaternary catchments (Plan 3). It is important to note that this application, however, only falls within quaternary catchment B11D.

1.2 Property Description

1.2.1 Land Tenure

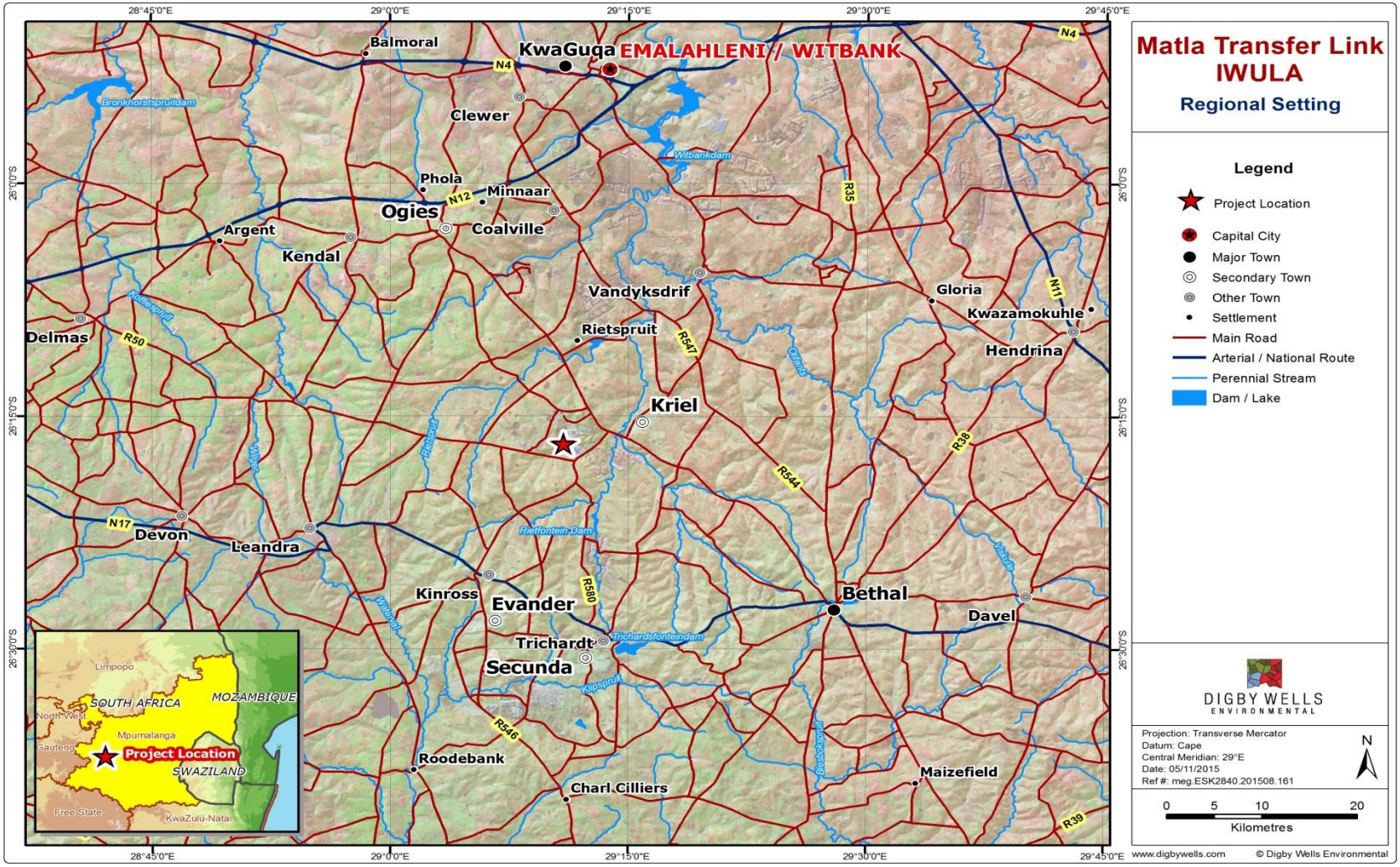
As depicted in Plan 4 (Land Tenure Map), KPS is situated on various portions of the farms Kriel Power Station 65 IS, Driefontein 69 IS, Vaalpan 68 IS and Onverwacht 70 IS whilst MPS occupies portions of the farms Matla Powerstation 141 IS, Driefontein 69 IS, Bakenlaagte 84 IS and Vlaklaagte 83 IS.

The envisaged pipeline route will traverse the properties as detailed in Table 1-1 below.

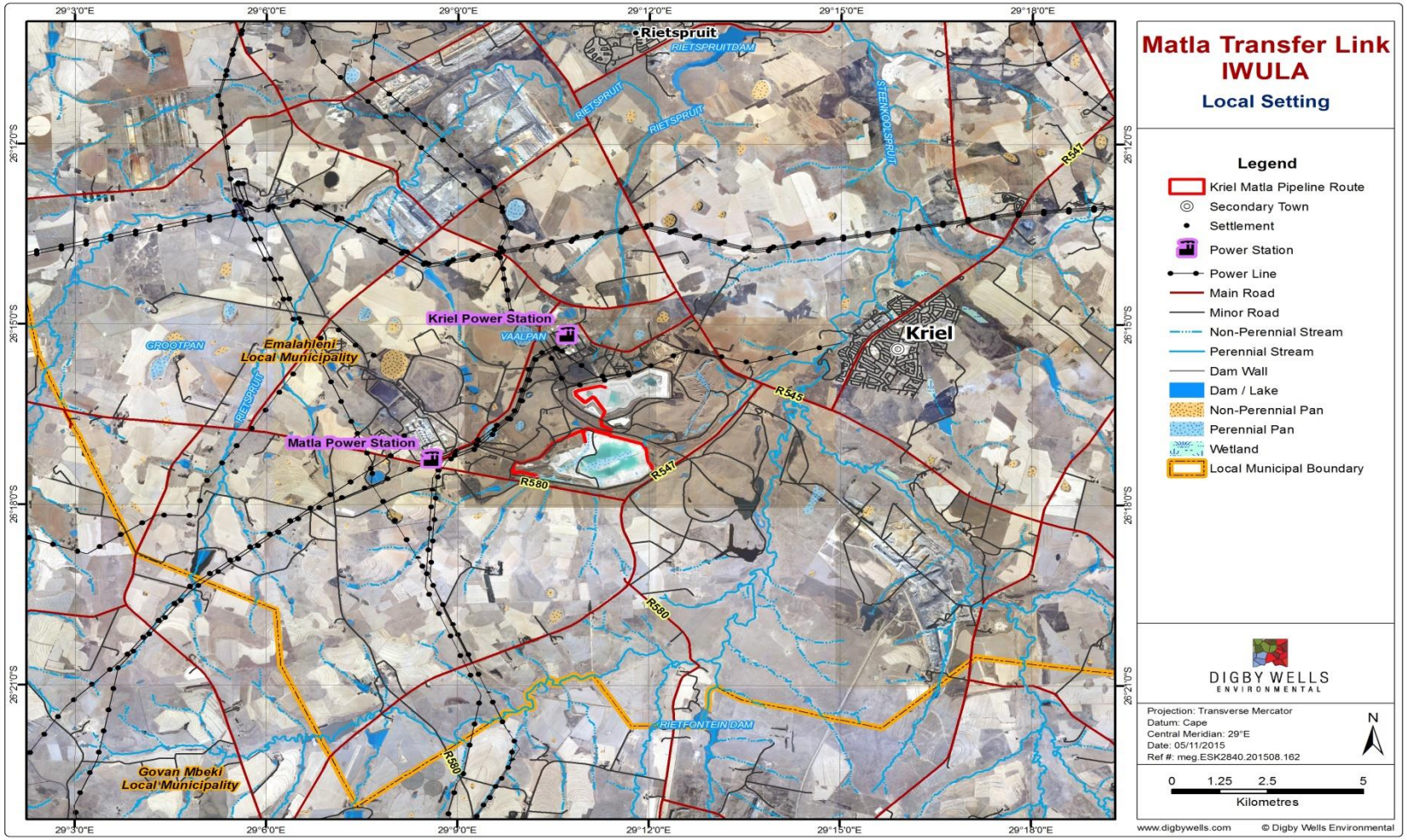
Table 1-1: Land tenure of the proposed pipeline route

Farm Name	Farm No.	Portion(s)	Farm/Portion Size (ha)	Owner	Title Deed
Bakenlaagte	84 IS	4	106.04	Eskom	T17261A/1977
Driefontein	69 IS	10	61.36	Eskom	T30943/1977
		11	52.80	Eskom	T30943/1977
		12	70.53	Eskom	T30943/1977
		13	71.30	Eskom	T30943/1977
		15	74.10	Eskom	T34862/1977

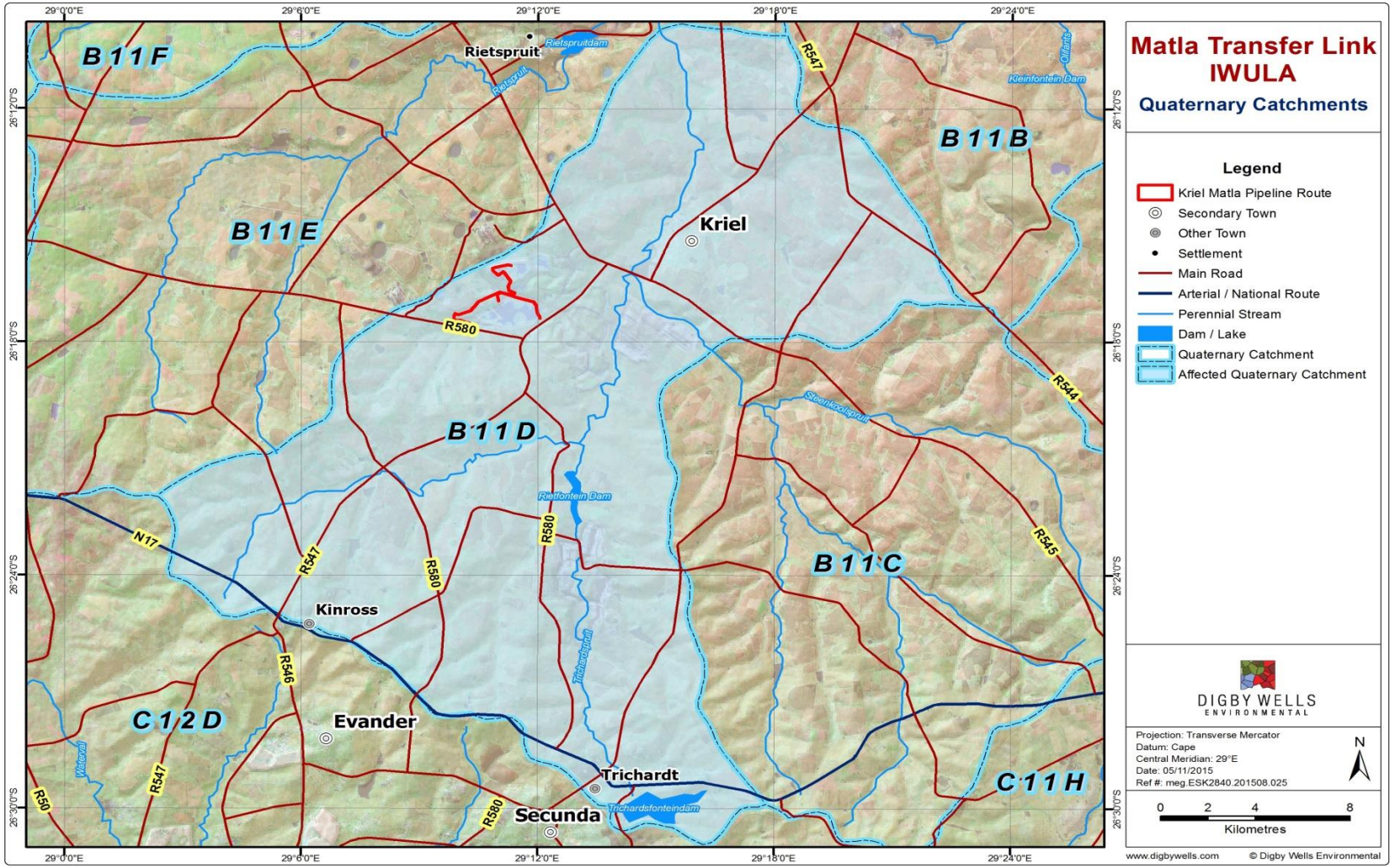
Farm Name	Farm No.	Portion(s)	Farm/Portion Size (ha)	Owner	Title Deed
		17	68.19	Eskom	T30943/1977
		30	43.58	Eskom	T34862/1977
Kriel Power Station	65 IS	Remaining	631.80	Eskom	T20601/1976
Onverwacht	70 IS	15	25.45	Eskom	T34862/1977
		16	96.30	Eskom	T34862/1977



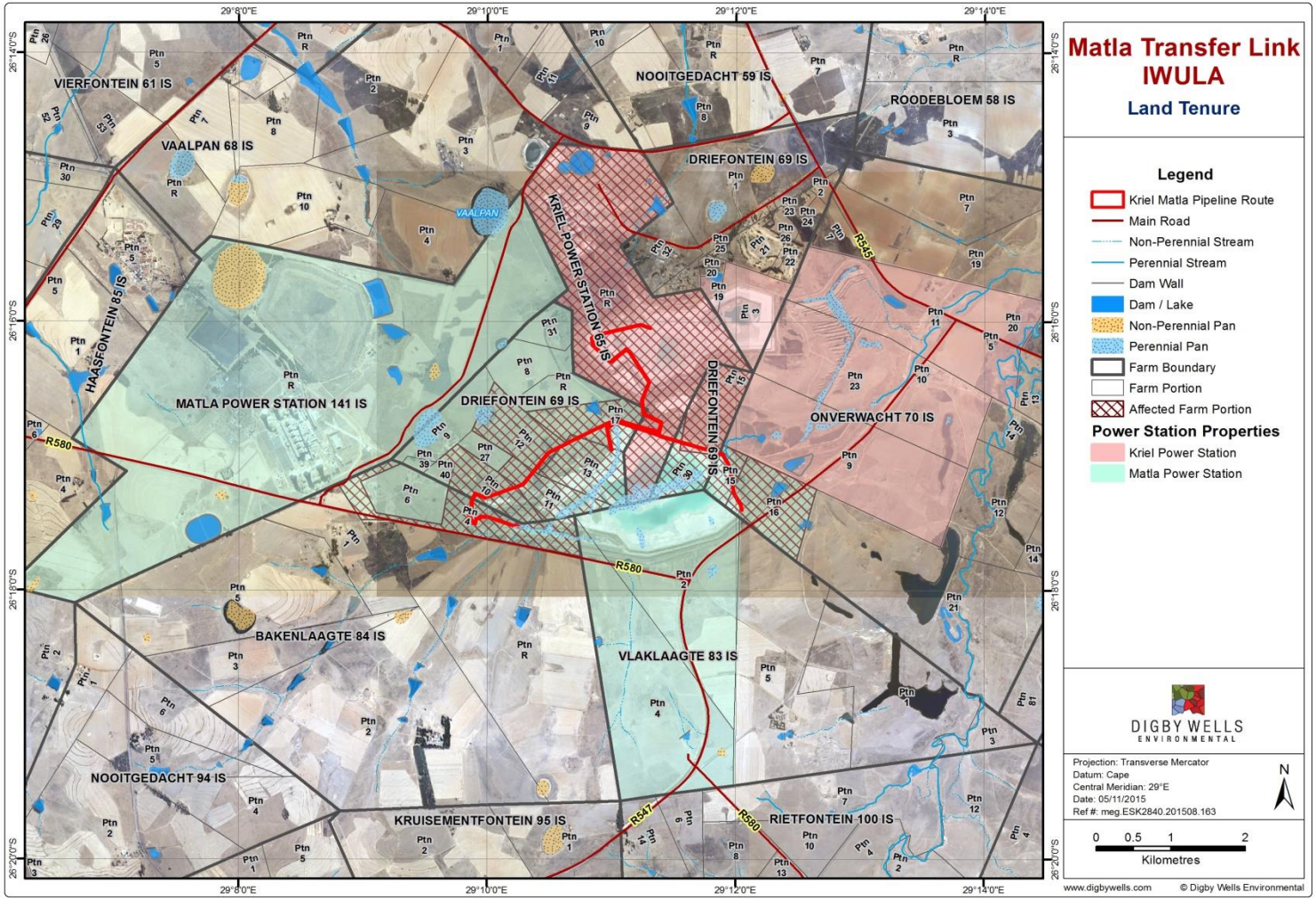
Plan 1: Regional Setting



Plan 2: Local Setting



Plan 3: Quaternary Catchments



Plan 4: Land Tenure

1.3 Sensitive Landscapes

According to the Mpumalanga Biodiversity Conservation Plan (MBCP) the land units in the surrounding landscape have been identified and categorised as important and necessary (Category 4), areas of least concern (Category 5) and areas with no natural habitat left (Category 6). Each of these categories permits or restricts specific land use types.

Category 4 specifically does not allow any surface mining activities/developments, including any mine waste and refuse dumps, to be developed, whereas Category 5 and 6 allow for restricted developments. Most of the surface area around the power stations are categorised as Category 5 and 6, indicating that the area is of least concern in terms of biodiversity sensitivity, as no natural habitat are found in these areas.

1.4 Current Land Use and Surrounding Economic Activities

Land use in the surrounding area consists mainly of agriculture and mining. The agricultural activities are mostly maize and cattle farming. The mining that takes place in the area is mostly coal mining, with opencast collieries within 5 km north-west and south east of the power stations. The town of Kriel is located 5 km east of the power station.

1.5 Purpose of the WULA

The purpose of this WULA is to:

- Provide an overview of the proposed activities with emphasis on water related activities and impacts;
- Provide a description of the baseline ecological conditions to be used as a base to identify potential impacts;
- Serve as a guide to water related measures that must be structured and progressively implemented over a short, medium and long term period;
- Present a plan of how the management of water and waste is integrated and compile monitoring plans to achieve such management;
- Document all the relevant information in a manner that enables the DWS to make informed decisions to authorise water uses; and
- Identify knowledge gaps.

1.5.1 Section 21 Water Uses Under Application

Eskom hereby applies for the licensing and registration of the water uses according to the requirements of the NWA, and are summarised in Table 1-2.

Table 1-2: Summary of the Section 21 water uses

Water Use (as per NWA)	Activity	Description
Section 21 (c): Impeding or diverting the flow of water in a watercourse.	Pipelines crossing over watercourse(s).	Crossing of altered channelled valley bottom wetland. Crossing of two non-perennial streams. Crossing of isolated seep wetland.
Section 21 (i): Altering the bed, banks, course or characteristics of a watercourse.	Pipelines crossing over watercourse(s).	Crossing of altered channelled valley bottom wetland. Crossing of two non-perennial streams. Crossing of isolated seep wetland.

1.5.2 Relevant Licensing and Registration Forms

A number of completed WULA forms will be submitted with this application (Table 1-3). These forms are appended to Appendix A.

Table 1-3: Relevant licensing and registration forms

Form Reference	S21 Use	No. of Forms	Purpose/Water Use
DW758		x 1	Company Details – *Eskom Holdings SOC Limited*
DW763	S21(c)	x 4	Impeding or diverting the flow of water in a watercourse – *Pipelines crossing over watercourse(s).*
DW768	S21(i)	x 4	Altering the bed, banks, course or characteristics of a watercourse – *Pipelines crossing over watercourse(s).*
DW901		x 3	Details of Property – *The pipelines will cross watercourses on the remainder portion of the farm Kriel Powerstation 65 IS and Portions 11 and 12 of the farm Driefontein 69 IS.*
DW902		x 1	Details of Property Owner - *Eskom Holdings SOC Limited*

2 CONTEXTUALISATION OF ACTIVITY

2.1 Power Generation

Kriel Power Station is a base load coal fired power station, operating on a wet-cooled and wet-ashing system.

Coal is supplied from Anglo Inyosi Coal's Kriel Mine, which is transported via an overland conveyor belt system to a coal stock yard area owned and managed by the mine.

Coal is pulverised in giant mills and combusted in furnaces. The heat generated converts water in the boilers to steam. The steam is passed through super heaters where steam temperature is increased at very high pressure and then conveyed in pipes to the high-pressure turbine rotor to spin. The turbines are linked directly to the generator to produce electricity for distribution via the integrated power grid.

2.2 Current Ashing System

During the electricity generation process, fly ash and coarse ash are produced as a result of the coal combustion process. All ash is disposed of on KPS's ash disposal complex, via a wet ashing system whereby ash from the boilers is removed in a slurry form and is pumped to the ash disposal system. The ash is conditioned for transportation by adding water to a ratio of water: fly ash ratio of 10:1. Excess water is returned, however this process consumes at least 5 Mℓ/day through absorption of water in the ash and other losses.

Annually, the slopes of the ash dam are covered with topsoil and re-vegetated to establish a vegetation cover in order to improve the visual quality and suppress wind-blown dust. Fly ash is also used for the construction of the ash disposal system walls as it extends in height. The fly ash provides for a stable material for construction.

Currently, KPS also sells some of the fly ash it generates that can be used for construction material and cement additive (pozolan). This fly ash is sold as a dry product and contains no water.

The current KPS ash disposal system consists of three ash disposal facilities (Dam 1, Dam 2 and Dam 3) located adjacent to one another (Plan 5). Details of each individual facility are described in Table 2-1.

Table 2-1: Kriel Power Station ash disposal system

Dam	Footprint (ha)	Upper Surface Area (ha)	Maximum Height (m)	Maximum Elevation (mamsl)
1	44.4	16.38	56.61	1 648.62
2	129.77	70.73	57.92	1 648.53
3	73.7	50.78	35.7	1 613.75

Apart from ash the ash disposal system also receives the following plant residues:

- Cooling water sludge is disposed of at the ash disposal system via the ash pipeline system;
- Demineralised plant regeneration effluent is neutralised at the water plant neutralisation sump and then pumped to the high level ash water return dams for use in the ashing system; and
- Material rejects from the mills are transported via truck to the ash dams for disposal.

Periodically industrial solid waste (i.e. building material) is disposed of within the ash dams.

Return water from the ash disposal system is collected via a penstock system to the lower ash water return dams (wing dams). All seepage water from the ash disposal system is collected in cut-off trenches/ stormwater canals and is gravity fed to the wing dams. Water in the wing dams is pumped up to the high level ash water return dams for reuse in the ashing process. Excess ash water is stored in the borrow pits, and Swartpan.

Water from the Swartpan is returned to the power station for reuse in the ashing system.

The water in the ash disposal system is in a closed circuit and all dirty water which does not evaporate or retained in the ash material is returned to the power station for reuse. All of the ash water return dams are constructed from earth and lined with clay.

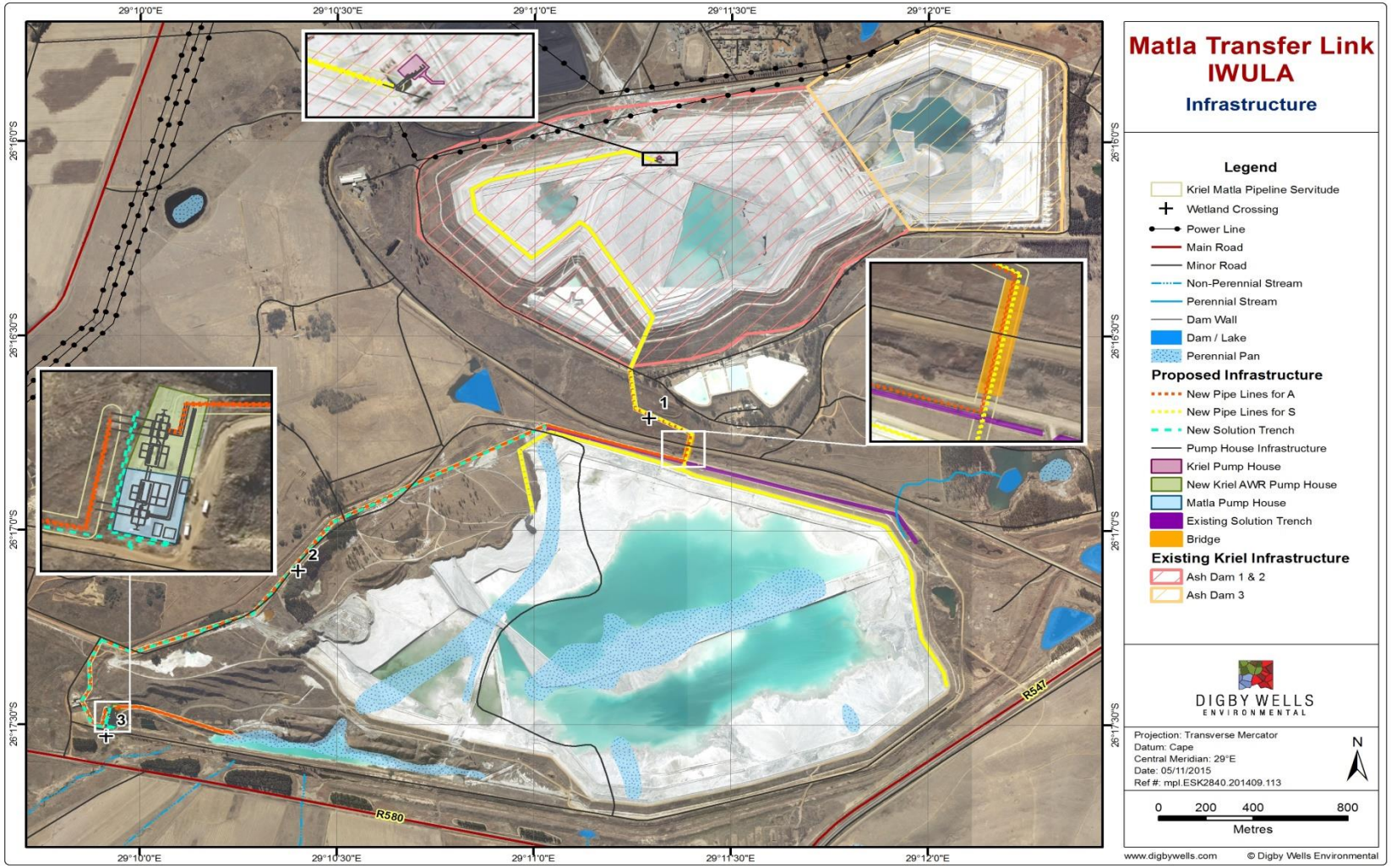
In order to maintain capacity in the ashing system and to address water management deficiencies, the power station has increased ash water storage capacity by dredging the ash water return water dams. The dredged material was disposed on the ash disposal system.

All water from the ash disposal system is treated in a sump adjacent to the ash disposal system by mixing with lime ($Ca(OH)_2$), in part to increase pH values so that corrosion is reduced prior to release of this water into the ash return water circuit.

2.3 Ash Dam Complex Capacity

As it is anticipated that the current ash dam complex will reach capacity by June 2017, studies are currently being conducted for a new ash dam, however, it is only expected to be commissioned in the 4th quarter of 2020. Consequently an intermediate solution for depositing ash is required for approximately 4 years. Two such intermediate solutions under consideration are:

- The “Step in and go higher option” – This option essentially relates to increasing the height of the current ash dam complex to extend its operational life; and
- The “Kriel to Matla Ash Transfer Link” – Which is the focus of this application, and is discussed in more detail in Chapter 3 of this document.



Plan 5: Infrastructure Layout

3 KRIEL TO MATLA ASH TRANSFER LINK

This Chapter details both the current ash disposal system and the envisaged ash transfer pipeline system from KPS to MPS.

3.1 Current Ash Disposal System at KPS

Kriel Power Station's ash disposal system utilises two systems, one (1) system to remove the Boiler Bottom Ash (BBA), or coarse ash, commonly known as the Ash Plant, and a second system to remove the Pulverised Fuel Ash (PFA), or "dust", commonly known as the Dust Handling Plant (DHP). Coarse ash is pumped by one (1) of two (2) ash pumps per unit, to either a Distribution Box (DB), an Ash Pump house at the DB or directly to Ash Dam 3 (Plan 5). Conditioned fly ash is transported via the overland conveyor systems to the DB, where it is mixed with sluice water.

From the DB ash is sluiced directly onto the Ash Dam or to both sumps at the Ash Pump house. This Ash Pump house contains 4 Ash pumps of which 2 of the 4 slurry pumps are utilised to pump the slurry mixture, via 2 pipelines, to the desired location on Ash Dam 1 and 2. Cross feed between these 2 pipelines is also possible (refer to Figure 3-1).

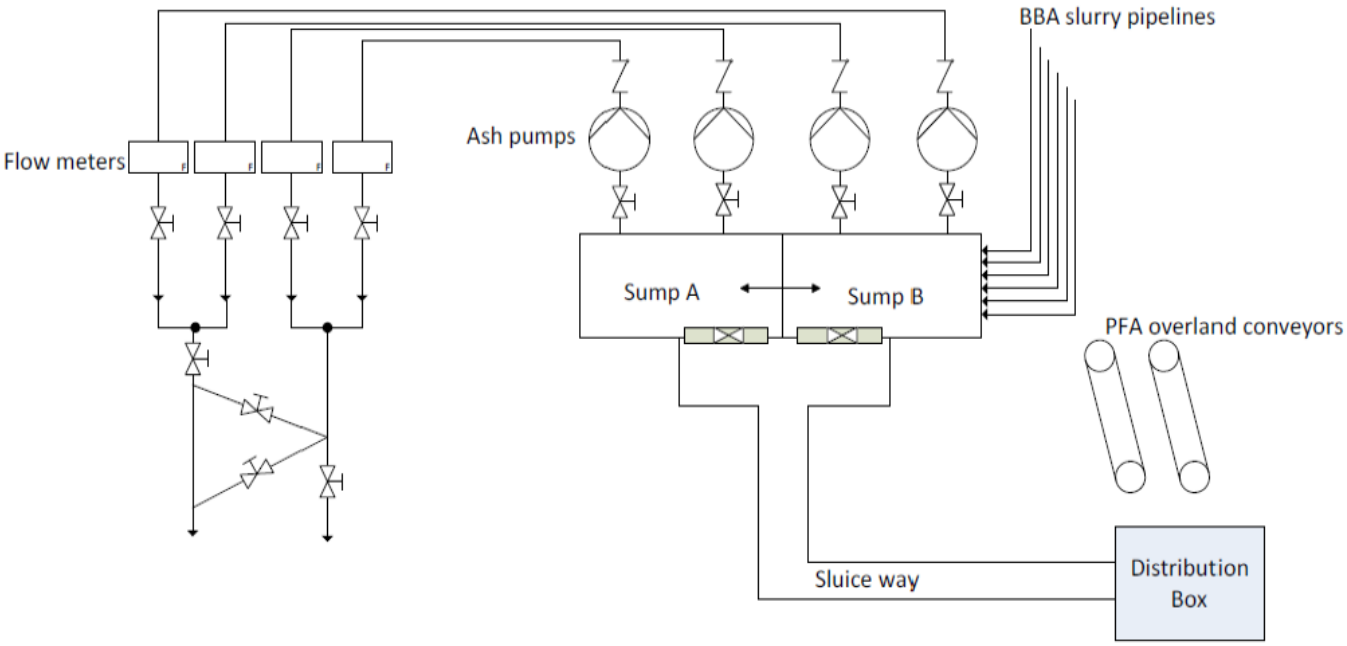


Figure 3-1: KPS ash pump house and distribution box layout

3.2 Current Ash Water Return System at MPS

Decanted water from Matla P. S. Ash Dam, drains through penstocks to an Ash Water Return (AWR) reservoir called the Final Cut. A barge mounted Pumping Station (Figure 3-2) with 2 x 100% Vertical Spindle pumps is connected in series with corresponding Booster

pumps situated inside a Booster Pump house (Figure 3-3) on ground level. The inlet pipes to the booster pumps are interconnected thus enabling cross feeding. The water is then pumped to either the Sluice Water Return (SWR) Dam or to the Head Tank for re-use in the ashing operations.

Figure 3-2: MPS Barge mounted pumping station

Figure 3-3: MPS Booster pump house

3.3 New Pipelines

Eskom intends to construct and operate a series of overland ash/slurry transfer pipeline systems between the existing KPS ash dam complex and the MPS ash dam complex.

3.3.1 Configurations and Routes

The configuration of the new pipeline systems is set out in Table 3-1, and illustrated on Plan 5. The pipeline systems will traverse various properties as set out in Table 3-2.

The details pertaining to the points where the pipelines will be crossing watercourses are given in Table 3-3. The crossing points “1” and “2” are illustrated on Plan 5.

Table 3-1: New pipeline configurations

Pipeline System	Number of Pipelines	Configuration	Route Distance	Total Pipeline Distance	Reference Colour on Plan 5
Ash	3	Parallel (1 set)	4.1 km	12.4	Red
Slurry	10	Parallel (2 sets)	4.6 km 1.2 km	29.3 km	Yellow

Table 3-2: Properties traversed by pipeline systems

Pipeline System	Properties Traversed	Property Owner	Distance Traversed on Property (m)	Total Distance (m)	Power Station
Ash	Bakenlaagte 84 IS Ptn 4	Eskom	1 066, 1 067, 1 068	3 201	Matla
Ash	Driefontein 69 IS Ptn 10	Eskom	676,677, 678	2 031	Matla
Ash	Driefontein 69 IS Ptn 11	Eskom	320, 320, 321	961	Matla
Ash	Driefontein 69 IS Ptn 12	Eskom	513, 515, 517	1 545	Matla
Ash	Driefontein 69 IS Ptn 13	Eskom	268, 270, 273	811	Matla
Ash	Driefontein 69 IS Ptn 17	Eskom	856, 857, 859	2 572	Matla
Ash	Kriel Power Station 65 IS Ptn RE	Eskom	433, 433, 434	1 300	Kriel
Slurry (1st set)	Kriel Power Station 65 IS Ptn RE	Eskom	3 054, 3 054, 3 056, 3 056, 3 058	15 278	Kriel
Slurry (1st set)	Driefontein 69 IS Ptn 15	Eskom	538, 538, 538, 538, 538	2 690	Matla
Slurry (1st set)	Driefontein 69 IS Ptn 17	Eskom	102, 104, 104, 105, 106	521	Matla
Slurry (1st set)	Driefontein 69 IS Ptn 30	Eskom	101, 101, 101, 101, 101	505	Matla
Slurry (1st set)	Onverwacht 70 IS Ptn 15	Eskom	539, 539, 539, 539, 540	2 696	Kriel
Slurry (1st set)	Onverwacht 70 IS Ptn 16	Eskom	316, 317, 318, 319, 320	1 590	Matla
Slurry (2nd set)	Kriel Power Station 65 IS Ptn RE	Eskom	459, 459, 459, 460, 461	2 298	Kriel
Slurry (2nd set)	Driefontein 69 IS Ptn 13	Eskom	24, 24, 24, 24, 25	121	Matla
Slurry (2nd set)	Driefontein 69 IS Ptn 17	Eskom	718, 720, 720, 721, 723	3 602	Matla

Table 3-3: Details of watercourse crossings

Pipeline System	Crossing Point	X Start (Decimal Degrees)	Y Start (Decimal Degrees)	X End (Decimal Degrees)	Y End (Decimal Degrees)	Length (m)
Slurry (1st Set)	1	29,18718	-26,27747	29,18946	-26,28081	521.4
Slurry (1st Set)	1	29,18717	-26,27747	29,18945	-26,28081	521.8
Slurry (1st Set)	1	29,18717	-26,27747	29,18945	-26,28081	521.5
Slurry (1st Set)	1	29,18716	-26,27746	29,18944	-26,28081	521.5
Slurry (1st Set)	1	29,18716	-26,27746	29,18943	-26,28081	521.5
Ash	1	29,18715	-26,27745	29,18942	-26,28081	521.8
Ash	1	29,18714	-26,27745	29,18941	-26,28080	522.1
Ash	1	29,18713	-26,27744	29,18940	-26,28080	522. 5
Ash	2	29,17219	-26,28630	29,17163	-26,28692	88.7
Ash	2	29,17224	-26,28624	29,17157	-26,28698	106.4
Ash	2	29,17228	29,17228	29,17150	-26,28705	124.1
Ash (Existing / Backup)	2	29,17202	-26,28653	29,17191	-26,28666	17.9
Ash (Existing / Backup)	2	29,17206	-26,28647	29,17184	-26,28672	35.6
Ash (Existing / Backup)	2	29,17211	-26,28641	29,17177	-26,28679	53.3

3.3.2 Design Philosophy

The pipeline systems were designed taking cognisance of the following aspects:

- The pipelines will be standardised with current infrastructure;
- The pipelines are to be easily accessible for maintenance;
- No redundancy on the AWR system;
- All AWR from KPS is to be pumped back to KPS;
- No interference with MPS normal operations;
- The two systems will be kept completely separate for maintenance and operational purposes;
- The control of Variable Speed Drives (VSDs) by the installed flow meters will be rectified;
- Enough sluice water is available at KPS; and
- KPS ash/slurry disposal pipeline discharge points will be on the northern side of the MPS ash dam.

3.3.3 Existing Infrastructure

Existing infrastructure to be leverage off include:

- Ash pumps;
- Ash pump motors;
- Existing MPS AWR system including barge mounted pumping station; and
- Booster pumps and motors at MPS.

3.3.4 Pipe Specifications

System	No. of Pipelines	Diameter (mm)	Pipeline Material	Configuration	Through put capacity per pump (m^3/hr)	Anticipated Volumes transported per day
Ash Water Return (AWR)	3	350	Commercial Steel (mild steel)	3 x Single pumps discharging into a dedicated pipeline operating simultaneously.	720	Kriel to Matla: 42 476.8 (m^3/day) Matla to Kriel: 38 390.1 (m^3/day)
Slurry	4	300	Commercial Steel (mild steel)	3 x Single pumps discharging into a dedicated pipeline operating simultaneously.	753.5	10 586.3 (Tons/day)

System	No. of Pipelines	Diameter (mm)	Pipeline Material	Configuration	Through put capacity per pump (m^3/hr)	Anticipated Volumes transported per day
				1 x Single pump and pipeline on standby.		

3.3.5 Crossing Structures

Along the entire servitude (Plan 5), solution trenches will be installed on either side of the pipeline to contain ash and AWR spillages as well as divert it to the nearest Ash Dam solution trench or containment sump. The servitude will also be equipped with a service road on either side of the pipes for ease of access for maintenance.

A mine haul road runs between Kriel and Matla Ash Dam which will be crossed by the pipe servitude. There are also two seasonal natural watercourses which exist on either side of the mine haul road (mine service road). Two pipe bridges (Plan 5) will be required for the pipes to cross the two watercourses (refer to Figure 3-4, also attached as Appendix B).

The servitude at KPS will be equipped with two collection sumps, one on either side of the servitude, which will receive ash and/or AWR from the trenches and contain it during a spillage. A bridge that is enclosed at the bottom and sides, will be installed over the

watercourse which will contain and divert ash and/or AWR spillages to either of the collection sumps.

The servitude at MPS will also be equipped with two 675 mm outer diameter concrete drain pipes on either side of the servitude. These drain pipes will contain and divert ash and/or AWR spillages to the MPS Ash Dam solution trench. A bridge that is enclosed at the bottom and sides will also be installed over the watercourse which will divert ash to the drain pipes. Furthermore, the current service roads at MPS Ash Dam will be utilised to access the AWR- and Slurry pipes.

Furthermore, for the pipe crossing at the Mine Haul Road (mine service road), concrete pipe sleeves will be installed which will accommodate the pipes. Two additional sleeves will also be installed for redundancy (refer to

Figure 3-4, also attached as Appendix B). Pipe sections at the sleeves will consist of three meter sections to accommodate ease of maintenance during the installation and removal of pipes.

In terms of the 1:100 year flood line, the Civil engineering report indicated that the worst possible flood flow for the 1:100 year recurrence period has been chosen as the design flow from the four alternative methods of calculating runoff. At this flow, the design velocity is not exceeded in the channels. Due to the high freeboard on the channels and the haul road bridge, the channel will cater for the 1 in 100 year flood although average velocity does increase marginally (from 1.2 m/s to 1.4 m/s). It is considered that there is high margin of

safety in the design of this channel, provided channel maintenance is carried out whilst in operation.

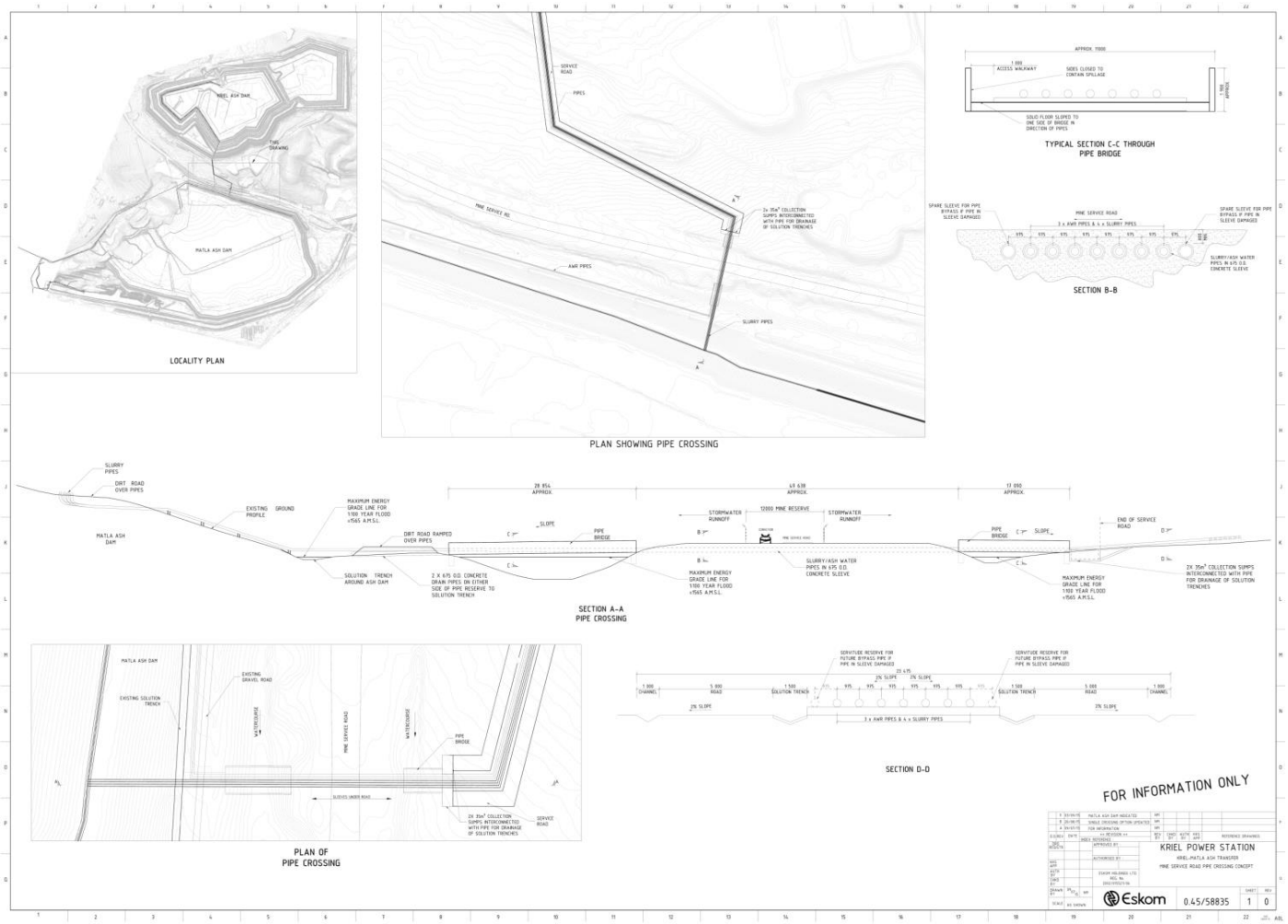


Figure 3-4: Crossing engineering designs

3.3.6 Construction Work Method for Pipeline

3.3.6.1 Site Establishment

The contractor's site establishment will be within the Eskom property. Additional establishment of laydown areas closer to the point of construction may also be required e.g. close to the Kriel pump house. All establishment areas of the contractor will also be fenced for security and safety.

3.3.6.2 Clearing of Vegetation

All topsoil and vegetation will be cleared over the servitude of the pipeline. Topsoil will be stored in a designated area until such time that it is reused for rehabilitation after decommissioning.

3.3.6.3 Excavation and Earthworks

Excavation of in-situ material for the construction of the roads, solution trenches and pipe plinths will take place with excavated material stored in a designated area for reuse. A mobile plant will therefore be required. Temporary batching facilities for the preparation of backfill material may be required depending on the characteristics of the fill material.

3.3.6.4 Road Construction

Construction of a maintenance road on either side of the pipeline will take place and will have a gravel wearing course. Existing excavated material will be used as far as possible. Any additional material required will be imported. Roads will be used for access for the construction of the remaining works in the servitude and as a maintenance road to gain access to the pipelines.

3.3.6.5 Construction of Solution Trenches and Sumps

Solution trenches will be constructed and lined with concrete. The trenches will be sloped for drainage of any spillages to the nearest Ash Dam solution trench or containment sump. The collection sumps will also be constructed after the solution trenches. The bridge foundations may also be constructed during this time.

3.3.6.6 Construction of Pipe Supports

Construction of pipe plinths within the servitude will take place for the installation of pipes. Once plinths have been completed, pipe section will be installed on the plinths.

3.3.6.7 Construction of Road Crossings

Instances where the pipeline servitude crosses an existing access road it will be catered for with the construction of a culvert with the existing road raised to pass over the pipeline. If possible, existing roads will be raised to be ramped over pipeline. Concrete drainage pipes

will then be provided on either side of pipeline to allow flow from solution trenches to pass under ramped road.

3.3.6.8 Installation of Concrete Sleeves under Road

Concrete sleeves will be placed by open trenching for the mine haul road crossing. Pipe sleeves will be jacked under the mine road and conveyor if open trenching is not possible.

3.3.6.9 Installation of Pipes in Sleeves

The AWR and slurry pipes will be jacked into the concrete sleeves in sections. The pipe sections will be bolted before it is jacked into the concrete sleeve.

3.3.6.10 Construction of Pipe Bridges

Construction of the two bridges will likely take place after the pipes have been installed under the road. Foundations for the bridges may be constructed earlier depending on the sequence of works by the contractor. The foundations for the bridges may include piled foundations depending on the geotechnical investigation. Construction will take place during the dry season to avoid the need to temporarily divert the watercourse to accommodate construction.

3.3.7 Pipeline Maintenance

Maintenance activities for the pipeline consist of the following:

- Routine maintenance will be undertaken on a weekly basis:
  - Routine visual pipe line inspections;
  - Pipe thickness measurements will be conducted along the entire pipeline; and
  - Pipes will be rotated 120º when required.
- Emergency maintenance during pipe burst and/or unblocking of Ash pipelines:
  - All pump discharge pipelines will be fitted with pressure transmitters, which will be utilised to trip the associated pump if a pressure drop is detected;
  - A visual inspection will be conducted to determine the location of pipeline failure;
  - The damaged pipe will be fixed immediately and thereafter the pipeline will be flushed to Matla's Ash Dam;
  - Trenches and collection sumps must be cleaned immediately to ensure optimum capacity is available; and
  - The containment facility will be cleaned by pumping the contained slurry and/or AWR to MPS solution trench.

3.3.8 Stormwater Management

The design and construction of the pipeline will be done with the objective of minimising the impact on the natural drainage of storm water in the area. The servitude typically consists of a pipeline servitude flanked by solution trenches on either side to collect any effluent in the event of a pipe leakage or spillage. An access road is then provided on either side of the solution trench with a 2% crossfall away from the solution trench to ensure any clean stormwater runoff from the road drains away from the solution trench into the surrounding environment.

Figure 3-5 below shows a typical cross section of the servitude.

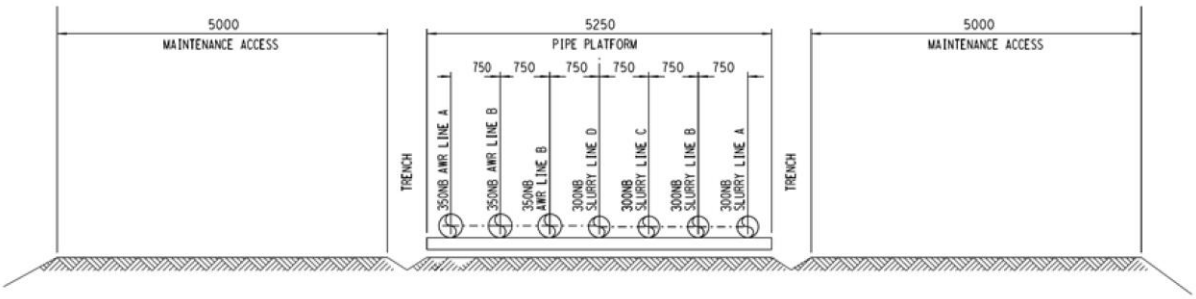


Figure 3-5: Typical cross section of servitude

The discharge of the solution trenches collecting any spillage from the pipes will be at the locations set out below.

3.3.8.1 Discharge into Collection Sump before first Watercourse Crossing (Bridge 1)

The portion of the servitude on the Kriel's side up to the first water crossing (Bridge 1) will discharge into two interconnected sumps. These will be sized to accommodate the flow from a burst pipe until the pumps are automatically shut down due to the pressure drop and any additional flow that may be incurred during the 1:100 storm event. Any spillage contained within the Bridge 1 will also drain into the collection sump.

3.3.8.2 Discharge into Matla Ash Dam Solution Trench after second Watercourse Crossing (Bridge 2) from Gantry

The spillage from the sleeves and Bridge 2 will drain into the solution trench along the Matla Ash Dam through two concrete drain pipes which will cross the ash dam access road.

3.3.8.3 Discharge into Matla Ash Dam solution trench for AWR pipes along Ash Dam

The AWR pipes will follow the Ash Dam access road which will be also used for maintenance as shown in the figure below. The pipes will be placed adjacent to the Matla Ash Dam solution trench which will collect any spillage from the pipeline. A new road and solution trench for this portion will therefore not be required.

3.3.8.4 Discharge into Solution Trench at AWR Pump House Discharging into Final Cut

As the AWR servitude deviates from the existing solution trench, a new solution trench and road will be provided along the pipeline. Most of the route will be placed alongside the existing access roads which will be used. The natural ground level along the pipeline slopes towards the Booster Pump House. The solution trench will therefore drain towards this pump house before discharging into an existing solution trench leading to the Final Cut.

4 WATER USES

4.1 Authorised Water Uses on the Property

In terms of Section 32 of the NWA, an existing lawful water use is defined as follows:

"*Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (01 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful use in terms of Section 33 of the Act*".

In 1986 Permit 899N was issued to the Kriel Power Station in terms of Section 12 (1) of the old Water Act of 1956 (Act No. 54 of 1956), which authorised the use of a specific volume of water. However, as mentioned before, the permit does not stipulate the management of specific activities and hence Kriel Power Station is applying to comply with the new legislation while acknowledging existing and current water uses.

In 2009, DWS (then Department of Water Affairs) issued Licence No. 27/2/1/C211/1/1 to Eskom based on the central Eskom WULA for abstraction of water. The WUL provides for a supply of 42 million m^3/annum (42 000 Mℓ) from the Usutu / Usutu-Vaal Water Schemes to Kriel power station and is based on a 99.5% assurance of supply level. The 99.5% assurance level implies that the risk of failure to supply water to Eskom from South Africa's water resources is 1 in 200 years.

4.2 Water Uses that Require Licensing

4.2.1 Water Uses in terms of Section 21 of the National Water Act, 1998 (Act 36 of 1998)

Water uses which require authorisation in terms of section 21 of the NWA include:

- 21 (c): Impeding or diverting the flow of water in a watercourse; and
- 21 (i): Altering the bed, banks, course or characteristics of a water course.

4.2.2 Description of Water Uses

The water uses as set out above pertains to the fact the envisaged pipeline systems forming part of the Project will cross water courses as defined by the Act.

4.3 Affected Water Resources

The pipeline systems will, along its route, cross an altered channelled valley bottom wetland, an isolated seep wetland two non-perennial streams. The altered channelled valley bottom wetland and non-perennial streams form part of the Onverwachtspruit.

5 BASELINE DESCRIPTION

The watercourses that the pipelines will traverse include an altered channelled valley bottom wetland and two non-perennial streams as well as an isolated seep wetland. The former being part of the Onverwachtspruit. This stream has been diverted in 1986 around the historical Kriel Mine's opencast pits and it currently flows between the two ash dams via a diversion channel. The stream is a tributary to the Steenkoolspruit.

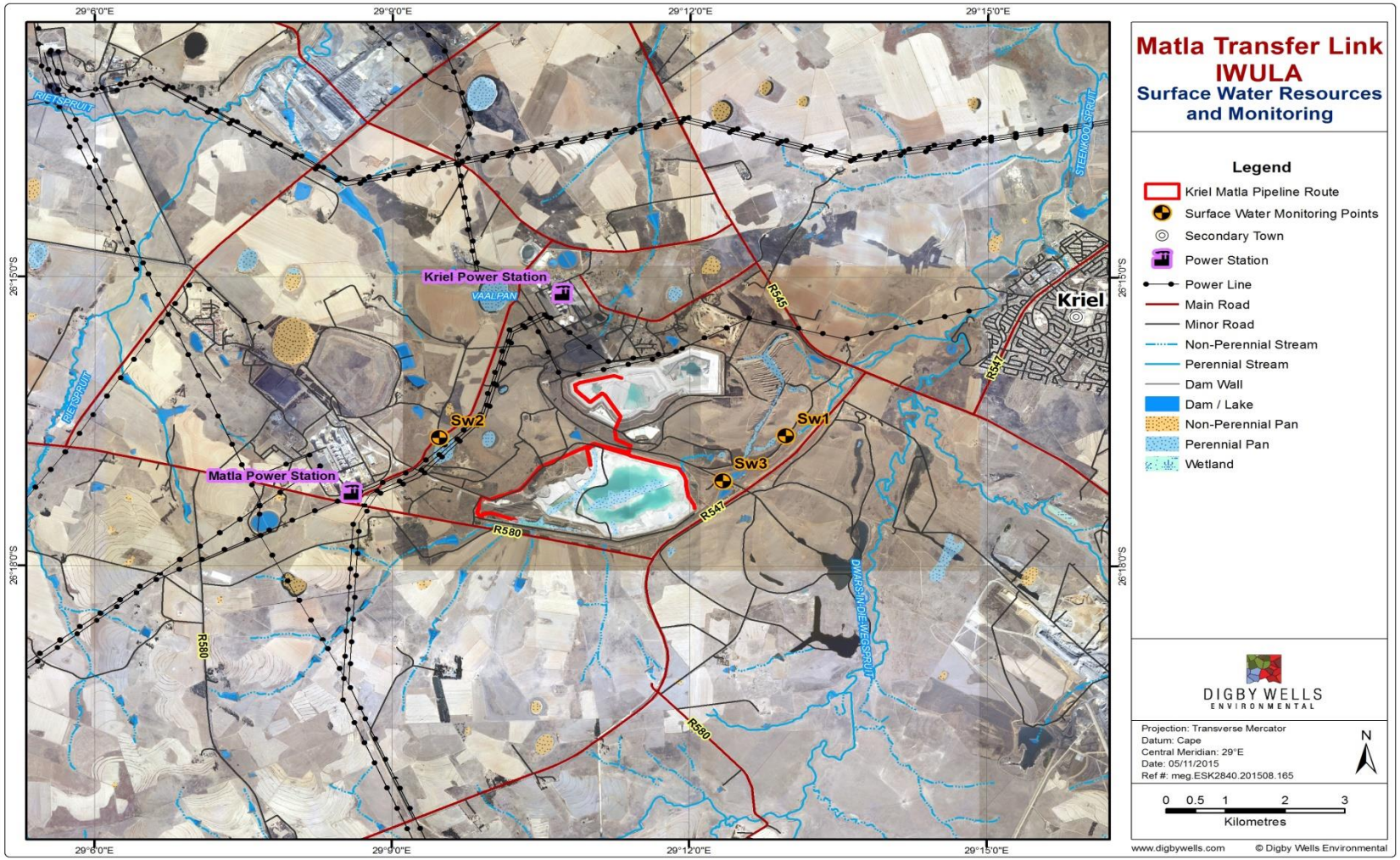
5.1 Surface Water

The Onverwachtspruit is located in the Olifants WMA (WMA 04) on the watershed between the B11D and B11E quaternary catchments, which forms part of the Steenkoolspruit sub-catchment. The Rietspruit, Steenkoolspruit, Onverwachtspruit and Pampoenspruit are the main rivers located in close proximity to the Kriel Power Station project area.

Land use activities associated with the subject river system were originally primarily cattle and maize agricultural activities, however, coal mining and power generating activities have occurred in the area with vast regions being covered in remediated land as well as active coal mining operations. Within the immediate catchment area, large ash dumps are present.

5.1.1 Water Quality

The Onverwachtspruit water quality results for the study completed by Digby Wells (2014) during surveys in October are presented in Table 5-1 and Table 5-2 below. Water quality monitoring points are shown in Plan 6.



Plan 6: Water monitoring points

Date	Sample ID		Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
	Class I	(Recommended)	<1000	<10	<200	N/S	<400	<150	<70	<200	<50	<0.2	<0.1	<150	5-9.5	<0.3	<1	<1
	Class II	(Max. Allowable)	1000-2400	10-20	200-600	N/S	400-600	150-300	70-100	200-400	50-100	0.2-2	0.1-1	150-370	4-5 or 9.5-10	0.3-0.5	1-2	1-1.5
		Duration	7 years	7 years	7 years	N/S	7 years	7 years	7 years	7 years	7 years	7 years	7 years	7 years	No Limit	1 year	None	1 year
2014/10/06	SW1		**1744.00**	0.13	54.70	284.00	**958.00**	**209.00**	**112.00**	184.00	**51.10**	0.00	0.00	**255.00**	8.61	0.00	0.07	0.42
2014/10/06	SW2		948.00	0.13	74.50	616.00	125.00	57.20	44.60	**200.00**	**56.70**	0.00	0.00	**156.00**	8.51	0.00	**7.44**	**3.83**
2014/10/06	SW3		713.00	0.13	91.20	184.00	271.00	67.30	44.80	108.00	16.20	0.00	0.00	115.00	8.64	0.00	0.17	0.86

Table 5-1: Water quality (benchmarked against the SANS 241-1:2011 Drinking Water Quality Standards)

Date	Sample ID		Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
	Class I	(Ideal)	<200	<6	<40	20	<80	<10	<70	<70	<25	-	-	<30	<8	-	<0.015	<0.7
	Class II	(Acceptable)	350	<10	<120	97.5	<165	<80	<100	<92.5	<50	-	-	<50	8.4	-	0.044	<1
2014/10/06	SW1		**1744.00**	0.13	54.70	284.00	**958.00**	**209.00**	**112.00**	184.00	**51.10**	0.00	0.00	**255.00**	8.61	0.00	0.07	0.42
2014/10/06	SW2		948.00	0.13	74.50	616.00	125.00	57.20	44.60	**200.00**	**56.70**	0.00	**0.68**	**156.00**	8.51	0.00	**7.44**	**3.83**
2014/10/06	SW3		713.00	0.13	91.20	184.00	271.00	67.30	44.80	108.00	16.20	0.00	0.00	115.00	8.64	0.00	0.17	0.86

Table 5-2: Water quality (benchmarked against resource quality objectives of the Olifants water management area)

The chemical results of the three sampled water resources can be summarised as follows (benchmarked against SANS 241-1:2011):

- Sample SW1 shows elevated concentrations of SO_4, Ca, Mg, K and subsequently high TDS and EC, and exceeds the SANS Class I drinking water quality standards. Calcium and K concentrations; and TDS/ EC are within the Class II water quality guideline concentrations. However, SO_4 and Mg exceed the maximum allowable limit; thus Class III water. This sampling point is an old mine void filled with water and therefor the high level of dissolved salts in the water. The water in this void is not suitable for human consumption due to the high sulfate and magnesium concentrations.
- Sample SW2 is a natural pan located on the western boundary of the Project site. The results show elevated concentrations of manganese (112.0 mg/L), sulfate (958.0 mg/L), ammonia (7.44 mg/L) and fluoride (3.83 mg/L). High ammonia might be an indication of animal waste. Manganese and sulfate might emanate from the storm water runoff that reports into the pan, as the area is surrounded by mine voids, rehabilitated areas and an un-rehabilitated ash dam. Fluoride is a naturally occurring substance, but can also be supplemented by agricultural fertilisers and combustion of coal. Phosphate fertilisers contribute to fluoride in irrigated lands.
- Sample SW3 is a sampling point on the unnamed, non-perennial stream located on southeast of the Project site. Water quality results indicate a water quality where all analysed constituents fall within the recommended guideline limits and therefore the water from this stream can be classified as Class I water.

When benchmarked against the resource quality objectives of the Olifants WMA, the chemical results of the three sampled water resources can be summarised as follows:

Note that the water quality objectives for the Olifants water management are more stringent than that of SANS and the standards have been classified as 'Ideal' and 'Acceptable'.

- In sample TDS, Cl, Ca, K and EC were exceeding the ideal Olifants WQO, but are still within the acceptable level. CaCO3, pH, SO_4 and Mg exceeded the acceptable level; and;
- Samples SW1 and SW2 indicated the same water quality when compared against the Olifants WQO. The water quality can be classified as acceptable for ecological purposes, but not ideal for domestic use.

5.2 Aquatics

A study completed by Digby Wells in 2014 was used to supplement the available information pertaining to the Present Ecological Status (PES) and is presented in the table below (Table 5-3). The Recommended Ecological Category and Default Ecological Management Class were obtained from DWS (2014).

Table 5-3: Summary of the findings of this study.

Catchment	Desktop	This study
Present Ecological Status	Class D (Largely modified)	Class D (confirmed)
Ecological Importance	Moderate	Moderate
Ecological Sensitivity	High	High
Default Ecological Management Class	Class B	Class C/D
Recommended Ecological Category	Class B	Class C/D

5.2.1 Flow and Sediment Regimes

The subject watercourse is a wetland ecosystem and therefore does not comply with standard river system features. Typically, due to the nature of the watercourse sediment is deposited within the wetland and therefore the erosional capacity of the system is limited. Flows in this system are increased during the summer period between November and March. Lower flows and inundation states are present from April to October.

5.2.2 Water Quality

The results of the *in situ* water quality analysis completed by Digby Wells (2014) during surveys in October and November 2014 are presented in the table below (Table 5-4).

Table 5-4: Water quality results obtained during the October and November 2014 surveys.

Constituent	Range	Kriel EWR (October)	Kriel EWR (November)
pH	6–9	7.72	8.78
Temperature (°C)	5–30	24	21.8
Conductivity (µS/cm)	<700	1 585	2120
DO (mg/l)	>5	6.4	9.6
DO (% saturation)	60-120	102	106

Constituent	Range	Kriel EWR (October)	Kriel EWR (November)
*Shading denotes exceeding recommended guidelines (DWAF, 1996)			

The results presented in the Table 5-4 indicate that there is an excessive concentration of dissolved solids. These concentrations would be seen as a limiting factor for sensitive aquatic organisms. With the exception of the conductivity levels, all other constituents considered were within guideline values stipulated in the guidelines for aquatic ecosystems (DWAF, 1996).

5.2.3 Riparian and in Stream Habitat

5.2.3.1 Morphology

A stream diversion at KPS has resulted in the creation of a channeled valley bottom wetland. As a consequence, considerable alteration to the hydrology, geomorphology and ecological functioning of this aquatic ecosystem has taken place as seen in the figure below (Figure 5-1).

Figure 5-1: River diversion at the Kriel PowerStation. Photograph captured during a site visit on the 6th of October 2014.

5.2.3.2 Vegetation

The riparian vegetation associated with the subject watercourse is described in the wetland component of this study.

5.2.3.3 Biota

The results of the Digby Wells (2014) study considered the macroinvertebrate communities associated with the subject watercourse. The results for the South African Scoring System 5 (SASS5) assessment are presented in Table 5-5.

Table 5-5: SASS 5 results for the low and high flow period (October and November) at subject river system.

Survey	October	November
Taxa	18	20
ASPT	4.7	4.5
SASS 5	85	89
Biological Band	B/C	B/C

Based on the results of the low flow survey the SASS 5 score was 85 with an ASPT of 4.7, with the high flow survey results presenting a SASS 5 score of 89 and an ASPT of 4.5. This would place the invertebrate community in a Class B or largely natural category. However, it should be noted that the biological banding provided in Dallas (2007) is meant as a guide. Therefore, based on the absence of families such as Heptageniidae, Perlidae, Tricorythidae and other sensitive families belonging to Odonata the site is classified as Class C or moderately modified.

Sensitivity of expected species of aquatic biota is considered highly tolerant to moderately tolerant to pollution. The absence of sensitive species indicates low habitat availability (due to anthropogenic impacts and low habitat diversity) and serious physico-chemical impacts which have been attributed to activities such as mining, cultivation, irrigation (i.e. agricultural return flows), sewage works, urban areas and industries (DWAF, 2013)

Despite attempts by Digby Wells (2014) no fish have been captured within the subject watercourse. However, an expected fish species list was generated according to information that is available from DWA 2013 and these are presented in (Table 5-6). As there is no available data on expected species in the Steenkoolspruit, expected species are taken from the upper Olifants catchment area, specifically B11A and B11B catchment areas.

Table 5-6: Expected fish species in the upper Olifants catchment area (DWAF, 2013).

Fish species	Common name
Barbus anoplus	Chubbyhead Barb
Barbus neefi	Sidespot barb

Fish species	Common name
Barbus paludinosus	Straightfin Barb
Clarius gariepinus	Sharptooth Catfish
Cyprinus carpio	Carp (Exotic)
Labeo umbratus	Moggel
Labeobarbus polylepis	Smallscale yellowfish
Micropterus salmoides	Largemouth bass (Exotic)
Pseudocrenilabrus philander	Southern Mouthbrooder
Tilapia sparrmanii	Banded Tilapia

None of the fish species listed above are considered red data species or form part of the protected species list of South Africa (Government Gazette, 16 April 2013). The almost threatened species *Labeobarbus polylepis* was found to be expected in the quaternary catchment, however, habitat in the subject watercourse is deemed not sufficient to support this species and therefore can only be expected downstream.

5.3 Wetlands

The identified wetlands were classified according to the hydro-geomorphic (HGM) determinants based on modification of the system proposed by Brinson (1993), and modified for use by Marneweck and Batchelor (2002) and subsequently revised by Kotze *et al.* (2004).

The affected watercourse is an unnamed tributary of the Steenkoolspruit River. This wetland has been significantly altered from its natural state and has been channelled by restrictive barriers in the form of roads and the northern wall of the Matla Coal Mine Ash Dam. The main watercourse associated with the proposed pipeline flows in a westerly direction. This wetland is dominated by *Phragmites australis* (Common Reed), a typical indicator of increased sedimentation. In addition, *Seriphium plumosum* (Bankrupt Bush) was prevalent, which is an indicator of over utilised, disturbed habitat. Examples of plant species recorded in wetland areas on site are listed in Table 5-7; the majority of which are alien plant species.

Table 5-7: Examples of plant species recorded in wetlands on site

Family	Species Name	Common Name	Ecological Significance
Asteraceae	*Helichrysum sp.*	/	/
Asteraceae	*Seriphium plumosum*	Bankrupt Bush	Native invader of wetlands and terrestrial grassland
Astereceae	*Tagetes minuta*	Khakibos	Alien forb
Myrtaceae	*Eucalyptus camuldulensis*	Red River Gum	Alien Invasive Tree
Poaceae	*Cortaderia selloana*	Pampas Grass	Alien Invasive Grass

Family	Species Name	Common Name	Ecological Significance
Poaceae	*Digitaria eriantha*	Digit Grass	Terrestrial Grass
Poaceae	*Imperata cylindrica*	Cottonwool Grass	Permanent Hydrophyte
Poaceae	*Hyparrhenia hirta*	Common Thatching Grass	Terrestrial Grass
Poaceae	*Phragmites australis*	Common Reed	Permanent Hydrophyte
Salicaceae	*Populus x deltoides*	Cottonwood Poplar	Alien Invasive Tree
Salicaceae	*Salix babylonica*	Babylon Weeping Willow	Alien Tree
Verbenaceae	*Verbena brasiliensis*	Brazilian Verbena	Alien Forb

The pipeline crosses wetland area at 2 points, as indicated in Table 5-8. Wetlands are classified as: an altered channelled valley bottom, isolated seep and hillslope seep leading to an altered channel to the south of Matla's Ash Dump.

Table 5-8: Wetland crossing points

Pipeline Crossing	HGM unit
1	Altered Channelled Valley Bottom
2	Isolated Seep

5.3.1 Wetland Current State

The WET-Health tool (as prescribed by Kotze *et al.* 2007) was used to determine the PES of wetlands associated with the study site. The health of a wetland can be determined from a measure of the deviation of wetland structure and function from the wetland's natural reference condition (Macfarlane *et al.* (2007)). The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The PES is determined according to Table 5-9.

Table 5-9: Impact scores and Present Ecological State categories used by Wet-Health

Description	Combined Impact Score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat	8-10	F

Description	Combined Impact Score	PES Category
and biota.		

5.3.1.1 Crossing 1

The initial pipeline crossing is over the main wetland system in the study area, linked to the Steenkoolspruit River. This wetland has undergone change to ecosystem processes, hydrology, geomorphology and vegetation and has been allocated a PES of 'E'. The three modules assessed by the Wet-Health tool are described below:

5.3.1.1.1 Hydrology

Water movement through this wetland would historically have been typified by slow infiltration through relatively dense grassland vegetation over a wider reach. Channelled flow, which is characteristic of the present state of the wetland, is uncharacteristic of natural unchannelled valley bottom wetlands. Slow infiltration allows for effective nutrient assimilation and water purification; in addition to the prevention of erosion. Due to the presence of roads and the northern wall of the Matla Ash Dump, this wetland is artificially channelled. The results of the Wet-Health Assessment are represented in Table 5-10.

5.3.1.1.2 Geomorphology

The natural landscape of this wetland does not represent the natural reference state. Due to channelling and loss of natural vegetation, erosion gulleys are present. Further to this, various roads transect the wetland area, severing natural flow.

5.3.1.1.3 Vegetation

Natural vegetation that would have been present in the wetland in its reference state includes plant species that are typical of the Highveld grasslands; the Eastern Temperate Grasslands vegetation type in particular (Mucina and Rutherford 2006). Due to the largescale disturbance to the catchment, however, little natural vegetation assemblage remains. The majority of the wetland had been colonised by the native invader, *Phragmites australis* (Common Reed) as well as alien forbs and grasses representing low overall diversity of species.

5.3.1.2 Crossing 2

Crossing 2 traverses an isolated seep that has been almost entirely colonised by alien trees. The greatest impact to this wetland is the presence of roads and excavations; resulting in marked alteration of natural landscape topography. The three modules assessed by the Wet-Health tool are described below:

5.3.1.2.1 Hydrology

The dense stands of alien trees that occupy the majority of this wetland will have a considerable impact on water availability in this small system. *Eucalyptus* sp. in particular have high water demands for respiration. In addition, natural infiltration of water through the wetland has been hampered due to the disturbance of the topography.

5.3.1.2.2 Geomorphology

As aforementioned, the geomorphology of this system is completely altered due to the presence of roads and human disturbance to the soil.

5.3.1.2.3 Vegetation

Natural vegetation has been almost completely outcompeted by *Eucalyptus camuldulensis* and *Populus canescens*.

Table 5-10: Results of the Wet-Health Assessment

Wetland System	Module	Health Score	PES Class
Crossing 1	*Hydrology*	7.5	E→
	Geomorphology	4.9	D↓
	Vegetation	5.2	D↓
	Overall Score	6.1	E→
Crossing 2	*Hydrology*	7	E→
	Geomorphology	4.5	D↓
	Vegetation	6.3	E→
	Overall Score	6.0	E→

5.3.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. In the method outlined by DWAF (1999) and Rountree (2012), a series of determinants for EIS (listed below) are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. Criteria for assessing the ecological importance and sensitivity of wetlands (Rountree, 2012) include:

- Primary Determinants:
  - Rare and Endangered Species;
  - Populations of Unique Species;
  - Species/taxon Richness;
  - Diversity of Habitat Types or Features;

- Migration route/breeding and feeding site for wetland species;
- Sensitivity to Changes in the Natural Hydrological Regime;
- Sensitivity to Water Quality Changes; and
- Flood Storage, Energy Dissipation & Particulate/Element Removal.

- Modifying Determinants:
  - Protected Status; and
  - Ecological Integrity.

The median of the determinants is used to determine the EIS of the wetland unit (Table 5-11).

Table 5-11: Interpretation of Median Scores (Ecological Importance and Sensitivity (EIS)) for Biotic and Habitat Determinants (DWAF, 1999)

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very high	>3 and <=4
Floodplains that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers. Recommended Ecological Management Class: **A**	
High	>2 and <=3
Floodplains that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers. Recommended Ecological Management Class: **B**	
Moderate	>1 and <=2
Floodplains that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers. Recommended Ecological Management Class: **C**	
Low/marginal	>0 and <=1
Floodplains that is not ecologically important and sensitive at any scale. The biodiversity of these floodplains is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers. Recommended Ecological Management Class: **D**	

Due to large modification of natural habitat as a result of a history of farming and mining, the study area as a whole is not regarded as ecologically sensitive. The wetland crossings were assigned an EIS of 'D' – a low ecological importance.

Table 5-12: Ecological Importance and Sensitivity

	Crossing 1		Crossing 2	
Determinant	**Score**	**Confidence**	**Score**	**Confidence**
1. Rare & Endangered Species	0	4	0	4
2. Populations of Unique Species	0	4	0	4
3. Species/taxon Richness	1	4	1	4
4. Diversity of Habitat Types or Features	1	4	1	4
5. Migration route/breeding and feeding site for wetland species	1	2	1	2
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	1	2
7. Sensitivity to Water Quality Changes	2	3	2	3
8.Flood Storage, Energy Dissipation & Particulate/Element Removal	3	2	1	2
9. Protected Status	0	4	0	4
10. Ecological Integrity	0	4	0	4
Total	**10**		**7**	
Median	**1**		**1**	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**D**		**D**	

5.4 General Site Sensitivity

The study area does not fall within any formally protected areas, or any areas that are earmarked for future protected status according to the National Protected Areas Expansion Strategy (NPAES). The Mpumalanga Aquatic Conservation Plan (C-Plan) does not identify the study area as ecologically important and has assigned the entire Kriel study area a status of 'not required'. Further to this, the Mpumalanga Biodiversity Sector Plan has classified the areas as 'moderately modified'.

5.4.1 National Freshwater Ecosystems Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources were considered to evaluate the importance of the wetland areas located within the project area (Nel *et al.* 2011).

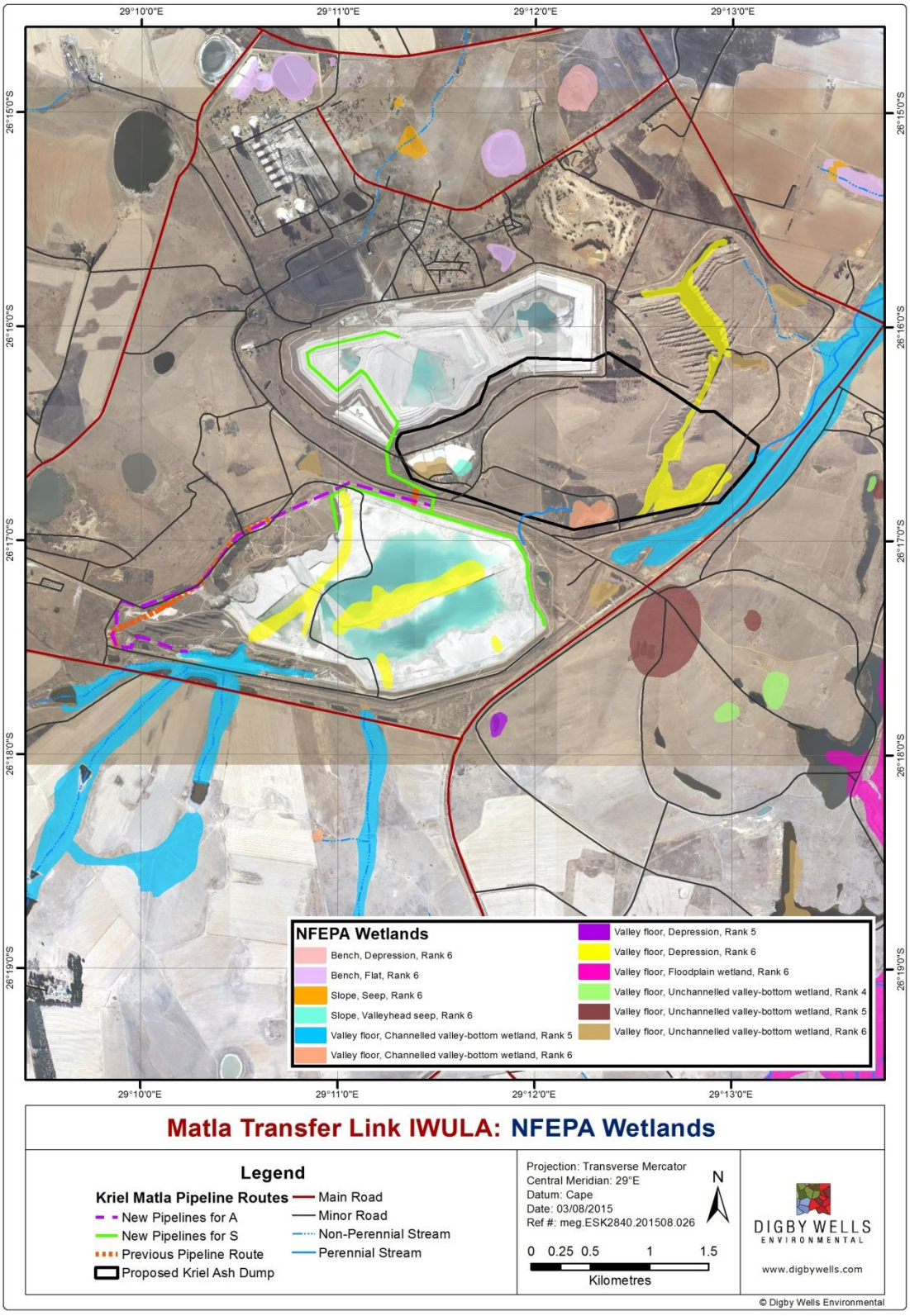
Spatial layers used include the wetland classification and ranking. The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. Table 5-13 below indicates the criteria which were considered for the ranking of wetland areas. Plan 7 represents the NFEPA wetlands identified on site. Not all of the wetland area present on site has been identified by NFEPA and this may be attributed to the large-scale desktop nature of the NFEPA assessment.

The main watercourse that intersects the pipeline route has not been identified by NFEPA. The artificial channelled valley bottom wetland to the south of the Matla Ash Dump has been assigned a rank of 5, indicating that this wetland has been identified as a Working for Wetlands site. Working for Wetlands is a joint initiative with the Department of Environmental Affairs (DEA) and DWS that places focus on the rehabilitation, wise use and protection of wetlands in a manner that maximises employment creation, supports small businesses and transfers relevant and marketable skills to beneficiaries.

Table 5-13: NFEPA wetland classification ranking criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5

Any other wetland (excluding dams).	6



Plan 7: NFEPA Wetlands

6 ASSESSMENT OF POTENTIAL IMPACTS

6.1 Impact Assessment Methodology

The impact assessment process utilises a rigorous, numerical environmental significance rating process which is based on the accepted impact assessment methodology that uses the probability of an event occurring and the severity of the impact, should an event occur, as factors to determine the significance of a particular environmental risk.

To determine the severity of any potential environmental impact, the criteria that are taken into consideration are the spatial extent of the impact, the duration of the impact and the severity of the impact. The probability of an impact occurring is determined by the frequency at which the activity takes place and by how often the type of impact in question has taken place or takes place in similar circumstances.

The aim of the Impact Assessment is to strive to avoid damage or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (DEA, 2013). Offsets that compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is described in Table 6-1.

Table 6-1: Mitigation Hierarchy

	**Avoid or Prevent**	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option, but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation.
	Minimise	Refers to considering alternatives in the project location, sitting, scale, layout, technology and phasing that would minimise impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimise impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Although rehabilitation may fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimise and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

The impacts of the development and operation of the proposed power line on the receiving wetlands areas within the project area were assessed at different stages of the development. A clearly defined rating scale is used to assess each impact in terms of severity, spatial extent and duration (which determines the consequence) and in terms of the frequency of

the activity and the frequency of the related impact (which determines the likelihood of occurrence). See Table 6-2.

The overall impact significance is then determined via a significance rating matrix (Table 6-3) utilising the scores obtained for consequence and likelihood of occurrence, to assign a final impact rating using the following equation.

Equation 1: Impact Significance

$$Significance = (Severity + Scale + Duration) \times Probability$$

The significance of an impact is determined and categorised into one of four categories, as indicated in Table 6-4. Impacts are rated against the scenario without mitigation and with mitigation measures as proposed in this WULA Report.

Table 6-2: Impact assessment parameter ratings

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.

Rating	Severity	Spatial scale	Duration	Probability
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 6-3: Probability Consequence Matrix

Significance										
	Consequence (severity + scale + duration)									
Probability / Likelihood		1	3	5	7	9	11	15	18	21
	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 6-4: Significance Categories

Significance		
High (Major)	**108- 147**	A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects, or very beneficial effects.
Medium-High (Moderate)	**73 - 107**	A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the (natural &/or social) environment and result in severe effects or beneficial effects
Medium-Low (Minor)	**36 - 72**	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.
Low (Negligible)	**0 - 35**	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects on the social and/or natural environment.

6.2 Surface Water Impacts

6.2.1 Construction Phase

A number of activities, especially those relating to the access of construction vehicles along the alignment of the pipeline can result in damage to and impacts on surface water resources. Construction vehicles and machinery that move along the alignment of a pipeline during construction would typically cross drainage lines. New access routes may be required should existing access for vehicles not be sufficient. Below are the activities and their associated impacts on the surface water resource.

6.2.1.1 Removal of Vegetation

- The removal of vegetation around a construction area exposes the surface area leaving the soil prone to erosion. This may result in siltation of the water resource and this will have an impact on the downstream water users and the aquatic life as well; and
- Inadequate storm water management and soil stabilisation measures in cleared areas could lead to erosion and associated sedimentation of nearby watercourses.

6.2.1.2 Installation of Pipelines

- The use of machinery during construction and installation of pipelines have the potential of hydrocarbons (fuel and oil) leakages which can result in the contamination of the receiving water resources;
- Movement of heavy construction machinery around stream may result in disturbance of the river banks, and destabilises the soil. This will increase the chance of erosion during rainfall thereby result in sedimentation of the water resources;
- The uncontrolled interaction of construction workers with the watercourses could lead to pollution of the water in the river. Examples of this may be the washing of equipment within the watercourse; and
- Establishing of new access paths for construction across watercourses may lead to the erosion of banks and disturbance of riparian vegetation that may trigger the further development of gulley (donga) erosion thereby reducing the quality of water.

6.2.1.3 Mitigation measures for the construction phase

The following recommendations are made as mitigation measures that must be implemented to prevent and/or minimise the above potential impacts:

- The construction phase should be limited to the dry months of the year (May-October) where possible to limit mobilisation of sediments or hydrocarbon runoff;

- Engineered solutions such as sediment fences or silt traps should be used where appropriate to limit increased sedimentation of surface water resources during construction;
- Minimise the removal of vegetation in the infrastructure footprint area;
- Revegetation of the construction footprint as soon as possible;
- Existing access roads must be prioritized to avoid construction of new access roads in the area; and
- The river must not be utilised for abstraction, or washing of equipment, etc., in order to minimise the risk of water pollution during construction activities. All necessary water abstractions from any surface water resource must be authorised as prescribed by the NWA and be subject to the provisions of a water use licence and general authorisation.

The table below present the pre-mitigation and post-mitigation impact significance rating of the above impacts.

Activity: Removal of Vegetation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Siltation of Water Resources			
Prior to mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	30 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	
Probability	5 (Likely)	The impacts are likely to occur.	
Nature	Negative		
Post mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	16 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	

Probability	2 (Improbable)	The impacts are improbable.	
Nature	Negative		
Activity: Pipeline Installation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Contamination of Water (Hydrocarbon Spillages)			
Prior to mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	40 (Minor)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	4 (Moderate)	Moderately negative impacts are anticipated	
Probability	5 (Likely)	The impacts are likely to occur.	
Nature	Negative		
Post mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	28 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	3 (Moderate)	Moderately negative impacts are anticipated.	
Probability	4 (probable)	The impacts are improbable.	
Nature	Negative		

6.2.2 Operational Phase

The risk associated with the operation of the pipelines would be spills or leaks associated with either poor seals or more significant faults such as breaks/bursts. This could lead to contamination of water resource when the slurry enters the stream or wetland.

6.2.2.1 Mitigation Measures for the operational phase

The following mitigation actions are recommended:

- It is recommended that pipeline structures at the river crossing should cover the bottom part of the pipeline, this should be designed and placed in way that enables it to contain and divert any spill/leakages away from the stream;

- Monitoring of pipeline leakages on the section where it crosses the stream should be undertaken on a weekly base. This will ensure detection of leaks or faults in the pipeline and immediately repair before significant spill/burst occur;
- It is recommended that water quality monitoring be undertaken on a monthly basis to ensure detection of impacts from leakages of the slurry;
- If pipeline spills/leakage occurs the following mitigation approach is recommended:
  - Ensure that the emergency spillage response plan is drafted and accessible to the responsible monitoring team;
  - Containment of sludge and water as much as possible using berms and cut off trenches;
  - Sludge which is present within the river reaches should be removed by mechanical means;
- Accidental spills or leaks or pipe bursts resulting in the contamination of the receiving water environment should be reported to the authorities and downstream communities/water users should be informed not to use the water until any potential impacts are sufficiently mitigated;
- Storm water management channels or catchment paddocks will be put in place, these is necessary to both contain any spillage as well as to contain runoff generated during normal and extreme rainfall events; and
- All pump discharge pipelines will be fitted with pressure transmitters, which will be utilised to trip the associated pump if a pressure drop is detected and therefore the pumping of sludge will be terminated immediately.

Activity: Pipeline Installation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Contamination of Water (Hydrocarbon Spillages)			
Prior to mitigation/ management			
Duration	5 (Project Life)	The impacts are anticipated to occur for the duration of the project.	60 (Minor)
Extent	3 (Local)	The impact might extend only as far as the development site area.	
Intensity	4 (Moderate)	Moderately negative impacts are anticipated.	
Probability	5 (Likely)	The impact may occur. <65% probability.	
Nature	Negative		

Post mitigation/ management			
Duration	5 (Project Life)	The impacts are anticipated to occur for the duration of the project.	30 (Negligible)
Extent	2 (Limited)	The impacts are limited to the site and its immediate surroundings	
Intensity	3 (Moderate)	Moderately negative impacts are anticipated	
Probability	3 (probable)	The impacts are improbable.	
Nature	Negative		

6.2.3 Decommissioning Phase

The decommissioning of the pipelines is set to leave the pipes in-situ. This does not pose any risk of contamination to the surface water resources assuming pipelines contain no residual contaminant.

6.3 Aquatic Impacts

6.3.1 Construction Phase

The impacts of the proposed pipeline crossing during the construction phase are presented below. The following impacts are expected to potentially occur as a result of the proposed water use.

Increased runoff as a result of vegetative cover loss could result in instream and riparian habitat modification or destruction through erosion, flow, bed, channel and water quality modification. Water quality modification can be related to an increase in the amount of suspended/dissolved solids which can result in increased sedimentation and changes to the physical chemistry of the water in downstream regions. These physical impacts could lead to reduced aquatic biodiversity.

Watercourse pipeline crossing			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Water and habitat quality modification			
Prior to mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	30 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	

Probability	5 (Likely)	The impacts are likely to occur.	
Nature	Negative		
After mitigation/ management			
Duration	2 (Short term)	The impacts are anticipated to occur for the duration of the construction phase which is predicted to be less than 1 year.	16 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the construction activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	
Probability	2 (Improbable)	The impacts are improbable.	
Nature	Negative		

Based on the above results for the impact assessment, negligible impacts are anticipated as a result of the proposed project during the construction phase.

During the construction phase vehicles will be used in proximity to aquatic resources. The use of these vehicles presents risk of persistent hydrocarbon pollution events which can be avoided through the use of the following management actions:

- Hydrocarbon spill kits and employee training in their use;
- Regular inspection for leakages and subsequent repair (maintenance); and
- The refuelling/oiling of vehicles in contained areas (bunded areas) built to the capacity of the facility provided with sumps.

The removal of vegetative cover as well as the construction of roads has been recognised as being responsible for increased runoff, sedimentation and subsequent water and habitat quality degradation in downstream portions of river systems (WRC, 2014). As such the careful management of vegetation removal and sedimentation control should take place. This can be achieved through the brief points below:

- Minimise the removal of vegetation in the infrastructure footprint area;
- Revegetation of the construction footprint as soon as possible;
- Where storm water enters river systems, sediment/silt and debris trapping, as well as energy dissipation control measures must be put in place;
- Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow;
- Sequential removal of the vegetation (not all vegetation immediately); and
- The vegetation of unpaved roadsides.

6.3.2 Operational Phase

The impacts of the proposed pipeline crossing during the operation phase are presented below. The following impacts are expected to potentially occur as a result of the proposed water use.

Habitat impacts resulting in flow, bed and channel modification could potentially occur within a limited area downstream of the proposed infrastructure.

Watercourse pipeline crossing			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Water and habitat quality modification			
Prior to mitigation/ management			
Duration	5 (Project life)	The impacts are anticipated to occur for the duration of the operation phase which is predicted as the time period in which the project will occur.	36 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the pipeline activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	
Probability	4 (Probable)	The impacts are probable to occur.	
Nature	Negative		
After mitigation/ management			
Duration	5 (Project life)	The impacts are anticipated to occur for the duration of the operation phase which is predicted to the time period in which the project will occur.	18 (Negligible)
Extent	2 (Limited)	The impacts are likely to be isolated around the pipeline activities.	
Intensity	2 (Minor)	Only minor rated intense impacts are anticipated.	
Probability	2 (Improbable)	The impacts are improbable.	
Nature	Negative		

The operation phase is expected to have a negligible impact on local aquatic biota before mitigation.

The construction and operation of pipeline infrastructure over the subject watercourse would potentially negatively influence the local aquatic habitat. As such, it is important to consider the following management actions:

- No crossings should take place over riffle/rapid habitats as these are the most sensitive; slow deep/shallow habitats should be favoured;
- The crossing points should be stabilised to reduce the resulting erosion and downstream sedimentation;
- Structures must not be damaged by floods exceeding the magnitude of those which are may occur on average once in every 100 years;
- The indiscriminate use of heavy vehicles and machinery within the instream and riparian habitat will result in the compaction of soils and vegetation and must be controlled;
- Erosion prevention mechanisms must be employed to ensure the sustainability of all structures to prevent instream sedimentation;
- The crossing points should be unobtrusive (above 1:100 water mark) to prevent the obstruction and subsequent habitat modification of downstream portions;
- Diversion trenches and berms should convey dirty water to temporary ditches so as to contain runoff;
- Soils adjacent the river that has been compacted must be loosened to allow for germination;
- Stockpiling of removed soil and sand must be done outside the 1:100 floodline or delineated riparian habitat (whichever is greater). This will prevent solids from washing into the river;
- Unpaved roads used to inspect and construct the pipelines should have their sides vegetated;
- No hinges/flanges should be present within the pipeline over the river system as these points are prone to leakages. Therefore, an elongated section devoid of flanges/hinges should be used; and
- Should a spillage occur an emergency management plan, including rehabilitation plan, with emergency cut off valves should be in implemented.

6.4 Wetland Impacts

The construction of the transfer link pipeline is not anticipated to have any major direct negative impacts on wetlands. It is not envisaged that the construction or operation of the pipeline will result in a change in PES to the affected wetlands, since these wetlands are already largely altered.

6.4.1 Disturbance due to Presence of Heavy Machinery

Movement of heavy machinery through wetland areas during the construction of the pipeline may result in compaction of sediment in the wetland, reducing natural infiltration through those areas. Further to this, minor disturbance of soil will result; which will promote the

spread of alien or invasive plant species already present in the wetland, such as: *Cortaderia selloana, Tagetes minuta* and *Seriphium plumosum.* Increased erosion and sedimentation may incur as an additional impact of soil disturbance.

During the operational phase, regular maintenance will be required. Due to the short-term operation of the pipeline (4 years), it is recommended that maintenance should only be undertaken bi-annually (or less frequent if possible) to prevent disturbance to the wetland. Minor disturbance to the wetland is expected during the operational phase. It is assumed that the pipeline will be left *in situ* after operation and that there will not be a decommissioning phase.

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significance*
Impact	***Disturbance to the soil – erosion, compaction and sedimentation***				
Construction Phase					
Pre-mitigation	Moderate (3)	Local (3)	Permanent (6)	Likely (6)	66 (Minor)
Post-mitigation	Moderate (3)	Local (3)	Short-term (2)	Likely (6)	42 (Minor)
Operation Phase					
Pre-mitigation	Moderate (3)	Limited (2)	Short-term (2)	Likely (6)	42 (Minor)
Post-mitigation	Minor (2)	Limited (2)	Short-term (2)	Likely (6)	30 (Low)

6.5 Mitigation Measures

Wetland areas should be avoided as far as possible during the construction and decommissioning phases. The following mitigation measures have been prescribed:

- To prevent soil compaction in the wetland, the surface sediments should be lightly loosened after heavy machinery and vehicles have passed through the wetland areas;
- Areas of bare soil should be revegetated with plugs or mats of *Cynodon dactylon* (Couch Grass) and *Imperata cylindrica* (Cottonwool Grass) to prevent erosion during floods;
- Steel containment structures should be fitter along the length of the section of pipeline that crosses the wetland and

- Diesel/oil spills should be reported within 24 hours and a spillkit should be readily available within proximity to the site to clean up the spill.

6.6 Risks

Unplanned events (risks) and their management measures are summarised in Table 6-5.

Table 6-5: Unplanned events, low risks and their management measures.

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon Spillage	Water quality degradation	■ Bunded storage of hydrocarbons outside 1:100 floodline or 500m buffer/delineated riparian habitat, whichever is greater. ■ Hydrocarbon spill kits and employee training in their use; ■ Regular inspection for leakages and subsequent repair (maintenance); and ■ The refuelling/oiling of vehicles in contained areas (bundeded areas) built to the capacity of the facility provided with sumps.
Leakage and rupturing of pipelines	Water and habitat quality degradation	■ No flanges should be installed over river systems or within the buffer zones. ■ Cut-off and continuous spillage monitoring systems. ■ All pump discharge pipelines will be fitted with pressure transmitters, which will be utilised to trip the associated pump if a pressure drop is detected ■ Implementation of an Emergency remediation plan should spillage occur.

6.7 Monitoring

The objective of the monitoring programme would be to monitor the potential water quality impacts resulting from the proposed pipeline during construction and operations. A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented.

The water quality parameters that should be monitored include TDS, pH, EC, SO4, Al, PO4, CN-, Fe, Mn, Ca, Mg, NO3, NH3, F, Cl, Na, K, SS, Turbidity and hydrocarbons. All surface water features should be sampled, including upstream and downstream of the proposed ash dam to establish if there is a change in water quality status due to the proposed activities. The monitoring programme should allow for a sampling frequency as indicated in

Table 6-6.

Table 6-6: Monitoring program sampling frequency over the respective project phase

Phase	Variables	Frequency
Construction	pH, TDS, EC and SS	Weekly
Operation	All	Monthly Where negative impacts are detected, immediate remediation measures should be undertaken and monitor monthly for a reasonable period until such impact has been mitigated.

7 SECTION 27 MOTIVATION

7.1 Existing Lawful Water Use

All current Section 21 water uses constitute existing lawful use. Kriel Power Station is operating under Exemption 1167B granted in terms of Section (4) of the Water Act, 1956 and WUL No. 27/2/1/C211/1/1 for abstraction of water.
Exemption 1167B permits:

- The purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and
- The discharge of the effluent into the Pampoenspruit downstream of the Maturation Pond.

7.2 Redress of Past Racial and Gender Discrimination

Eskom's social responsibility is carried out through the Eskom Development Foundation, a Section 21 company, which is responsible for the integration of all corporate social investment initiatives. Eskom supports economic projects that complement the ASGISA (Accelerated and Shared Growth-South Africa) program objectives.

Development grants are awarded for the purposes of contributing towards meeting identified economic and social needs.

Economic grants are offered for the purposes of contributing to the development and sustainable growth of SMME's (Small, Medium and Micro Enterprises) from previously disadvantaged communities with focus on job creation, skills development and the alleviation of poverty projects in Agriculture, Manufacturing, Trade and Services sectors are considered.

Social grants are offered for the purposes of contributing to the development of formally constituted/registered non –profit organisations involved in social projects from primarily disadvantaged communities in order to aid their sustainability and growth. Projects in the education, health, and nutrition as well as sanitation sectors area are considered for social grants.

Kriel power station is not directly involved in the above initiatives but has implemented an adult literacy program for employees at the power station. This has enabled previously disadvantaged employees to progress up to higher levels within the organisation.

7.3 Efficient and Beneficial Use of the Water

Power generation is recognised as a significant indirect contributor to the Gross National Product (GDP) of South Africa, as it contributes about 15% to the GDP and creates employment opportunities to approximately 250 000 people whilst only using 2% of South Africa's water resource (GCIS, 2011).

Eskom generates about 95% of the electricity in South Africa and also exports it to countries in Africa. The power generated at Kriel Power Station feeds into the national grid.

The power generation industry recognises the critical importance of water to both its operations and to the long term sustainable growth of the area. The energy sector is highly dependent on reliable supplies of water for the generation of electricity (steam generation and cooling processes), and an elaborate and sophisticated network of water transfer and storage schemes have been developed specifically to support this sector and ensure high levels of reliability. The water sector is on the other hand highly dependent on a constant and reliable supply of electricity to transfer water from the various storage schemes to areas were water is required.

The production of electricity is therefore in the best interest of the public at large. Kriel supplies electricity to the national grid and the station is expected to be in operation until 2043. However, should this project not be authorised, electricity production from KPS will cease by mid-2017, adding to the country's existing power generation woes.

7.4 The Socio-Economic Impact

KPS cannot operate without approval for this project. It is as important an input as coal. In summary the benefits relate to:

- Electricity provision;
- Improved local, regional and national economy; and
- The generation of jobs.

The economy of the area is critically dependent on access to affordable electricity that is generated at minimal impact to the environment. The power station cannot continue without the water use licence. If the power station closed down, supply of electricity to the national grid would be decreased and some of the South African population would be without power as this would exacerbate the frequent power shortages experienced, especially during winter. Closure of the power station would also result in the loss of jobs with subsequent, significant direct and indirect implications on the local economy.

7.5 Catchment Management Strategy

The Catchment Management Strategy for the local catchment has not yet been finalised but the Olifants Water Management Area Internal Strategic Perspective (ISP) (DWAF, 2004) provides the framework for DWA's management of the catchment.

Water quality within the Olifants River Water Management Area is highly impacted upon by coal mining. With the Olifants River as one of the main rivers which flow through the Kruger National Park and across international borders and due to the location of the park at the downstream extremity of the water management area, provision of water for meeting the ecological requirements is one of the controlling factors for managing water resources throughout the water management area.

Kriel Power Station is involved in the Upper Olifants Forum and will review its water management philosophy if necessary.

It is important to note that this water use application does not amount to consumptive usage.

7.6 Effects on the Water Courses and Other Users

This water use is non-consumptive, nor would the flow of water be altered, therefore this use will have no impacts on up or downstream users. The impact undertaken in Section 6 indicated that the significance of the potential impacts on the surface water, aquatic and wetlands varies between negligible and minor prior to the implementation of mitigation measures.

7.7 Class and Resource Objectives of the Water Resource

The Witbank dam catchment guidelines are used by Eskom as the water quality objectives for the Rietspruit and the Steenkoolspruit. The Witbank dam guidelines were determined as part of the Olifants River Basin Water Quality Management Plan and are applicable to all streams in the Witbank dam catchment.

7.8 Investment by the Water User

Eskom has employed various service providers in order to identify and determine the potential alternatives available in the meantime to dispose of the ash until the ash facility is authorised and constructed in the fourth quarter of 2020.

7.9 Strategic Importance of the Water Use

Electricity generation is seen as a strategic important use of water and if this water use is not authorised the power station will not be able to continue with power generation operations at KPS.

7.10 The Quality and Quantity of Water in the Resource which may be required for the Reserve

The resource quality objectives are already in place.

Table 7-1: Set of interim resource water quality objective (RWQO) for the management units of the Upper Olifants Sub- area and the Loskop Dam sub catchment

Water Quality Variable	Units	Management Units								
		1	2	3	4	5	6	7	9	10
PHYSICAL										
Conductivity	mS/m	35	70	90	90	70	90	70	70	90
pH		6.5 – 8.4	6.5 - 9.0	6.5 - 9.0	6.5 - 9.0	6.5 - 9.0	6.5 - 9.0	6.5 - 9.0	6.5 – 9.0	6.5 – 8.4
Dissolved Oxygen	% sat	70	70	70	70	70	70	70	70	70
Suspended Solids	mg/l	-	25	25	25	25	-	-	-	-
Turbidity	NTU	100	50	50	50	50	-	-	-	5
CHEMICAL, INORGANIC										
Alkalinity, $CaCO_3$	mg/l	120	-	-	-	-	-	-	120	-
Boron, B	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.15
Calcium, Ca	mg/l	24	150	150	150	150	150	150	150	150
Chloride, Cl	mg/l	20	25	175	175	25	50	25	25	30
Fluoride, F	mg/l	0.75	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.75
Magnesium, Mg	mg/l	15	70	80	80	70	80	70	70	80
Potassium, K	mg/l	25	50	50	50	50	50	50	50	40
Sodium, Na	mg/l	30	70	115	115	70	115	70	70	70
Sulphate, SO_4	mg/l	30	200	620	840	380	380	140	200	400
Total dissolved solids	mg/l	240	450	650	650	650	650	450	450	650
Sodium Adsorption Ratio (SAR)	$meql^{0.5}$	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
CHEMICAL, ORGANIC										
Dissolved Organic Carbon	Mg/l	10	10	10	10	10	10	10	10	10
METALS (Dissolved)										
Iron, Fe	mg/l	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Manganese, Mn	mg/l	0.18	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.18
Aluminium, Al	mg/l	0.02	0.02	0.2	0.02	0.02	0.02	0.02	0.02	0.02
Chromium VI	mg/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
PLANT NUTRIENTS										
Ammonia*, NH_3-N	mgN/l	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Nitrate, NO_3-N	mgN/l	6	6	6	6	6	6	6	6	6
Phosphate**, PO_4-P	mgP/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.07
Total Phosphorus**	mgP/l	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.18
Total Inorganic Nitrogen**	mgN/l	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.9
MICROBIOLOGICAL										
Faecal Coliform	# per 100ml	130	130	130	130	130	130	130	130	130
Chlorophyll a	mg/l	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

* Free, unionised ammonia from NH_3
** Median values

7.11 The Quality and Quantity of Water in the Resource Which May be required for Meeting International Obligations

The impact assessment has indicated that the probability that the water quality and quantity will be affected is considered low.

7.12 Probable Duration

KPS plans to utilise the transfer link until such time as the new ash dam facility has been commissioned. It is recommended that the WUL, should it be approved, be valid for up to and including the year 2022 to accommodate any unforeseen delays in the new facility being commissioned.

8 CONCLUSION

In conclusion, the authorisation of the water use applied for in this application is of national importance. Considering both the temporary nature of the envisaged project and the significance of the predicted impacts, which is partly driven by the fact that the project will commence within extensively modified water courses, it is recommended that this water use be authorised as a matter of urgency.

Appendix A: Registration Forms

Appendix B: Engineering Designs

Eskom	Concept Design Report	Group Technology

Title: **Kriel to Matla Ash Transfer Link.**

Unique Identifier:	**377-PRJ-1-BDDD-D00185-14**
Alternative Reference Number:	**N/A**
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Compiled by	Functional Responsibility	Authorised by
.....	.....	.....
GW Jenner	**JH Fourie**	**I Atiya**
Engineer	**Chief Engineer**	**Discipline Manager**
Bulk Materials Handling	**Bulk Materials Handling**	**Bulk Materials Handling**
Date: 09/09/2015	Date: 9-9-2015	Date: 10-9-2015

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EXECUTIVE SUMMARY

Kriel P. S. Ash Dam will reach its maximum capacity in June 2017[10]. According to the latest schedule a new ash dam will only be commissioned in September 2020, thus for a period of approximately 3,5 years the following intermediate solutions are considered:

- 'Step in and go higher' on the current Ash Dam and
- Kriel-Matla Ash Transfer Link (As per section 1.1 of the URS found in Appendix A).

This report provides an investigation on the feasibility of the 'Kriel to Matla Ash Transfer Link'. It will also serve as input into the Environmental Impact Assessment (EIA) application.

A Sensitivity Analysis was conducted based on the determination of the ash production by utilising the Burn Plan [12] and the 90 % Availability and 90 % Load factor. The results of this assessment were then used to determine the equipment requirements.

CONCLUSIONS

Ash disposal system

- 100 % of Kriel P.S. ash can be transferred to Matla P. S. Ash Dam.
- The system will require that three (3) of the currently installed four (4) ash pumps be in operation.
- Four (4) ash pipelines will need to be installed.

AWR System

An AWR system requirement comparison is depicted in Table 10 below.

Table 1: Comparison of AWR system requirements

AWR system requirements	Burn Plan	90 % Load factor and 90 % Availability
Quantity of Kriel P.S AWR returned to Kriel's system	100 %	100 %
Extra sets of one (1) Barge- and one (1) Booster pump connected in series.	Two (2)	Three (3)
Matla P.S. has an extra Barge mounted Pumping Station which could be utilised	Refurbishment required	Modification and refurbishment required
Extension of Booster Pump house at Matla	To accommodate two (2) extra Booster pumps	To accommodate three (3) extra Booster pumps
AWR pipeline installation	Two (2)	Three (3)

Cost comparison.

Table 2: Cost comparison

Cost estimation	Burn Plan	90 % Load factor and 90 % Availability
Approximate cost estimation	R 158 m	R 183 m (R 25 m additional)

- The currently installed flow meters on the ash discharge pipelines were not correctly specified and can't provide a signal to the VSD's for control purposes.

Electrical

There is a concern of overloading on the overhead power line; depending on how many of the equipment that is fed by it, is in operation simultaneously. The limitation of the overhead line's, current carrying capacity is due to the current load of the ash water return, ash conveyor and slurry plant booster pumps ,11kV coal substation, 380 V South face seepage plant and also upcoming contractor's yard.

Recommendations

- Matla Ash Dam life reduction can be mitigated by conducting a stability analysis to evaluate possible height increase.
- Design a system to transfer 100 % of Kriel P.S ash production to Matla Ash Dam and return all Kriel AWR back for a period of approximately 3,5 years.
- Capacity of the system will be based on the “load factor” and “availability” requirements.
- Proposed pipe servitude between Kriel and Matla to be surveyed and marked to facilitate EIA evaluation.
- New flow meters need to be specified that will enable the control of the velocity in the slurry discharge pipelines by utilising the installed VSD pump motors.
- A detailed load flow study need to be conducted in the Feasibility stage (Basic Design) to quantify the potential risk of overloading of the overhead power lines.

1. INTRODUCTION

Kriel P.S. is a coal fired power station consisting of six (6) units which produce a combined base load of 3 000 MW. The power station has a remaining operating life of 25 years and is scheduled to be decommissioned in 2039. To generate 3 000 MW of electricity coal is burnt by the boilers which produces ash as a waste product. The ash is then disposed of and stored on the Ash Dam.

The Ash Dam will reach its maximum capacity by June 2017 [10]. Studies are currently being conducted for a new Ash Dam, which will be commissioned in September 2020, according to the latest schedule. Thus an approximate four (4) year intermediate solution is required.

Two (2) intermediate solutions under consideration are

- the 'Step in and go higher' of the current Ash Dam,
- the 'Kriel to Matla Ash Transfer Link'.

The 'Kriel to Matla Ash Transfer Link' investigates transferring ash to Matla Power Station's Ash Dam for the interim period.

2. SUPPORTING CLAUSES

2.1 SCOPE

This report discusses the feasibility of temporarily pumping ash from Kriel P.S to Matla P.S Ash Dam.

2.1.1 Purpose

Provides cost estimation and the technical feasibility of pumping ash to Matla's Ash Dam and returning all the AWR back to Kriel P.S. The report will also serve as an input into the EIA application.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions with particular reference to Kriel – and Matla P.S.

2.2 NORMATIVE / INFORMATIVE REFERENCES

2.2.1 Normative

[1] 240-53113685, Rev 2, Design review procedure.

[2] 240-54041252, Rev 1, Standard for Boiler, Coal and Ash Plant Sizing on Existing Power Stations.

[3] 240-71273834, Rev 1, Coal Quality Specification for Eskom Power Stations at staithe/ silo inlet.

[4] 474-9273, Rev 1, Bulk Materials Handling Plant Design Capacity.

[5] SANS 62-1: 2003 Part 1: Pipes suitable for threading and of nominal size not exceeding 150 mm.

[6] SANS 719: 2008 Electric welded low carbon steel pipes for aqueous fluids (large bore).

[7] ESK-1559 R01, Rev 1, Slurry Test Report, Patterson and Cook

[8] Kriel Power Station Ash Dam Pumping, EC Soft, Nico Barnard.

2.2.2 Informative

[9] Presentation, “Ash dam/dump remnant life evaluation”, by Andre Kreuiter, February 2013

[10] Presentation, “Ash Dam/Dump Production Risks”, by Group Technology Engineering, May 2013

[11] Matla Ash Dam Operating and Maintenance Manual, Barnard 2002

[12] Burn Plan, , 6 March 2014

[13] 0.45/56752, Rev 0, Ash Plant – Kriel To Matla Slurry & AWR Lines Overall Route

[14] 0.45/56753, Rev 0, Ash Plant – Matla Final Cut AWR Barge Pump Pipework General Arrangement

[15] 0.45/56754, Rev 0,Ash Plant – Matla AWR Booster Pump House Layout Showing Proposed Kriel Pump house Extensions

[16] 0.45/56755, Rev 0, Ash Plant – Kriel To Matla Ash Lines Enlargement At Matla Ash Dam Intersection

[17] 0.45/56756, Rev 0, Ash Plant – Kriel To Matla Ash Lines Enlargement of AWR Discharge Area

[18] 0.45/56758, Ash Handling Plant Distribution Box Pump House General Arrangement

[19] 0.45/56759, Rev 0, Ash Plants Combined Slurry Pipework Combined Flow Diagram Showing Modifications

[20] 0.45/56760, Rev 0, Ash Plants Combined Ash Water Return System Combined Flow Diagram With Proposed Mods

[21] 0.45/58835, Rev B, Kriel – Matla Ash Transfer Mine Service Road Pipe Crossing Concept

[22] 0.45/198, Rev 1, Kriel Power Station, Station MV and LV Ash Dam Pump station Boards Electrical Diagram

2.3 DEFINITIONS

Ash dam seepage trenches: A trench along the base of the Ash Dam collecting seepage water.

AWR pump set: It is a set of one (1) Barge- and (1) Booster pump connected in series.

2.3.1 Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS4

Abbreviation	Description
AWR	Ash Water Return
BBA	Boiler Bottom Ash
CV	Calorific Value
C_w	Slurry concentration by mass
DB	Distribution Box
DHP	Dust Handling Plant
EIA	Environmental Impact Assessment
ha	Hectare
m	million
MCR	Maximum Continuous Rating
PFA	Pulverized Fuel Ash
PFD	Process Flow Diagram
PS	Power Station

Abbreviation	Description
PSM	Power Station Manager
SWR	Sluice Water Return
VSD	Variable Speed Drive
ar	As received

2.5 ROLES AND RESPONSIBILITIES

The development of the design proposals is the responsibility of Group Technology Engineering.

2.6 PROCESS FOR MONITORING

N/A

2.7 RELATED / SUPPORTING DOCUMENTS

N/A

3. SYSTEM DESCRIPTION

Kriel P.S. Ash Disposal System

Kriel Power Station's ash disposal system utilises two systems, one (1) system to remove the BBA (coarse ash), commonly known as the Ash Plant, and a second system to remove the PFA (dust), commonly known as the Dust Handling Plant (DHP). Coarse ash is pumped by one (1) of two (2) ash pumps per unit, to either a Distribution Box (DB), an Ash Pump house at the (DB) or directly to Ash Dam 3. Conditioned fly ash is transported via the overland conveyor systems to the DB, where it is mixed with sluice water.

From the DB ash is sluiced directly onto the Ash Dam or to both sumps at the Ash Pump house. This Ash Pump house contains four (4) Ash pumps of which two (2) of the four (4) slurry pumps are utilised to pump the slurry mixture, via two (2) pipelines, to the desired location on Ash Dam 1 and 2. cross feed between these two (2) pipelines is also possible (refer to Figure 1).

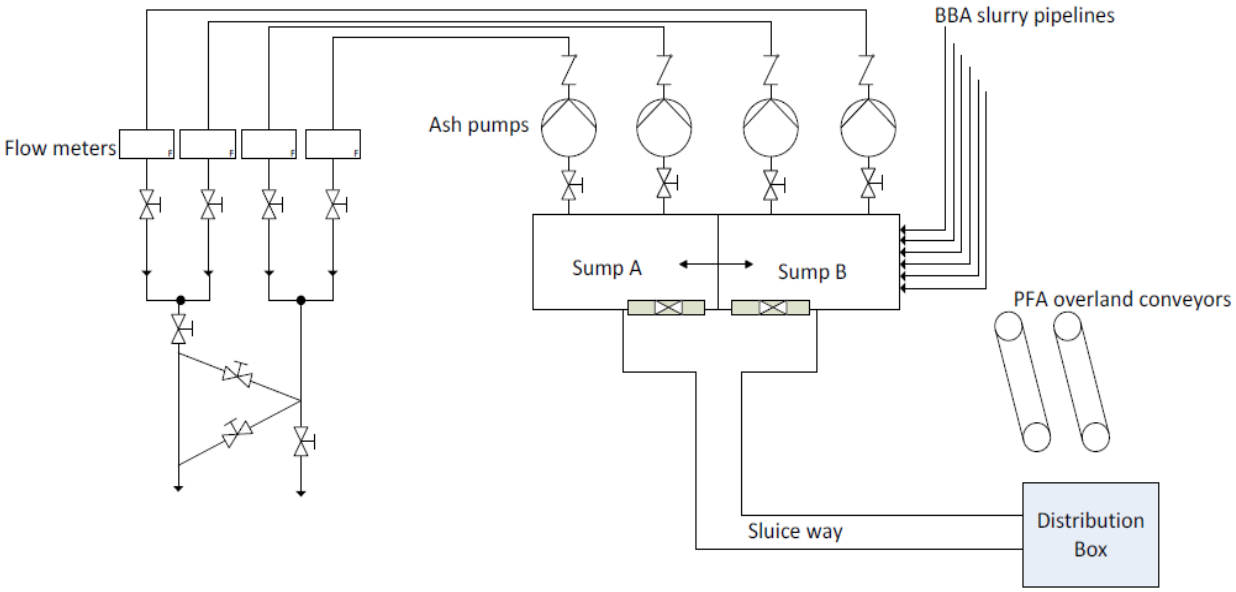

Figure 1: Kriel Power Station Ash pump house and distribution box layout

Matla P. S. AWR system

Decanted water from Matla P. S. Ash Dam, drains through penstocks to an AWR reservoir called the Final Cut. A barge mounted Pumping Station (refer to Figure 2) with two (2) 100% Vertical Spindle pumps is connected in series with corresponding Booster pumps situated inside a Booster Pump house (refer to Figure 3) on ground level. The inlet pipes to the booster pumps are interconnected thus enabling cross feeding. The water is then pumped to either the SWR Dam or to the Head Tank for re-use in the ashing operations.

Figure 2: Matla P. S. Barge mounted Pumping Station

Figure 3: Matla P. S. Booster Pump House

4. DESIGN PARAMETERS, LIMITATIONS AND ASSUMPTIONS

4.1 ASSUMPTIONS

The following assumptions were made for this evaluation:

i. Ash pump discharge and AWR pump discharge pipeline profiles from a 2012 Aerial survey.

ii. Rate of rise for Matla P.S. Ash Dam will increase from 1.1 m/y to 2.2 m/y [9].

iii. The quantity of water retained in ash is 0.386 m^3/T [11].

iv. Four (4) Ash pumps can be run simultaneously in the Ash Pump house.

v. No evaporation taken into consideration.

vi. Available storage volume in Final Cut not considered.

4.2 DESIGN PHILOSOPHY

- Standardize with current equipment.
- Accessible Ash and AWR pipe line route for ease of maintenance.
- No redundancy on AWR system pipelines.
- All Kriel P.S AWR will be pumped back to Kriel.
- Ensure there is no interference with Matla P.S. normal operations.
- The two (2) systems will be kept completely separate for maintenance and operational purposes.
- The control of VSD drives by the installed flow meters will be rectified.
- Assume enough sluice water available at Kriel P.S.
- Kriel P.S ash slurry disposal pipelines discharge points, will be on the northern side of Matla Ash Dam.

4.3 PLANT OPERATING CONDITIONS

i. Ashing and dusting at Kriel P.S. Ash pump house will be conducted on a continuous basis.

ii. One (1) redundant ash disposal pipeline will be provided.

4.4 STORAGE CAPACITY

i. In the event of the Ash Pump house not being available, dust can be stored in Fly ash storage silos on site, which has a storage capacity of 780 Tons per silo.
ii. Emergency BBA disposal area should be allocated on the Kriel Ash Dam.

4.5 DESIGN PARAMETERS

4.5.1 Pipeline Design Considerations

The following considerations were taken into account:

Ash disposal system:

- The ash disposal system is modelled from Kriel P.S. Ash Pump house to the nearest and furthest discharge point on the northern side of Matla P. S. Ash Dam.
- Pipe Roughness Factor (Combined Ash) – 50 µm [7].

AWR system:

- New pipe.

4.5.2 Velocity

Water

Design velocity	: 2.5 m/s.
Design flow rate	: 720 m³/h (350 NB pipe).

Slurry

Design velocity	: 2.81 m/s [7] (BBA at 30%).
Design mixture flow rate	: 753 m³/h (300 NB pipe).
Conveyed ash	: 169 Tph

4.5.3 Properties of Water (AWR)

Temperature	: 25 °C.
Density	: 997.1 kg/m^3.
Dynamic viscosity	: 6.5 x 10^{-4} Ns/m^2.
Vapour pressure	: 7.4 kPa.

4.5.4 Properties of Air

Altitude	: 1 650 m.a.m.s.l.
Atmospheric pressure, P_{atm}	: 83.02 kPa.

4.5.5 Properties of Ash Slurry

Particle density of ash, ρ_s	: 2 300 kg/m³.
Slurry concentration by mass, C_w	: 20% - capacity determination
	: 30% - equipment design
Density of slurry mixture, ρ_m	: 1 119 kg/m³ @ C_w = 20 %
Temperature	: Approx. 40 ºC

4.5.6 Pipe Roughness and Standard

Absolute roughness co-efficient	: 0.067 mm – Commercial steel pipes (rough).
Standard	: SANS 719.

4.5.7 Final Cut

Maximum height level	: 1 551 m.a.m.s.l.
Minimum height level	: 1 548 m.a.m.s.l.
Area	: 4.5 ha.
Total storage volume	: 270 000 m^3 (Approx.).

4.6 CURRENT INSTALLED EQUIPMENT

4.6.1 Kriel P. S. Ash Pumphouse

4.6.1.1 Ash pumps

Pump supplier	: Metso.
Pump model	: HG250 EHC-D C3.
Impeller diameter	: 600 mm.
Number of vanes	: 3.
Pump speed	: 1 046 rpm (current).
Maximum passing particle size	: 160 mm.

Pump centre - line : 1 645.8 m.a.m.s.l.

4.6.1.2 Ash pump motors

Motor control : VSD.

Motor supplier : WEG.

Pump motor details : 355 kW, IEC 355L, 4-pole, 525 V, 50 Hz.

Maximum switchgear capacity : 355 kW.

4.6.1.3 Pipe specifications

Discharge pipes : 300 NB.

4.6.2 Matla P. S. AWR System.

4.6.2.1 Barge Mounted Pumping Station.

4.6.2.1.1 Matla P. S. Barge Mounted Pumping Station.

a. Barge pumps

Pump type : Vertical spindle.

Pump supplier : KSB.

Pump model : ETA 250 – 40.

b. Barge pump motors

Motor supplier : GEC.

Pump motor details : 160 kW, 3 phase, 3.3 kV, 35 A, 50 Hz, 1490 rpm.

Maximum switchgear capacity : 160 kW.

c. Pipe specifications

Discharge pipe : 350 NB

4.6.2.2 Extra Barge Mounted Pumping Station (refer to drawing 0.45/56753).

Matla P.S. has an extra barge mounted Pumping Station which is not in operation (refer to Figure 4). This pumping station will be evaluated to determine whether it can be utilised for this application.

Figure 4: Extra Barge Mounted Pumping Station

a. Barge pumps

Pump supplier	: KSB.
Pump model	: ETA 250 – 50.
Impeller diameter	: 475 mm.

b. Barge pump motors

Motor supplier	: WEG.
Pump motor details	: 250 kW, 3 phase, 3.3 kV, 53 A, 50 Hz, 1 490 rpm.

4.6.2.3 Booster pump house

4.6.2.3.1 Booster pumps

Pump supplier	: KSB.
Pump model	: Omega 250 – 600.
Impeller diameter	: 538 mm.

4.6.2.3.2 Booster pump motors

Motor supplier : GEC.

Pump motor details : 350 kW, 3 phase, 3.3 kV, 75 A, 50 Hz.

Maximum switchgear capacity : 350 kW.

4.6.2.3.3 Pipe specifications

Discharge pipe : 350 NB.

5. SENSITIVITY ANALYSIS (REFER TO DRAWINGS IN APPENDIX B)

5.1 CAPACITY DETERMINATION AND EQUIPMENT REQUIREMENT ANALYSIS

Kriel P.S. burns two (2) different qualities of coal as illustrated in Table 1 and Table 2. Unit's 1 to 3 burns coal with an ash content of 28.76% (ar) [3] and Units 4 to six 6 burns coal with an ash content of 36.43% (ar) [3]. For the following analysis, it is assumed that during a week each of the Units will burn its "own" quality coal and during weekends, all the units will burn Units 4 to 6 coal.

The coal requirements and ash production for Kriel P. S. are depicted in Table 3 based on the Burn Plan, 6 March 2014 [12] for the period from June 2017 [10] to September 2020.

Table 3: Coal burn and ash production values based on Burn Plan, 6 Mar2014 [12].

Burn Plan, 6 March 2014, Coal Burnt and Ash Production		
	Coal burnt [kTons/annum]	**Ash production [kTons/annum]**
Unit 1 - 3	2 381	738
Unit 4 - 6	2 798	1 020
Total	**5 179**	**1 758**

Subsequently, the station coal requirements and ash production can also be determined by utilising a 6% Total Moisture content [3] together with a 90 % Load factor and 90 % Availability, which is depicted in Table 4.

Table 4: Coal burn rates and ash production values based on 90 % Availability and 90 % Load factor.

90 % Availability and 90 % Load factor, Coal burnt and Ash production		
	Coal burn [kTons/annum]	**Ash production [kTons/annum]**
Unit 1 - 3	5 236	1 622
Unit 4 - 6	8 736	2 242
Total	**13 972**	**3 864**

It is determined that Matla P. S. Ash Dam life will be reduced by 23 months when using the Burn Plan, 6 March 2014 [12] and with 41.4 months when using the 90 % Load factor and a 90 % Availability.

By using the quantity of ash produced in Table 1 and Table 2, as well as the pump capacity of the current Ash pumps installed in Kriel P.S Ash Pump house (refer to Section 4.6.1), the number of Ash pumps required to pump 100 % of ash from Kriel P.S to Matla was determined. Table 5, illustrates the results:

Table 5: Ash disposal system analysis

	Ash pumps required	**Pumps installed**	**Redundancy [%]**
Burn Plan, 6 March 2014	1.2	4	100
90 % Availability and 90 % Load factor	2.6	4	33

From Table 5 it is evident that three (3) Ash pumps are required to be in operation to pump Kriel P.S. ash to Matla P.S. Ash Dam, this will allow for one (1) pump to be on standby for redundancy.

To determine the water volumes the following assumptions are made:

- Water conveyed: 680 m³/h.

The results are displayed in Table 6.

Table 6: Water volumes

	AWR transferred to Matla P.S Ash Dam [m³/annum]	AWR quantity transferred back to Kriel P.S AWR [m³/annum]
Burn Plan, 6 March 2014	7 050 672	6 372 323
90 % Availability and 90 % Load factor	15 504 021	14 012 371

The required operational AWR pump sets and their pumping hours are depicted in Table 7.

Table 7: AWR system analysis

Ash pumped	AWR pumps sets.	Pumping time [h]	Availability [%]
Burn Plan, 6 March 2014	1.01	12.1	50.5
90 % Availability and 90 % Load factor	2.2	17.8	74

From Table 7, it is evident that when the Burn Plan, 6 March 2014 [12] is utilised, two (2) AWR pump sets are required and when utilising the 90 % Load factor and a 90 % Availability, three (3) AWR pump sets are required, to pump Kriel P.S AWR back to their system.

To accommodate the extra Booster pumps (Kriel) and the associated electrical and C&I infrastructure a separate Booster pump house will be built next to the current pump house (refer to drawing 0.45/56754). The pump house will also be equipped with its own office, spares room and toilet facilities (with the use of a conservancy tank) which will facilitate totally separate operations

between Kriel- and Matla P.S. Furthermore, Matla P.S owns an extra Barge Mounted Pumping Station which will be modified to accommodate three (3) Barge pumps and will be utilised to pump Kriel's AWR from the Final Cut to the Kriel Booster pump house. Subsequently, pipelines will need to be installed from the barge mounted pumping station to the Booster Pump house and from there to Kriel P.S. AWR Dams.

5.2 ELECTRICAL

Operating philosophy

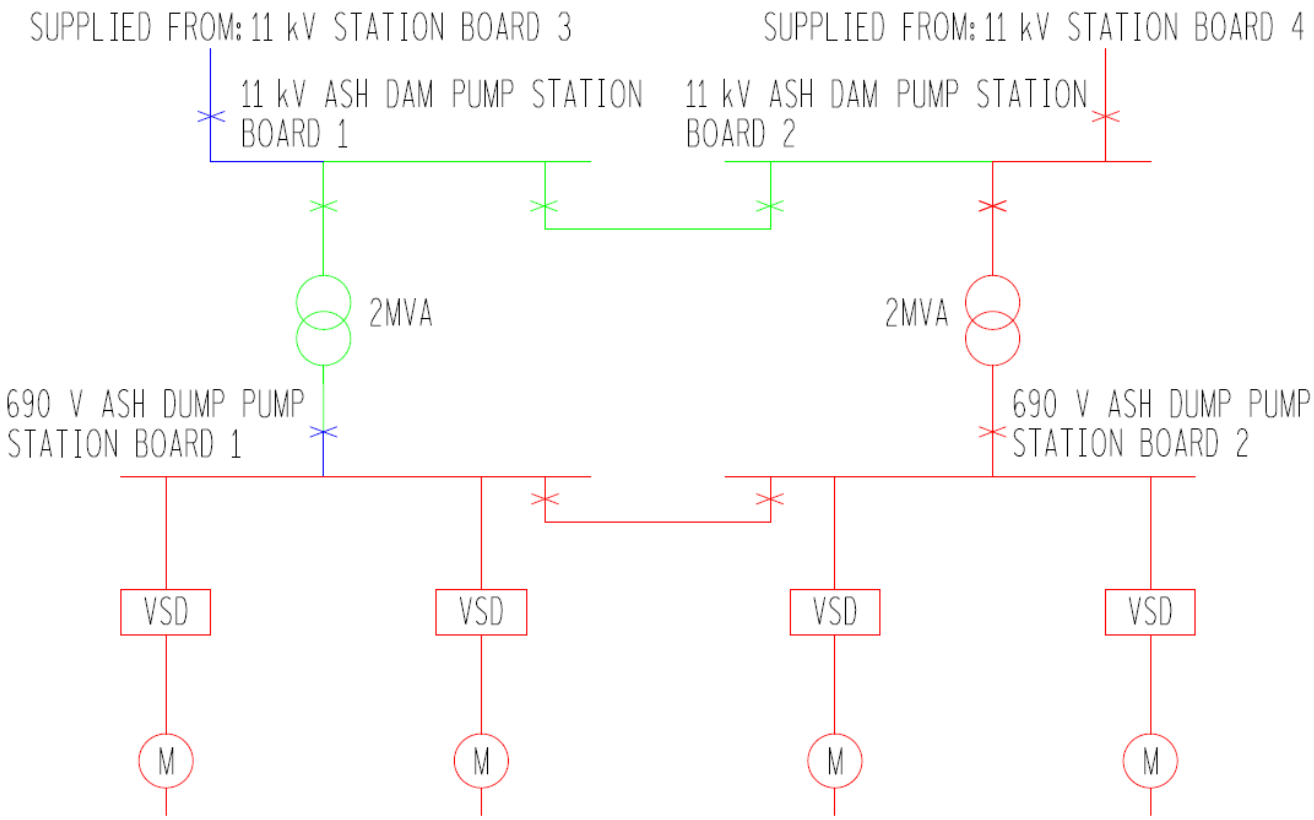

Figure 5: Schematic of electrical supply network.

Two (2) overhead power lines from Station Board 3 (A) and 4 (B) among other plants supplies six (6) AWR pumps at the AWR Dams, two (2) AWR pumps situated near the DB and four (4) Ash pumps. The overhead power lines feed into two (2) 11 kV Ash dam pump station boards at the Ash Pump House situated near the DB, called the 11 kV Ash Dam pump station board 1 and 2. Each 11 kV Ash Dam pump station board supplies a 2 MVA transformer. In turn, each transformer then supplies another 690 V station board also known as the 690 V Ash Dam Pump station boards 1 and -2.

Cross feeding between the 11 kV Ash Dam Pump station boards 1 and -2 as well as the 690 V Ash Dam Pump station boards 1 and -2 is possible.

The preferred operation as depicted in Figure 5 in red, one (1) 11 kV Station board will be utilised which will supply power to one (1) 11 kV Ash Dam pump station board. The 2 MVA transformer will then be able to supply all four (4) ash pumps due to the cross feeding ability (indicated in red) between the two (2) 690 V Ash Dam Pump station boards.

During normal operation, the cross feeding will also be done between the 11 kV Ash Dam Pump station boards. This will keep the other transformer energised. A circuit breaker will cut the power supply before it enters the other 690 V Ash Dam pump station board as indicated in Figure 5 in green. This will provide the necessary redundancy, if required.

6. PIPE SERVITUDE (REFER TO DRAWINGS IN APPENDIX B).

Figure 6, illustrates the proposed pipeline servitude.

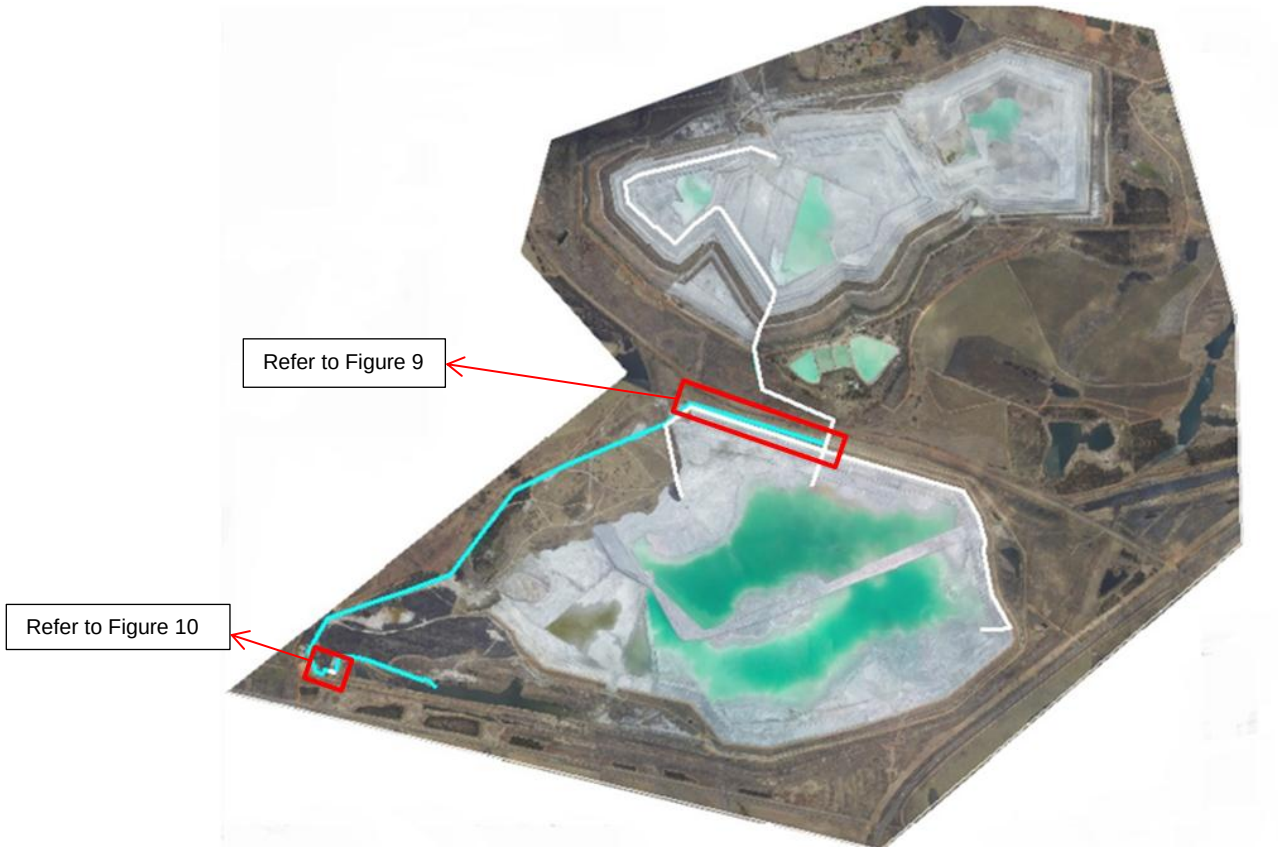

Figure 6: Ash and AWR pipeline servitude

Table 8: Ash and AWR pipeline servitude

Pipeline servitude	Model	Battery limit
White	Ash disposal system	Kriel P.S Ash pump station to Matla P.S Ash dam discharge points.
Blue	AWR system	Kriel P.S Barge Pumping Station at Matla P.S Final Cut to Kriel P.S AWR solution trench.

6.1 SERVITUDE SELECTION CRITERIA

The selection of the pipeline servitude was based on:

- Easy access for maintenance personnel, construction vehicles and construction personnel to pipelines.
- Utilising the nearest Ash Dam Solution trenches to contain and store ash spillages and AWR.
- Minimal interference with roads and the avoidance of natural obstructions.
- Possible discharge points on Kriel Ash Dam 1 to provide an extra ashing option.
- Shortest possible route for pipeline.
- AWR pipeline servitude to follow the same route as the ash disposal pipeline to simplify EIA.
- Consideration of future extension of Matla P.S Ash Dam.

6.2 MODIFICATIONS REQUIRED DUE TO PIPELINE SERVITUDE (REFER TO DRAWINGS 0.45/56752, 0.45/56755, 0.45/58835, 0.45/56753)

The Ash- and AWR pipeline servitude (refer to drawing 0.45/56752, 0.45/56755, and 0.45/58835) will consist of seven pipes, four (4) slurry- and three (3) AWR pipes. Along the entire servitude trenches will be installed to contain ash and AWR spillages as well as divert it to the nearest Ash Dam solution trench or containment sump. The servitude will also be equipped with a service road next to the pipes for ease of access for maintenance.

A mine haul road runs between Kriel and Matla Ash Dam which will be crossed by the pipe servitude. There are also two seasonal natural watercourses which exist on either side of the mine haul road (mine service road). Two pipe bridges will be required for the pipes to cross the two watercourses as indicated in the Figure 7 below (refer to drawing 0.45/58835 sheet 1):

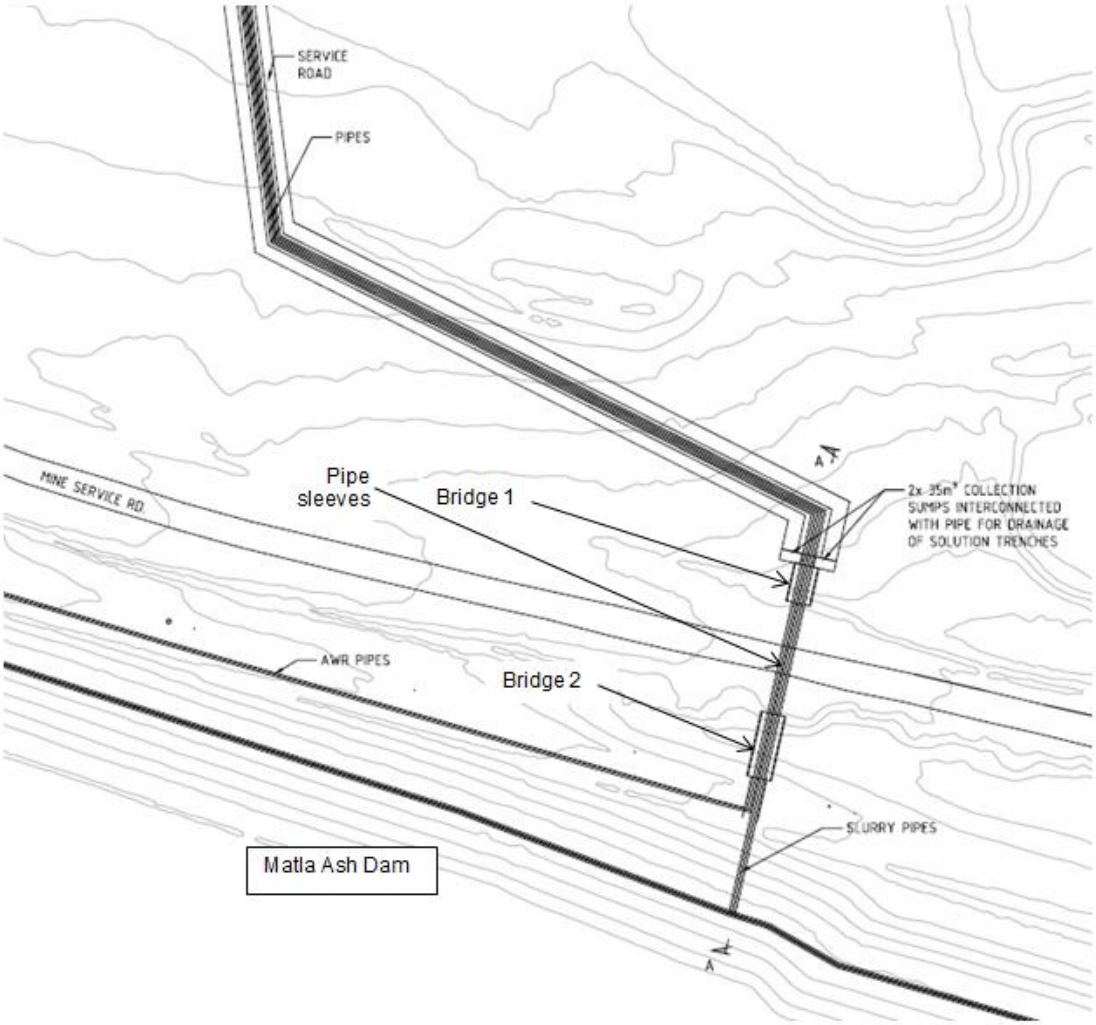

Figure 7: Haul road and watercourse crossings

The servitude at Kriel P.S will be equipped with two (2) collection sumps, one on either side of the servitude, which will receive ash and/or AWR from the trenches and contain it during a spillage. A bridge that is enclosed at the bottom and sides will be installed over the watercourse which will contain and divert ash and/or AWR spillages to either of the collection sumps.

The servitude at Matla P.S will also be equipped with two (2) 675 mm outer diameter concrete drain pipes on either side of the servitude. These drain pipes will contain and divert ash and/or AWR spillages to the Matla P.S Ash Dam solution trench. A bridge that is enclosed at the bottom and sides will also be installed over the watercourse which will divert ash to the drain pipes. Furthermore, the current service roads at Matla P.S Ash Dam will be utilised to access the AWR- and Slurry pipes.

Furthermore, for the pipe crossing at the Mine Haul Road (mine service road), concrete pipe sleeves will be installed which will accommodate seven (7) pipes. Two (2) additional sleeves will also be

installed for redundancy (refer to drawing 0.45/58835 sheet 1). Pipe sections at the sleeves will consist of three (3) meter sections to accommodate ease of maintenance during the installation and removal of pipes.

6.3 STORMWATER MANAGEMENT

The design and construction of the pipeline will be done with the objective of minimising the impact on the natural drainage of storm water in the area. The servitude typically consists of a pipeline servitude flanked by solution trenches on either side to collect any effluent in the event of a pipe leakage or spillage. An access road is then provided on either side of the solution trench with a 2% crossfall away from the solution trench to ensure any clean stormwater runoff from the road drains away from the solution trench into the surrounding environment.

The figure below shows a typical cross section of the servitude:

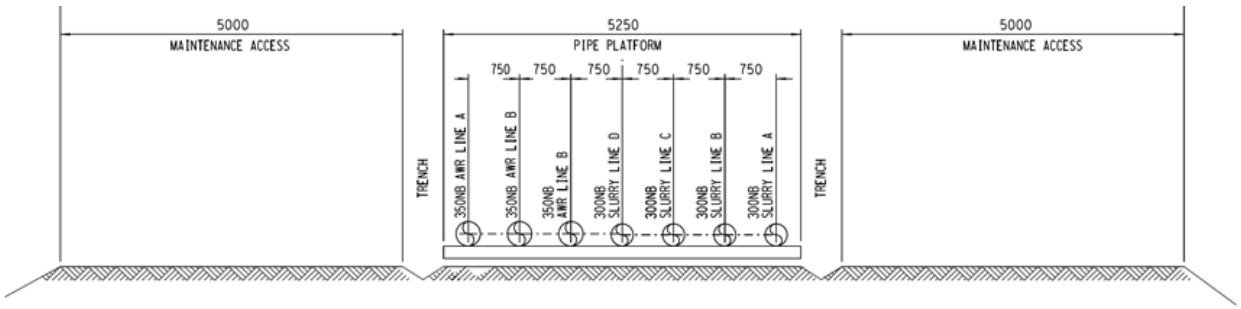

Figure 8: Typical section through pipeline servitude

The discharge of the solution trenches collecting any spillage from the pipes will be at the following locations:

Discharge into collection sump before first watercourse crossing (Bridge 1)

As indicated in Section 6.2, the portion of the servitude on the Kriel's side up to the first water crossing (Bridge 1) will discharge into two interconnected sumps. These will be sized to accommodate the flow from a burst pipe until the pumps are automatically shut down due to the pressure drop. Any spillage contained within the Bridge 1 will also drain into the collection sump.

Discharge into Matla ash dam solution trench after second watercourse crossing (Bridge 2) from gantry

The spillage from the sleeves and Bridge 2 will drain into the solution trench along the Matla Ash Dam through two concrete drain pipes which will cross the ash dam access road as indicated on drawing 0.45/58835 sheet 1.

Discharge into Matla Ash Dam solution trench for AWR pipes along Ash Dam

Figure 9: AWR route along solution trench

The AWR pipes will follow the Ash Dam access road which will be also used for maintenance as shown in the figure below. The pipes will be placed adjacent to the Matla Ash Dam solution trench which will collect any spillage from the pipeline. A new road and solution trench for this portion will therefore not be required.

Discharge into solution trench at AWR pump house discharging into Final Cut

Figure 10: New Kriel AWR Pump House and infrastructure

As the AWR servitude deviates from the existing solution trench, a new solution trench and road will be provided along the pipeline. Most of the route will be placed alongside the existing access roads

which will be used. The natural ground level along the pipeline slopes towards the Booster Pump House. The solution trench will therefore drain towards this pump house before discharging into an existing solution trench leading to the Final Cut.

6.4 PIPELINE MAINTENANCE

Maintenance activities for the pipeline consist of the following:

Routine maintenance:

- Routine visual pipe line inspections; and
- Pipe thickness measurements will be conducted along the entire pipeline.
- Pipes will be rotated 120^{o} when required.

Emergency maintenance during pipe burst and/or unblocking of Ash pipelines:

- All pump discharge pipelines will be fitted with pressure transmitters, which will be utilised to trip the associated pump if a pressure drop is detected;
- A visual inspection will be conducted to determine the location of pipeline failure.
- The damaged pipe must be fixed immediately and thereafter the pipeline will be flushed to Matla's Ash Dam.
- Trenches and collection sumps must be cleaned immediately to ensure optimum availability.
- The containment facility will be cleaned by pumping the contained slurry and/or AWR to Matla P.S. solution trench.

6.5 CONSTRUCTION WORK METHOD FOR PIPELINE

The following is a summary of the construction activities required for the ash transfer from Kriel P.S to Matla Ash Dam. The final sequence of construction will be determined by the contractor and the following will therefore be subject to change.

6.5.1 Pipeline Servitude:

Site establishment

The contractor's site establishment will be within the Roshcon area as indicated in drawing 0.45/56752). Additional establishment areas closer to the point of construction may also be required e.g. close to the Kriel pump house. All establishment areas of the contractor will also be fenced for security and safety.

Clearing of vegetation

All topsoil and vegetation will be cleared over the servitude of the pipeline. Topsoil will be stored in a designated area until such time that it is reused for rehabilitation after decommissioning.

Excavations and earthworks

Excavation of in-situ material for the construction of the roads, solution trenches and pipe plinths will take place with excavated material stored in a designated area for reuse. Mobile plant will therefore be required. Temporary batching facilities for the preparation of backfill material may be required depending on the characteristics of the fill material.

Road construction

Construction of the roads will take place which will have a gravel wearing course. Existing excavated material will be used as far as possible. Any additional material required will be imported. Roads will be used for access for the construction of the remaining works in the servitude.

Construction of solution trenches and sumps

Solution trenches will be constructed and lined with concrete. The trenches will be sloped for drainage of any spillages. The collection sumps will also be constructed after the solution trenches. The bridge foundations may also be constructed during this time.

Construction of pipe supports

Construction of pipe plinths within the servitude will take place for the installation of pipes. Once plinths have been completed, pipe section will be installed on the plinths.

Construction of road crossings

Instances where the pipeline servitude crosses an existing access road will be catered for with the construction of culvert with the existing road raised to pass over the pipeline. If possible, existing roads will be raised to be ramped over pipeline. Concrete drainage pipes will then be provided on either side of pipeline to allow flow from solution trenches to pass under ramped road.

Installation of concrete sleeves under road

Concrete sleeves will be placed by open trenching for the mine haul road crossing. Pipe sleeves will be jacked under the mine road and conveyor if open trenching is not possible.

Installation of pipes in sleeves

The AWR and slurry pipes will be jacked into the concrete sleeves in sections. The pipe sections will be bolted before it is jacked into the concrete sleeve.

Construction of pipe bridges

Construction of the two bridges will likely take place after the pipes have been installed under the road. Foundations for the bridges may be constructed earlier depending on the sequence of works by the contractor. The foundations for the bridges may include piled foundations depending on the geotechnical investigation. If construction takes place during the wet season, the natural watercourse may require temporary diversion to facilitate construction of the bridges.

6.5.2 Ash Water Return Booster Pump House and Associated Infrastructure

Site establishment

In addition to the main contractors yard situated within the Roshcon area, additional establishment yards will be required which will be at the site of the pump house construction. This will also be used for storage of building material required as well as temporary storage of excavated material.

Clearing of vegetation

All topsoil and vegetation will be cleared and stored until reuse.

Excavations and earthworks

Excavation for the building will take place with the existing material being used as far as possible. Any additional material required will be imported

Construction of pump house

The new booster pump house will be similar in concept to the existing pumphouse and be situated in the open area adjacent to the building. Potable water and electrical supply will be taken from the existing building. Disposal of sewage effluent will be catered through the provision of a conservancy tank which will be periodically emptied by Matla Power Station.

Modification and installation of barge

It is envisaged to utilise the existing barge at Matla which will be modified to accommodate a third pump. The barge may be modified on or off site.

Construction of pipeline to barge pumps

The pipeline from the installed barge will be constructed. Plinths will be provided for the pipelines as well as a new culvert for the crossing of an existing road.

6.6 DECOMMISSIONING

Decommissioning of the transfer pipeline is planned to commence after four (4) years of operation.

Decommissioning will include the following:

- All pipes will be removed.
- All additional infrastructure at Matla P.S AWR will be handed over to Matla P.S.
- All pipe plinths will be removed.
- Access roads that will not be used after decommissioning will be rehabilitated with vegetation. The solution trenches will also be demolished and the servitude rehabilitated.

7. COSTING

Table 9: Cost estimation

Description	Cost
Mechanical	R 62 m
C&I (7.5 %)	R 5 m
Electrical (10 %)	R 6.5 m
Civil	R 32.5 m
Construction & Installation	R 32 m
Preliminary & General	R 20 m
Total	**R 158 m**

Table 9 represents the cost for the installation of four (4) Ash pipelines, two (2) AWR pump sets and its associated pipelines.

With reference to Section 5.1, when utilising a 90 % Load factor and 90 % Availability, the installation of a third AWR pump and associated pipeline is required at an additional cost of approximately R 25 m.

8. CONCLUSIONS

Ash disposal system

- 100 % of Kriel P.S. ash can be transferred to Matla P. S. Ash Dam.
- The system will require that three (3) of the currently installed four (4) ash pumps be in operation.
- Four (4) ash pipelines will need to be installed.

AWR System

An AWR system requirement comparison is depicted in Table 10 below.

Table 10: Comparison of AWR system requirements

AWR system requirements	Burn Plan	90 % Load factor and 90 % Availability
Quantity of Kriel P.S AWR returned to Kriel's system	100 %	100 %
Extra sets of one (1) Barge- and one (1) Booster pump connected in series.	Two (2)	Three (3)
Matla P.S. has an extra Barge mounted Pumping Station which could be utilised	Refurbishment required	Modification and refurbishment required
Extension of Booster Pump house at Matla	To accommodate two (2) extra Booster pumps	To accommodate three (3) extra Booster pumps
AWR pipeline installation	Two (2)	Three (3)

Cost comparison.

Table 11: Cost comparison

Cost estimation	Burn Plan	90 % Load factor and 90 % Availability
Approximate cost estimation	R 158 m	R 183 m (R 25 m additional)

- The currently installed flow meters on the ash discharge pipelines were not correctly specified and can't provide a signal to the VSD's for control purposes.

Electrical

There is a concern of overloading on the overhead power line; depending on how many of the equipment that is fed by it, is in operation simultaneously. The limitation of the overhead line's, current carrying capacity is due to the current load of the ash water return, ash conveyor and slurry plant booster pumps ,11kV coal substation, 380 V South face seepage plant and also upcoming contractor's yard.

9. RECOMMENDATIONS

- Matla Ash Dam life reduction can be mitigated by conducting a stability analysis to evaluate possible height increase.
- Design a system to transfer 100 % of Kriel P.S ash production to Matla Ash Dam and return all Kriel AWR back for a period of approximately 3.5 years.
- Capacity of the system will be based on the "load factor" and "availability" requirements.
- Proposed pipe servitude between Kriel and Matla to be surveyed and marked to facilitate EIA evaluation.
- New flow meters need to be specified that will enable the control of the velocity in the slurry discharge pipelines by utilising the installed VSD pump motors.
- A detailed load flow study need to be conducted in the Feasibility stage (Basic Design) to quantify the potential risk of overloading of the overhead power lines.

10. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Riaan Louw	Project Engineering Manager
Alicia Simbudayal	EDWL – Civil & Structural Department
Niloshen Moodley	LDE – Civil & Structural Department
Benjamin Tselane	Civil Engineer – Kriel Power Station
Clinton Smith	LDE - Integration CoE
Kholo Paledi	Configuration Management Lead
Kagiso Molokoane	Senior Engineer – Malta Power Station

11. REVISIONS

Date	Rev.	Compiler	Remarks
July 2014	1	G Jenner	NA
September 2015	2	G Jenner	NA

12. DEVELOPMENT TEAM

The following people were involved in the development of this document:

Henk Fourie

Graham Jenner

Dyke Monyane

Busi Green

Niloshen Moodley

13. ACKNOWLEDGEMENTS

Duke Stuurman

Kagiso Molokoane

Riaan Louw

Benjamin Tselane

APPENDIX A: URS

Eskom
Generation

User Requirement Specification for Design and Construction of Ash Dam 4.

Compiled By :	Supported By:
Duke M Stuurman System Engineer	**Herbert Lebone Kopela** Auxiliary Eng. Manager

Acceptance of URS

Zulu Zulu Production Manager		10 / 04 / 2013
Jabu Leteane OPS Manager (ash and coal)		10 / 4 / 2013
Kakanyo Mabaso Mechanical Maintenance Manager		10 / 4 / 2013
Pinky Ncanana C&I Maintenance Manager		10 / 04 / 2013
Mpho Maluleke Electrical Maintenance Manager		22 / 03 / 2013
Livhuwani Tshilate Environmental		03 / 04 / 2013
Harry Mokabane C & I Engineering Manager		03 / 04 / 2013
Alfred Maditjane Electrical Engineering Manager		22/03/2013

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1 Introduction

The current ash dams at Kriel Power Station have been providing disposal services since the establishment of the station. This ash disposal site is reaching the end of its capacity, and an assessment report done in 2009 indicated that as of the middle of 2019 a new ash disposal facility will be required.

The report used the original design data for the ash dams, which was for 2.2 million tons of ash per year. Due to increased production and lower coal qualities, the current annual production of ash is 3.1 million tons. It is thus expected that the dams will reach the end of their life in terms of absolute height by 2017, and may reach the limit on the Rate of Rise as early as 2016.

A new ash disposal facility for Kriel thus needs to be established as soon as possible. The new facility should provide sufficient capacity for Kriel up to the end of its extended 60 year life in 2039 plus 5 years contingency.

To ensure continued environmental responsible ashing, an EIA process must be undertaken to identify and assess feasible sites for the new ash facility. As a means to comply with the necessary legal requirements, the new ash disposal facility and associated structures must be appropriately designed and licensed, as ash disposal is listed as a waste disposal activity and therefore authorisation in terms of the NEMA and NEMWA (WMLA) legislation is required. An integrated EIA and WMLA must be undertaken in line with the requirements of the NEMA processes.

To keep costs as low as possible and to minimize the impact on the environment, the following items must be adhered to the maximum extent possible:

- The dam should be of the 'wet' type as currently used to prevent hugely expensive modifications on the Kriel Units
- The dam must be as close as possible to the station and should not cross land owned by other parties due to the high risk of spillage from a wet ash pipeline or from a dry conveying system.
- Maximum use of existing infrastructure such as the return water pumps and the slurry pumping systems should be made.
- Minimize the costs by using the adequate lining system as per the said ash classification.

The capacity requirements for the new dam are:

- Sufficient storage capacity should be made to provide Kriel with an ash disposal facility that will last it to the end of its extended life in 2039 plus an additional 5 years contingency.
- The ash dam must comply with all relevant latest technical standards and regulations internal to Eskom.
- The ash dam must comply with all external legislative requirements, including the NEMA and NEMWA Acts and Regulations.
- A new Station Water Use License must be obtained and updated according to the requirements of the DWA to include the new ash dam.

Abbreviations

AWR	Ash Water Return
C & I	Control and Instrumentation
DRA	Definition Release Approval
EIA	Environmental Impact Assessment
ERA	Execution Release Approval
EXCO	Eskom Executive Committee
FAT	Factory Acceptance Tests
GCIMC	Group Capital Investment Management Committee
HMI	Human Machine Interface
LCC	Life Cycle Cost
MCR	Maximum Continuous Rating
MIT	Modification Impact Team

MTBM Mean Time between Maintenance
MTTR Mean Time to Repair
NEMA National Environment Management Act
NEMWA National Environment Management Waste Act
OEM Original Equipment Manufacture
OHSA Occupational Health and Safety Act No. 85 of 1993
P&ID Piping and Instrumentation Diagram
PLC Programmable Logic Controller
PLCM Project Life Cycle Model
PMFA Public Finance Management Act
PTW Permit to Work
RACI Responsible, Accountable, Consulted, Informed
RBO Reliability Basis Optimization
Redundant A system/equipment is redundant when it is duplicated to allow continued service in case of failure
RFQ's Request for Quotations
SAGC South African Grid Code
SAT Site Acceptance Tests
SCW Stator Coolant Water
TEAM Thermal, Electrical, Ambient, Mechanical
UAGS Unplanned Automatic Grid Separations
UCF Unit Capability Factor
UCLF Unit capability Loss Factor
WML Waste Management License
WUL Water Use License

1.1 Project purpose and objectives

If Eskom is to meet its mandate and commitment to supply the ever-increasing needs of end-users in South Africa, it has to continually expand its infrastructure of generation capacity, transmission and distribution power lines. This expansion includes not only the building of new power stations but also expanding and upgrading of the existing power stations to extend their lives.

The purpose of this project is to design and construct a new ash dam to allow Kriel Power Station to continue ashing in an environmentally responsible way for the duration of its operating life. The need for new the ash dam is due to the original design life of the station of 30 years has been reached and life of the station has been extended to 2039. Therefore the station is left with 4 – 5 years on the existing dams and the remaining station dam's life span is affected by the new ash production rates that are more than the original design rates.

The purpose of this User Requirement Specification is to document the user requirements of the Kriel Power Station Ash Dam 4 Project. The objective of this project is to:

- Conduct an Environmental Impact Assessment (EIA) for the Ash Dam 4 Project
- Identify possible sites for the dam
- Do geotechnical studies on proposed sites to determine if the soil properties will allow for the construction of the dam
- Perform LCC studies for the possible transport and deposition technologies for each proposed sites to determine which site will have the lowest life cycle cost.
- Do detailed geotechnical studies on the recommended site to determine its exact soil properties. These must be incorporated in the design and construction of the ash dam.
- Purchase land and servitudes as required for the New Ash Dam.
- Apply for the New Water Use License to include the New Ash Dam.
- Design, procure and install a liner and cover that meets the latest regulatory requirements

2.3 Reliability

The ash dam has to be properly designed with its supporting systems and is required to be reliable to ensure the proper handling of ash as it is classified as a hazardous waste and to provide storage capacity for all the ash produced in Kriel until the station end of life.

2.4 Availability

The station will entirely depend on ash dam 4 in the future; therefore the dam must be available at all times. The supporting plants must be at their maximum availability.

2.5 Maintainability

The operation and maintenance of the current ash dams is managed by Roshcon, and it is expected that this will continue into the future. The system engineer will be responsible to ensure plant maintenance strategies as per the provided OEM manuals are in place and executed to sustain the performance of the plant through all maintenance departments. The new ash dam should have the same maintenance requirements as the existing dams. Any monitoring requirements for the liner system, including the drainage and leak detection layers should be detailed after design.

2.6 Expandability

The plant shall be designed to meet the current operating conditions of the station taking into account the future ash produced in the station as the coal quality is deteriorating and more ash is being produced. The new dam will not cater for future expansions. It will be designed to last Kriel Power Station to the end of its life.

2.7 Spares management

Critical spares for all the supporting plant systems shall be highlighted and listed by the OEM. The first batch of these spares shall be supplied during the plant handover to the client. All other spares to be made stock items will also be highlighted and listed with all the required specifications supplied.

3 System Requirements

3.1 Automation system

The plant shall be automated as far as possible to ensure minimal operator intervention.
Control systems must be interfaced and compactible to the ash plant control room.
All the C&I equipment's must be standardized and compactible as per the current Kriel C&I equipment standard.

3.2 Alarm /event handling

The new facility shall be designed to use the existing protection controls recently upgraded. All the systems on the system must interface to the existing systems.

3.3 Technical requirements

All the design data used including the design drawings, reports, manuals and construction drawings must be submitted to the station as part of the modification process and documented as such.

3.4 Operator interface

- Do the Basic Design of the Ash Dam.
- Do the Detail Design and Construction of the New Ash Dam
- Verify current dams' remaining operating life, if life will be reached before new dam is completed,
    - Investigate alternative ashing options for the short fall period
    - Obtain required EIA approval for preferred option
    - Procure required land
    - Design, manufacture, construct and commission the preferred option.

1.2 Key dates

Key dates for this project are as follows:

Activity	Completion date
CRA Approval	June 2011
DRA Approval	February 2014
ERA Approval	July 2014
Execution	January 2016
Construction Completion	December 2019

1.3 Ownership

Kriel Power Station engineering will take ownership with Auxiliary Engineering department being a lead client. The responsible person will be Herbert Lebone Kopela; email: kopelaHL@eskom.co.za.

The following forms part of the Client Team ownership:
Responsible System Engineer – Duke M Stuurman (Auxiliary Plant Engineering)
Chemical Services Manager – Neo Muthavine
Electrical Engineering Manager - Alfie Maditjane
C & I Engineering Manager – Harry Mokabane
Mechanical Maintenance Manager – Kakanyo Mabaso
C & I Maintenance Manager – Pinky Ncanana
Electrical Maintenance Manager - Mpho Maluleke
Environmental Management Officer – Khuliso Rasimphi
Operating Support Manager – Jabu Leteane
Production Manager – Zulu Zulu

2 System Characteristics

2.1 Life expectancy

The system is expected to last until the station's end of life estimated to be 2039 with 5 more years as a contingency for the station decommissioning period.

2.2 Supportability

Spare parts, drawings, designs, OEM (original equipment manufacturer) manuals and other technical information for the overall ash dam and its supporting plants to be supplied need to be readily available when commissioning.

Operator intervention will be required to ensure smooth running of the plant. The plant will be monitored by Roshcon and Kriel operating support department, the supporting plants must be monitored from the operating support Control Room.

3.5 Power supply requirements

Power supply will be needed on both the dams and the new facilities that will be designed. A feasibility study must include checking the available power and the modifications will be done to suit the new plants. The current available voltage levels are 380 volts, 3.3kV and 11kV.

4 Training

Training on the operating and maintenance of the new Ash Dam 4 shall be conducted for the following departments:

- Operating Department
- Mechanical Maintenance Department (MMD)
- C & I Maintenance Department (CID)
- Electrical Maintenance Department (EMD)
- Engineering Department
- Roshcon

Training manuals and maintenance manuals will be made available for all the above-mentioned departments.

5 Information and Documentation management

All the documentation and information regarding the system (i.e. manuals, system design and drawings) shall be made available to Kriel Power Station and should be filed via the system engineer and project manager responsible for the project. At least one electronic and hard copy of the project documentation should be kept at documentation including a CD. Drawings should be in CAD DWG or DGM latest version electronically and in hard copy. All drawings and documentation will be captured in Smart Plant software when it is officially rolled out within the station. Documentation shall be kept at Kriel Power Station Library.

The library is located at:
Engineering Department Building – Ground Floor
Kriel Power Station

Contact Details:

Tel	: (017) 615 2367
Fax	: (017) 615 2615

Office Hours:

Monday – Thursday	: (7H00-12H00) and (13H00-16H00)
Friday	: (7H00-12H00)

6 Cost and Project Release

6.1 Project capital cost

The capital costs for this project are estimated to amount to R556 Million. This includes an environmental impact assessment (EIA), construction of the plant as well as a risk allowance. A risk allowance of 10% is included for this project.

6.2 Execution release approval

Project Development Department (PDD) investment process is to be followed for all required funds approvals for this project.

7 Management Philosophy

7.1 Quality

The implementation of this project shall comply with the International Standard for Quality (ISO) 9001:2008.

7.2 Site Management Issues

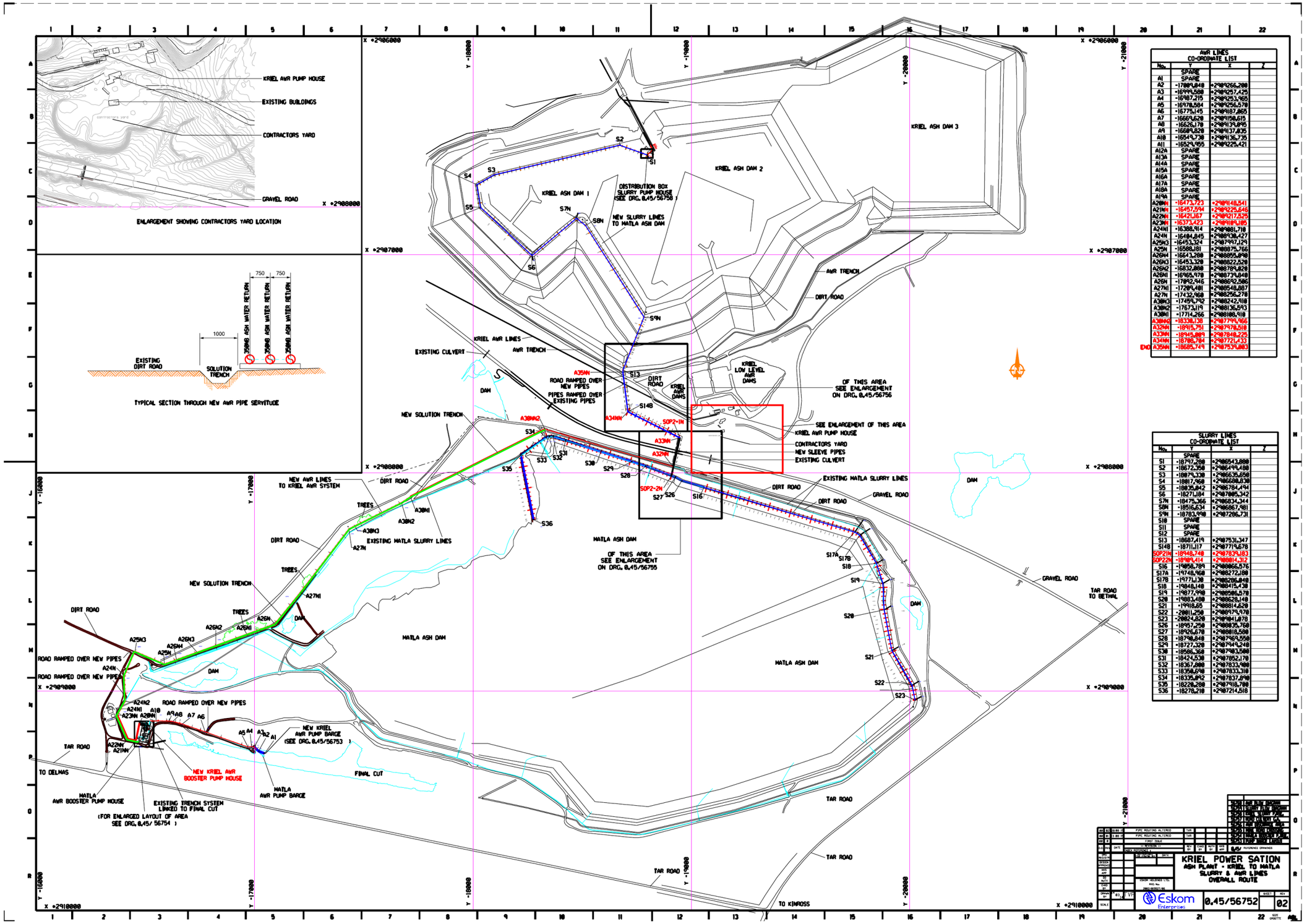
An identified site for the project and its developments shall conform to Kriel Site Information guide.

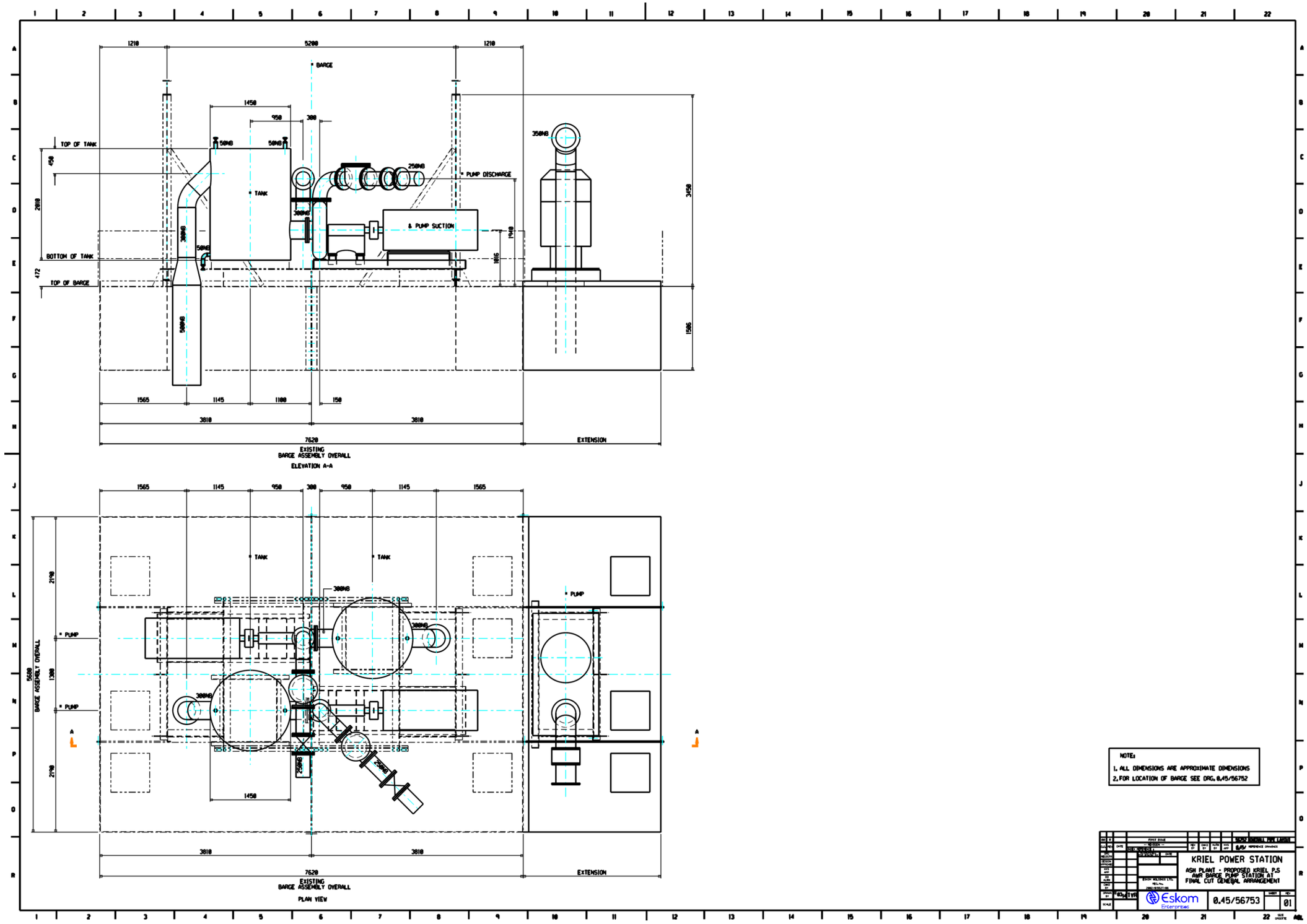
7.3 Environmental management

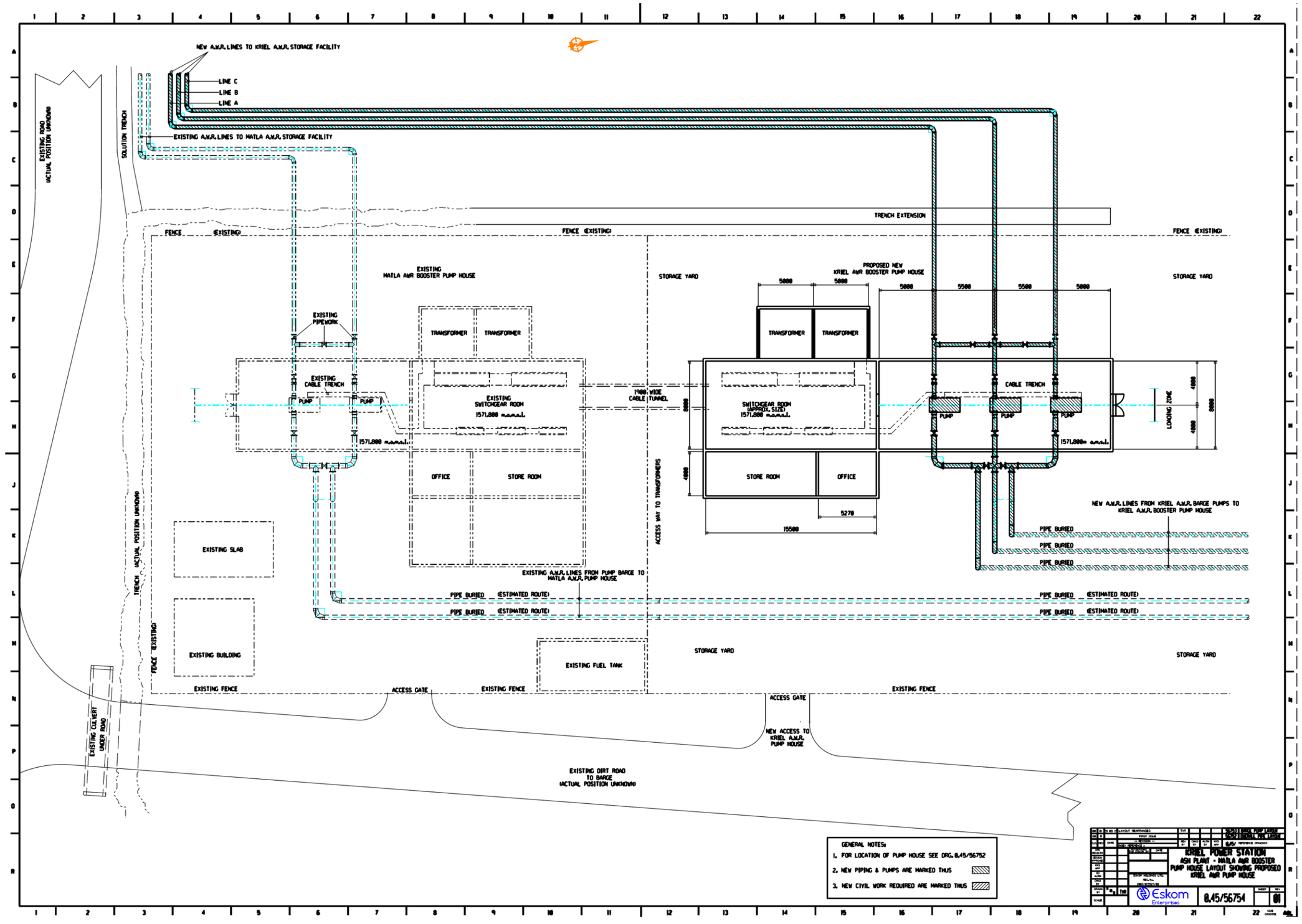
The proposed modification shall comply with environmental standard ISO for Environmental Management Systems 14001:2004 and Eskom's Waste Management Procedure (RER 0221. All Environmental, Legal, Statutory, will be dealt with under the WUL, WML and EIA processes. Current operating and maintenance procedures will be amended as necessary.

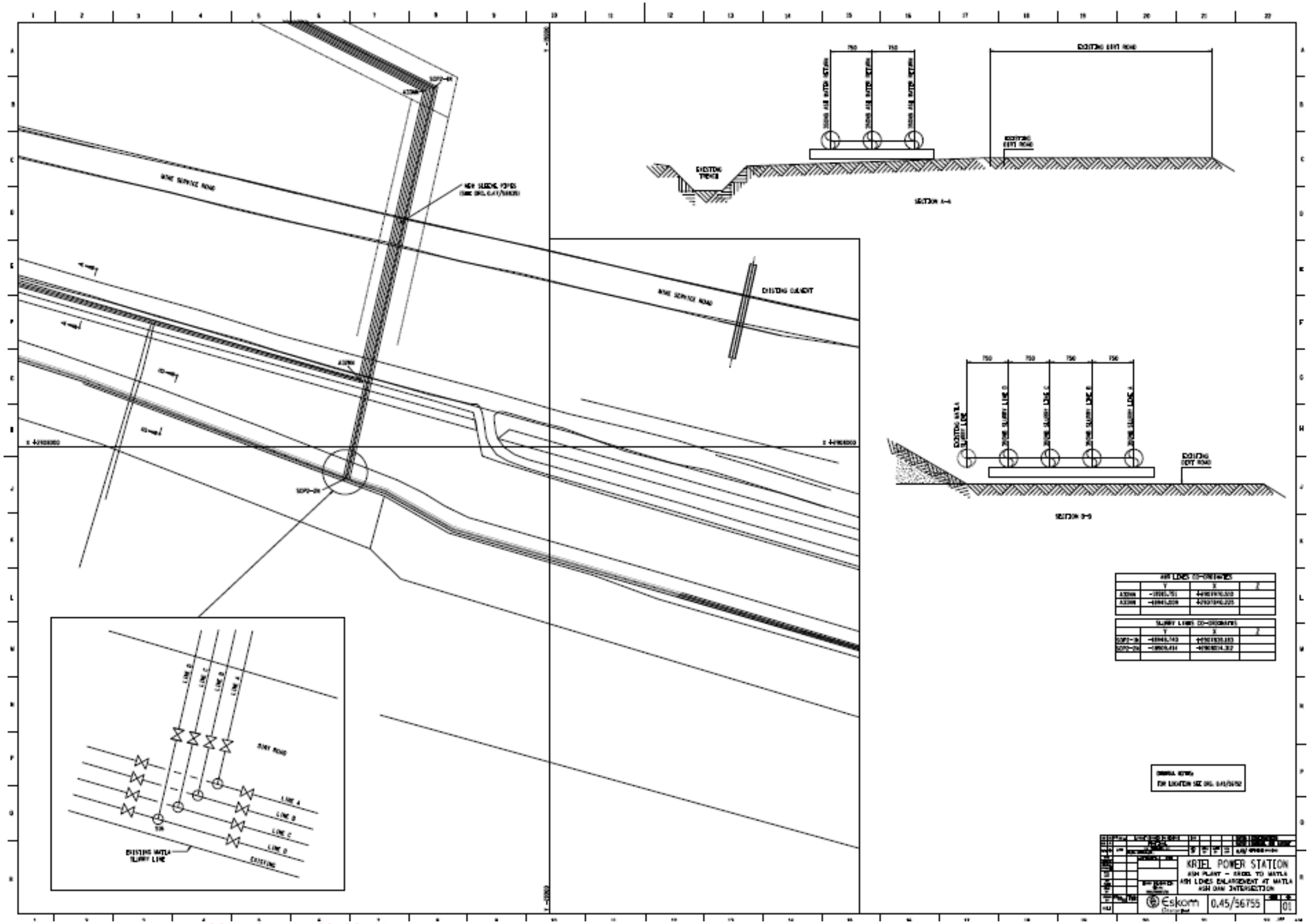
APPENDIX B: DRAWINGS

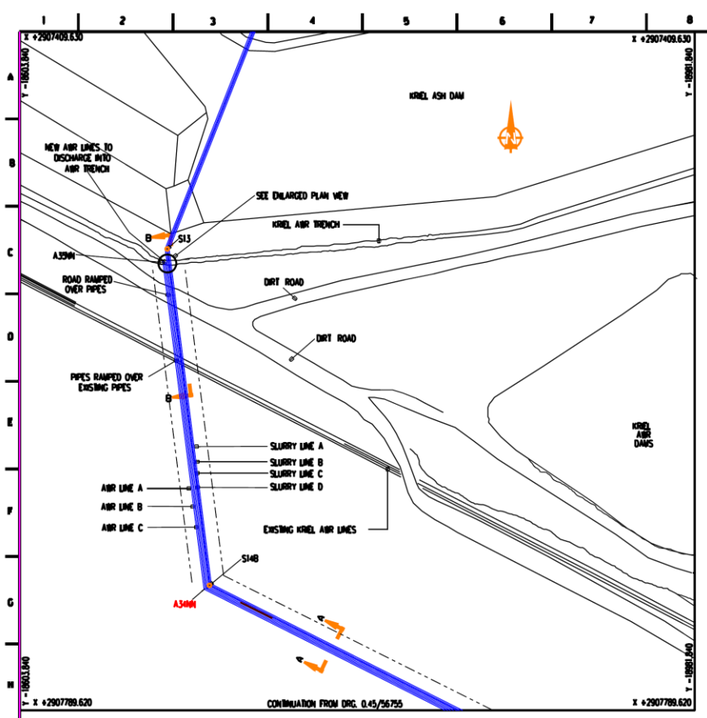
Drawing number	Revision	Title
0.45/56752	2	Ash Plant – Kriel To Matla Slurry & AWR Lines Overall Route
0.45/56753	1	Ash Plant – Matla Final Cut AWR Barge Pump Pipework General Arrangement
0.45/56754	1	Ash Plant – Matla AWR Booster Pump House Layout Showing Proposed Kriel Pump House Extensions
0.45/56755	1	Ash Plant – Kriel To Matla Ash Lines Enlargement At Matla Ash Dam Intersection
0.45/56756	1	Ash Plant – Kriel To Matla Ash Lines Enlargement of AWR Discharge Area
0.45/56758	1	Ash Handling Plant Distribution Box Pump House General Arrangement
0.45/56759	1	Ash Plants Combined Slurry Pipework Combined Flow Diagram Showing Modifications
0.45/56760	1	Ash Plants Combined Ash Water Return System Combined Flow Diagram With Proposed Mods
0.45/58835	0	Kriel – Matla Ash Transfer Mine Service Road Pipe Crossing Concept
0.45/198	1	Kriel Power Station, Station MV and LV Ash Dam Pump station Boards Electrical Diagram, Sheet 6

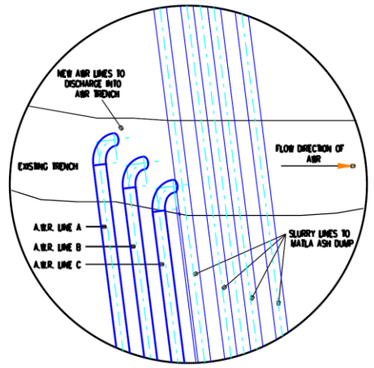








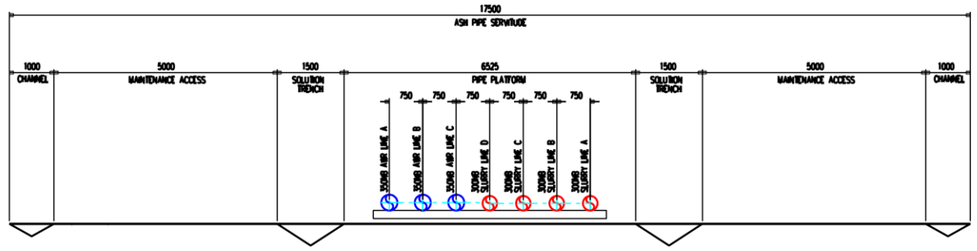




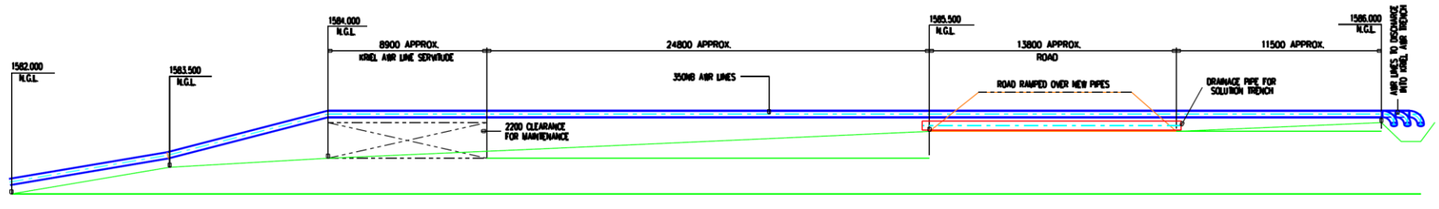
ENLARGED PLAN VIEW AT A.I.R. LINES DISCHARGE END

AIR LINES CO-ORDINATES			
	Y	X	Z
A344N	-18708.704	+2907721.433	
A359N	-18685.749	+2907539.003	

SLURRY LINES CO-ORDINATES			
	Y	X	Z
S13	-18687.419	+2907531.347	
S14B	-18711.117	+2907719.678	



SECTION A-A



SECTION B-B
(SLURRY LINES NOT SHOWN)

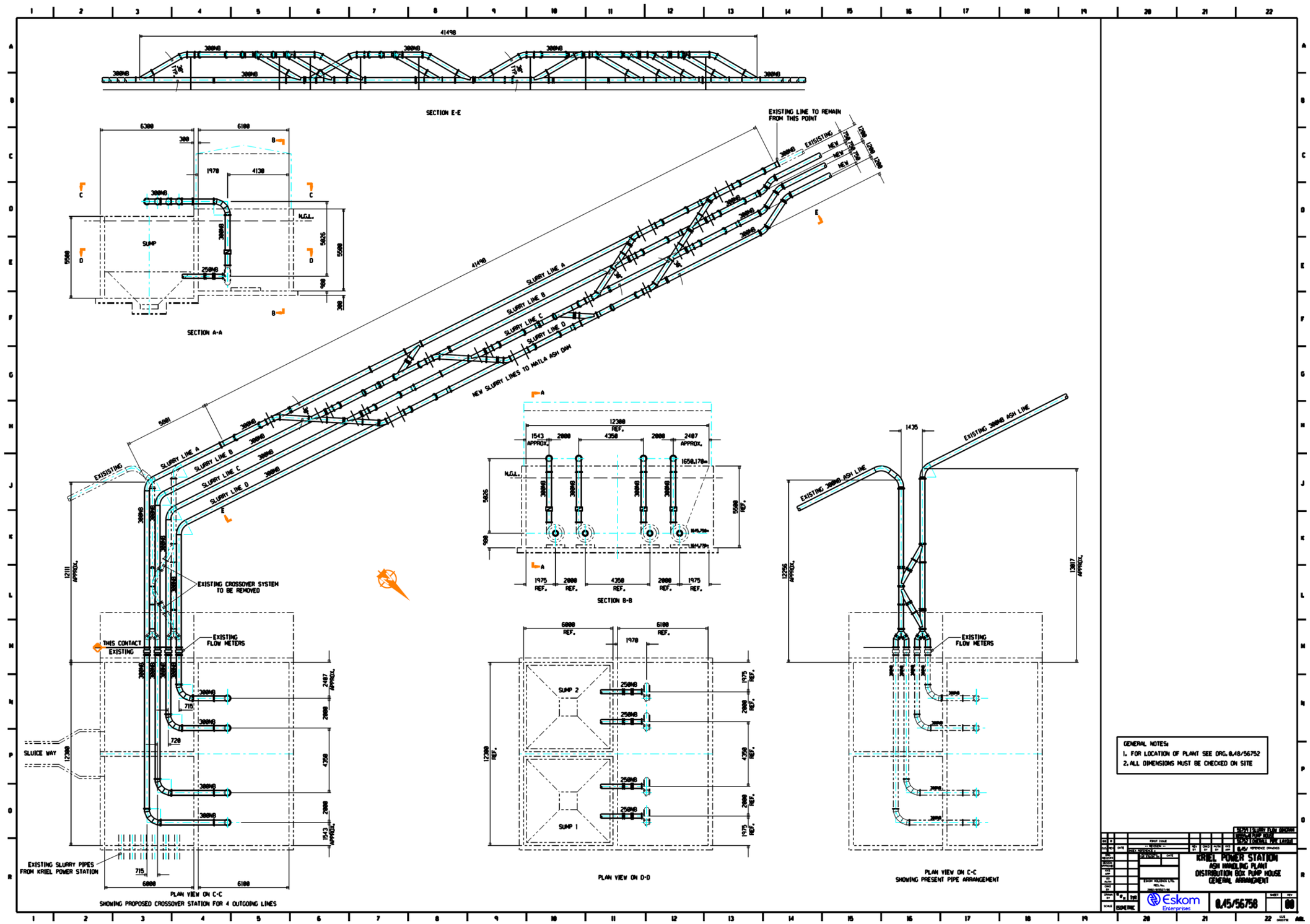
GENERAL NOTES:
1. FOR LOCATION SEE DRG. 0.45/56752

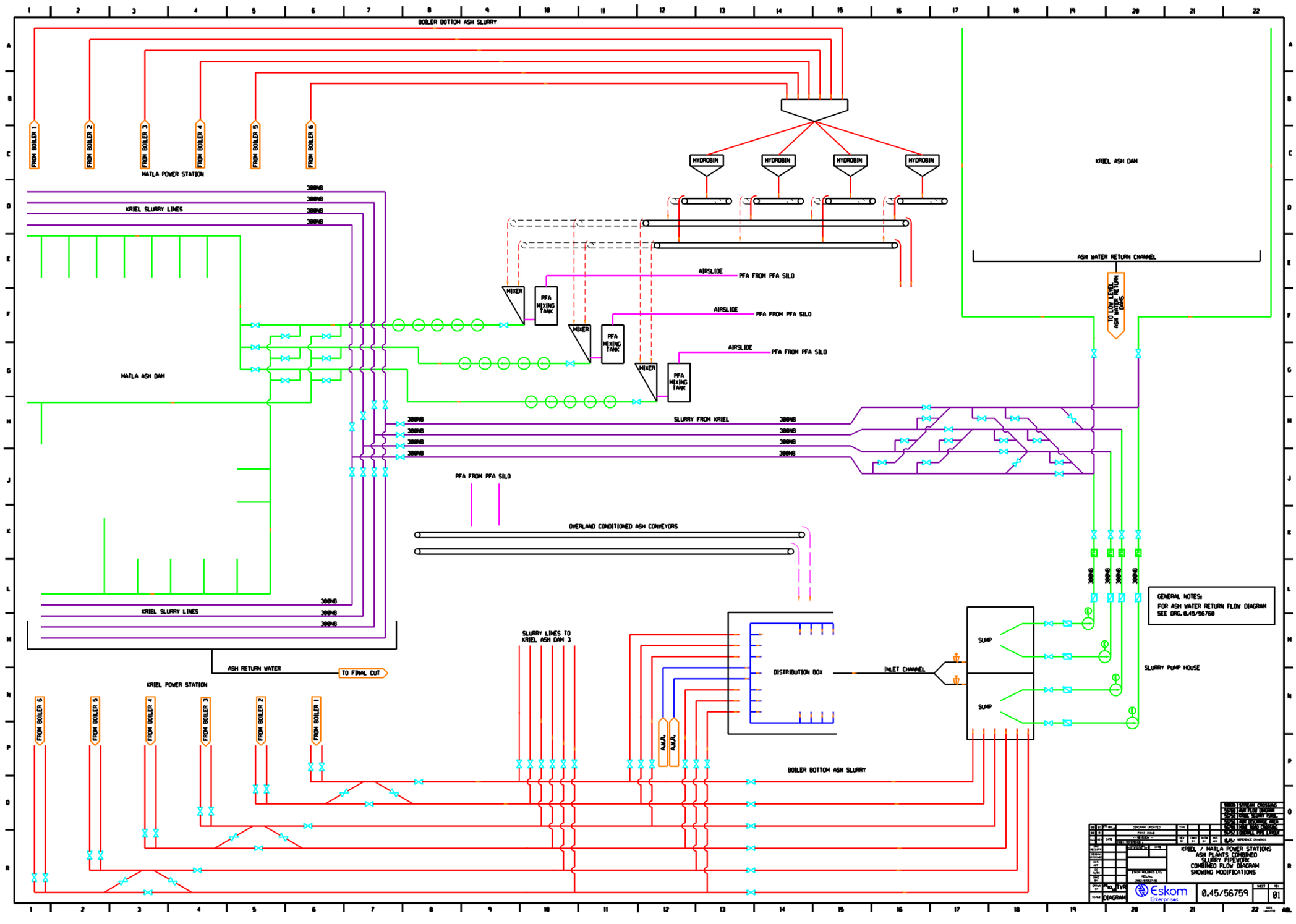
KRIEL POWER STATION
ASH PLANT - ENLARGEMENT OF KRIEL AIR DISCHARGE AREA AT KRIEL ASH DAM FOR KRIEL MATLA ASH TRANSFER

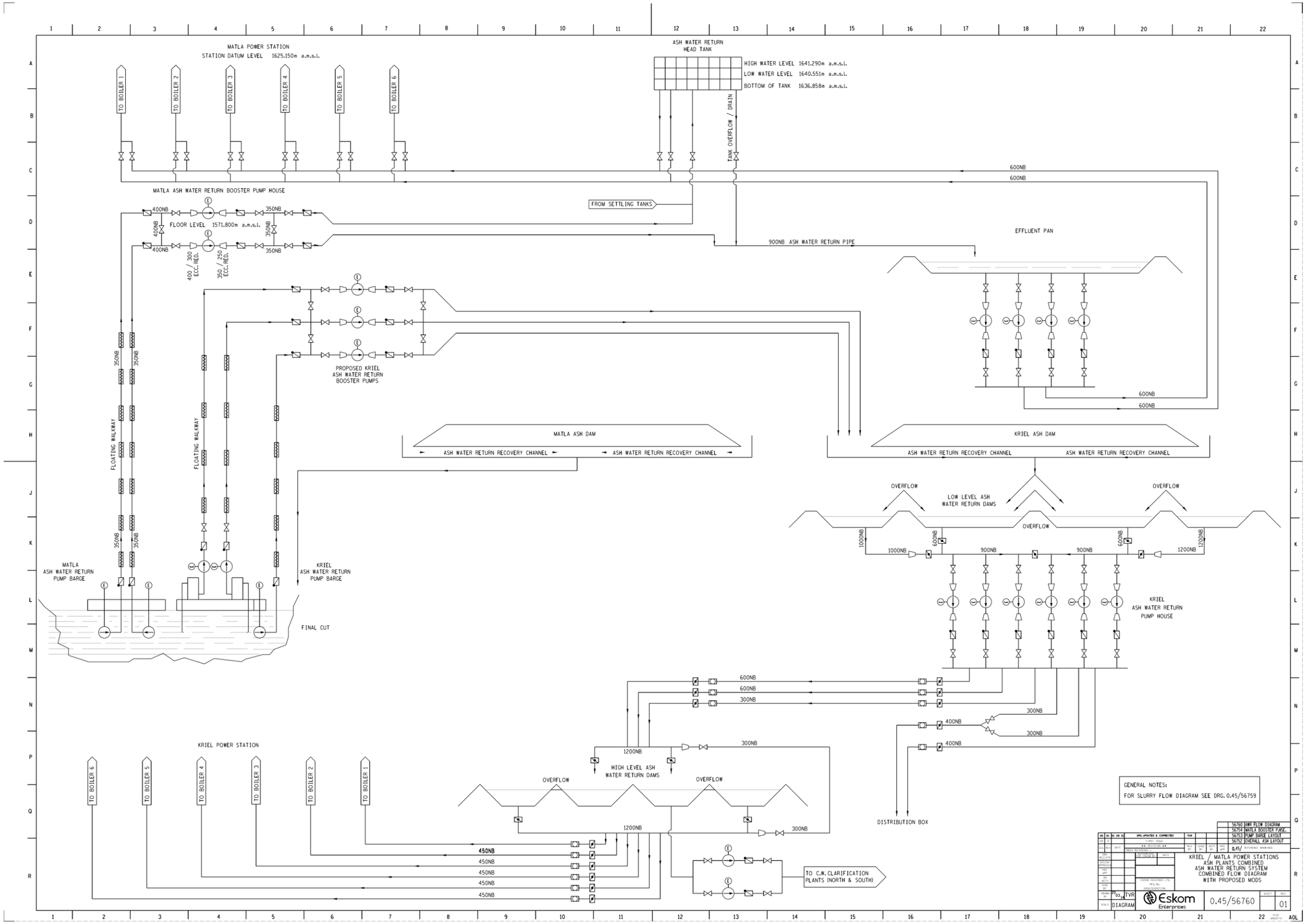
Eskom Enterprises

0.45/56756

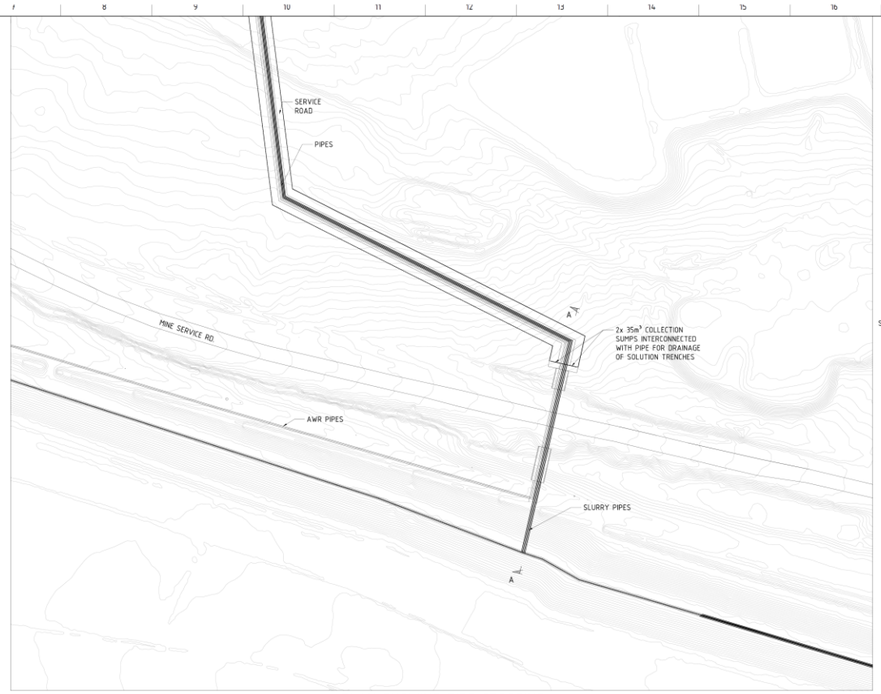
01



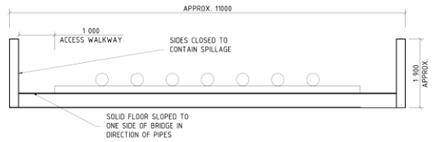




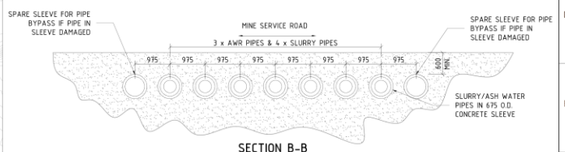
LOCALITY PLAN



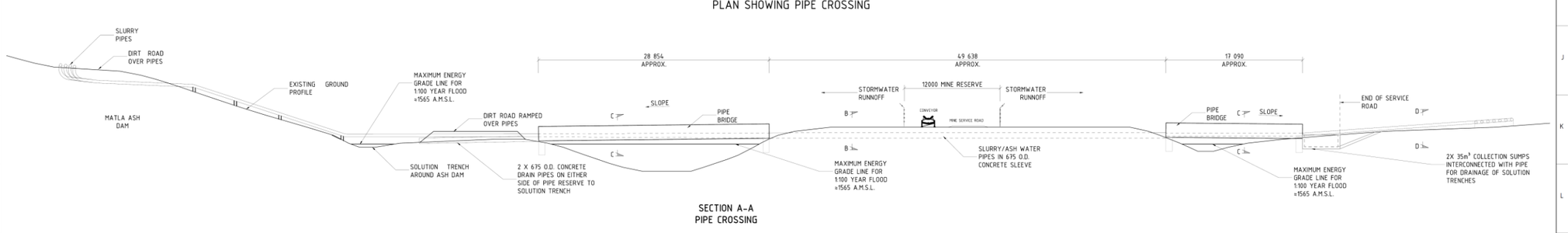
PLAN SHOWING PIPE CROSSING



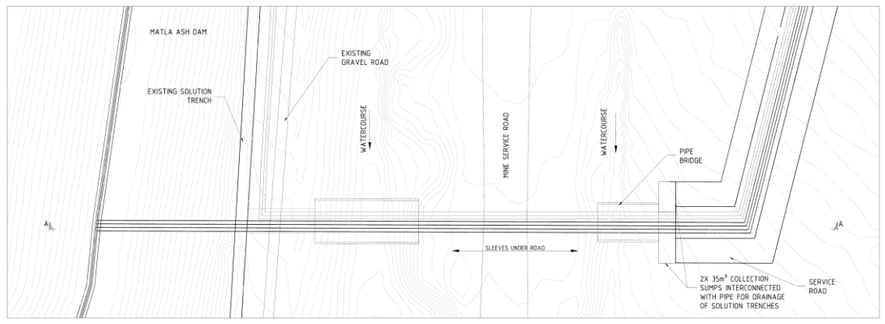
TYPICAL SECTION C-C THROUGH PIPE BRIDGE



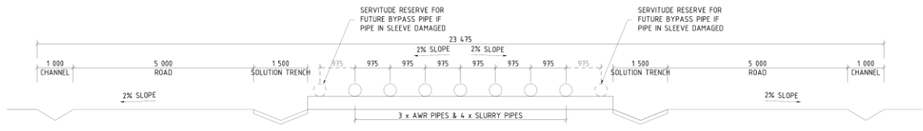
SECTION B-B



SECTION A-A
PIPE CROSSING



PLAN OF
PIPE CROSSING



SECTION D-D

FOR INFORMATION ONLY

D.O. REV	DATE	** REVISION **	REV BY	CHKD BY	AUTH BY	KKS APP	REFERENCE DRAWINGS
		INDEX REFERENCE					
	0	03/09/15 MATLA ASH DAM INDICATED	NM				
	B	26/08/15 SINGLE CROSSING OPTION UPDATED	NM				
	A	09/03/15 FOR INFORMATION	NM				

DRG REGISTR — APPROVED BY —
KKS APP — AUTHORISED BY —
AUTH BY
CHKD BY
DRAWN BY 09/07/15 NM
SCALE AS SHOWN

ESKOM HOLDINGS LTD. REG. No. 2002/015527/06

KRIEL POWER STATION
KRIEL-MATLA ASH TRANSFER
MINE SERVICE ROAD PIPE CROSSING CONCEPT

Eskom 0.45/58835 SHEET 1 REV 0