GIJIMA

Gijima Supply Chain Management Services (Pty) Ltd

MYEZO ENVIRONMENTAL MANAGEMENT SERVICES

Environmental Stewardship

GIJIMA – ARBOR RAILWAY SIDING – BASIC ASSESSMENT REPORT

ARBOR RAILWAY SIDING BASIC ASSESSMENT REPORT FOR PROPOSED OPERATIONS OF A RAIL SIDING TO STORE, HANDLE AND RAIL COAL, MPUMALANGA PROVINCE.

Document Name: GAB – R – Updated BAR

Volume 3 of 3 – Specialist Reports

Date: 26 November 2019

Rev 2.0

DARDLEA Ref: 1/3/1/16/1N-213

Myezo Ref No: GAB 2018/11

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The water management plan for the proposed extension of the existing siding on the southern side of Arbor Station

For the client

Gijima Supply Chain Management Services (Pty) Ltd
Reg. No.: 2001/015676/07

Signoff

Engineer: I. van der Linde _____ Date: 2018/09/08

Client: _____ Date: _____

Date: September 2018

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1] Introduction:

Gijima Supply Chain Management Services (Pty) Ltd (Gijima for short) is currently operating a coal loading facility on the northern side of Arbor Station. This facility is not very conducive for the staging and loading of trains and it was decided to also develop the southern side of the station as a loading facility in order to increase the overall loading capacity of the siding. However, due to the shortage of funds it was also decided that this development will be phased in on a piecemeal basis and the income generated from this facility will fund the capital requirement for the development.

It is the intention to utilize the two lines next to the existing platform (indicated as red and yellow lines on the drawings) as the future loading lines. All the other infrastructure required to comply with the various regulations will eventually be placed within the existing Transnet boundary as shown in yellow shading on Figure 1.

Figure 1: Proposed site for the future expansion of the existing facility

2] Site location:

Arbor Station is located in the Mpumalanga Province right next to the R555 highway between the towns of Delmas and Ogies. It is surrounded by the towns of Delmas, Kendal and Balmoral. The GPS coordinates of the station building at Arbor are 26° 02' 25.95" S and 28° 52' 59.60" E.

Figure 2: The location of Arbor Siding

The area in question is situated to the south of Arbor station as indicated on Figure 1 and is approximately 6.4ha in size.

3] Phasing in of the infrastructure:

It is the intention to initially use the infrastructure "as is" with the minimum construction possible to modify the site in order to stockpile the coal and load it on to the trains. For the sake of the ease of reference this stage will be called "Phase 1". The infrastructure which will be constructed in phase 1 will be in line with the future infrastructure requirement for phase 2.

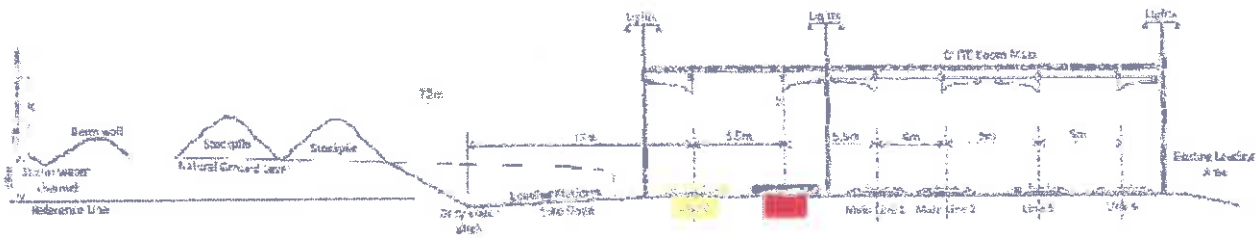
Phase 2 will represent the completed works to stockpile 17 000 tons of coal and a throughput of 72 000 tons per month. The water management calculations will be done for this scenario.

3.1] Layout for phase 1:

The terrain will only be cleared and leveled and some minor earthworks will be required to enable the front end loaders to get to the rail track structure to load the trasins. Figure 3 gives the proposed startup layout for phase 1.

A storm water drain and berm wall will also be installed on the TFR boundary line to divert the runoff storm water away from the siding in order to separate the clean and dirty water systems.

Figure 3: Layout for Phase 1



Cross-section of the siding for phase 1

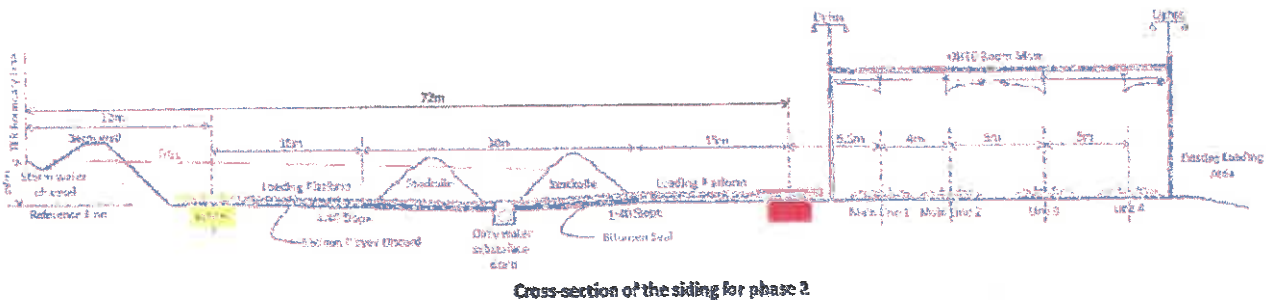
Figure 4: Cross section for phase 1

3.2] Layout for phase 2:

Line 6 will be moved to the TFR boundary which will then encapsulate the dirty area between line 5 and line 6. In order to manage and contain the polluted runoff the following items are added to the basic layout design: See Figure 5

- Redirecting the contaminated water flow
- Adding a silt trap
- Adding a Pollution Control Dam (PCD)

Figure 5: Layout for Phase 2



Cross-section of the siding for phase 2

Figure 6: Cross section for phase 2

3.3] Water management strategy:

- Storm water runoff from the catchment area will be guided around the siding by means of the storm water drain and the berm wall.
- For phase 1 the polluted water will be guided to the existing culvert underneath the railway tracks on the eastern side of the siding. From there the existing dirty water channel will discharge it into the existing PCD. See Figure 15.
- After completion of phase 2 the entire siding will slope westwards with a fall of 1:100 and then the polluted water will flow that way by means of drainage channels and culverts to be discharged into the silt trap and the new PCD.
- Water will be extracted from the PCD at a rate of 90 000 liters per day (about 27 000m^3 per year) for mainly dust suppression purposes.
- There is no need for the supply of potable water due to the infrastructure which already exists on the northern siding.

3.4] Soil sealing arrangements:

No soil sealing will be performed for the phase 1 layout because this setup will only be in place temporarily. Any pollution that might occur during this period will physically be removed when the phase 2 layout is being constructed. This is evident when comparing the natural ground level line (red line) with the stockpile levels on Figures 4 & 6.

The following methodologies will be used for the phase 2 layout in order to comply with the "Class C" specification for landfills in providing a double seal:

The PCD:

Spray a 1mm thick bitumen emulsion seal / binder on the floor and the sidewalls and then cover it with a 1.5mm thick HDPE membrane. The advantage of this methodology is that the bitumen will "glue" to the HDPE liner and thereby strengthen it. Due to its "gluing" effect it will also localize and inhibits any leakage through the plastic liner.

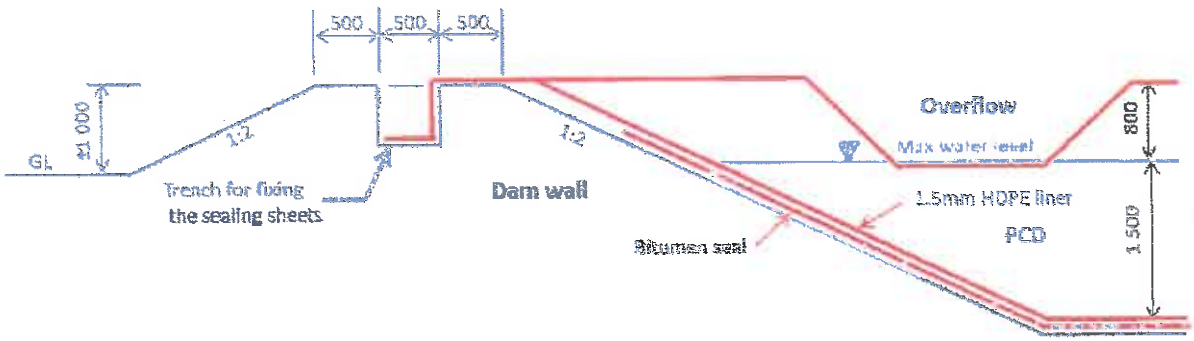
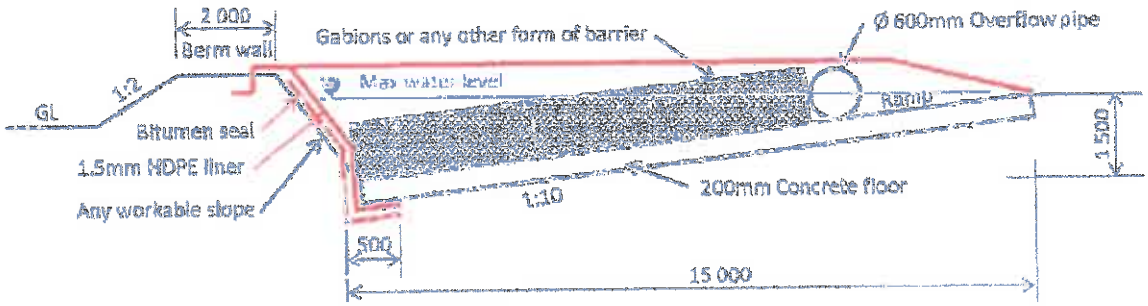


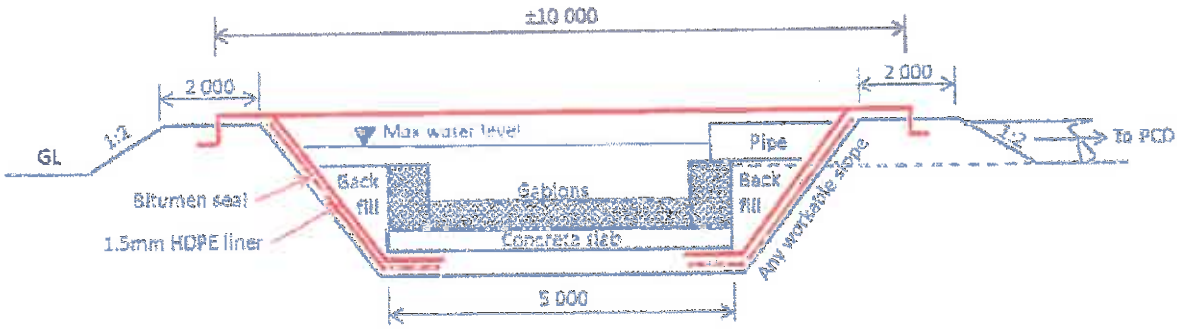
Figure 7: Sealing arrangement for the PCD

The silt trap:

Sealing the silt trap is similar to the PCD except that the floor or ramp will be covered with a 200mm thick concrete slab.



Side view section



Front view section

Figure 8: Sealing arrangements for the silt trap

The stockpile areas:

Spray a 1mm thick bitumen layer on top of the prepared surface area for the stockpiles and cover it with a 150mm low permeable material (such as a clayey discard layer). As soon as water is added (which will be daily) the very fine particles will settle at the bottom of the layer to form a very effective natural seal. This seal will "grow" over time as the vehicle wheels pulverize the surface particles and the seal will become even more effective.

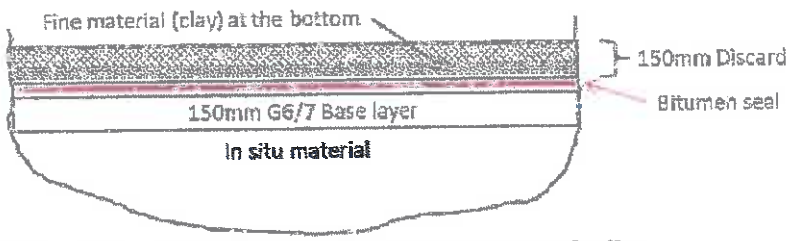


Figure 9: Sealing arrangement for the stockpiles

The dirty water channels:

Subsurface drains:

Unfortunately the dirty water catchment drains have to run through the centre line of the stockpile areas for this specific kind of loading area layout. For maintenance and safety reasons it would be better to install subsurface drains to collect and discharge the dirty water in this case.

The subsurface drains will effectively be 500mm x 500mm in size. The drains will be lined with a 1.5mm HDPE liner and the water will permeate to the drainpipe by means of a thick geo-fabric and a coarse sand fill at the top as shown in Figure 10. The slope of all the subsurface drains will be 1:1000.

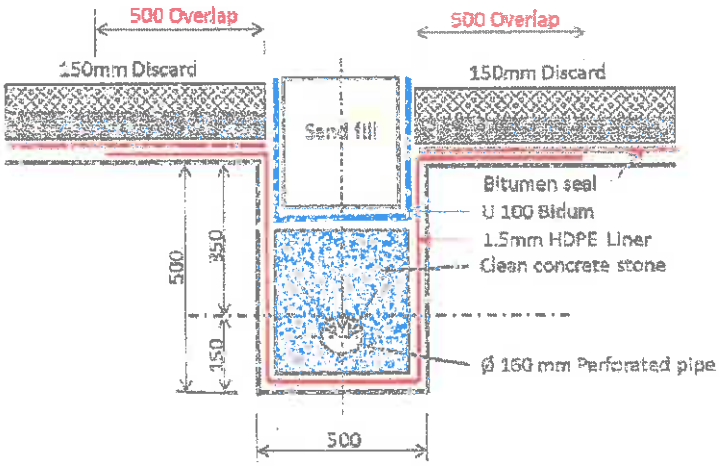


Figure 10: Layout for the subsurface drains

Surface drains:

Open drains will be lined with a 1.5mm HDPE liner and weighed down at the bottom by means of either sand bags, hand stone or even coarse gravel.

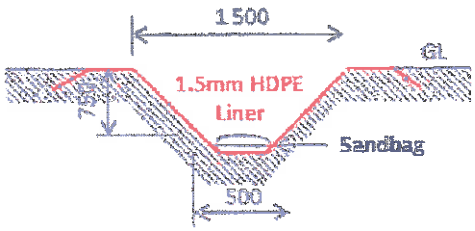


Figure 11: Sealing of the open drains

Underfloor drainage:

According to the "Class C" specification for landfills subsurface drains have to be installed below the floor of the PCD for monitoring purposes. Due to the relatively small size of the PCD a single ring drain at the floor edges will suffice. Although the final ground levels for phase 2 are yet unknown it will be assumed that the outlet of the ring drain will daylight inside the storm water channel. These drains are indicated on Figure 5 by the red lines.

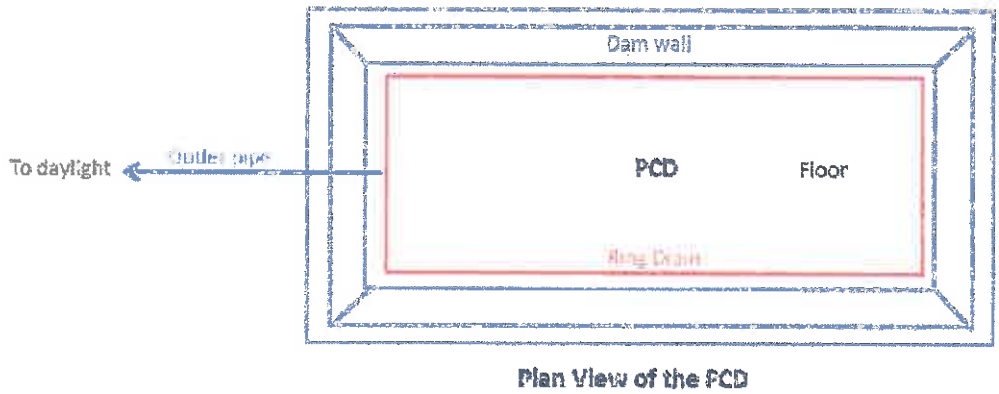


Figure 12: Layout of the underfloor drains

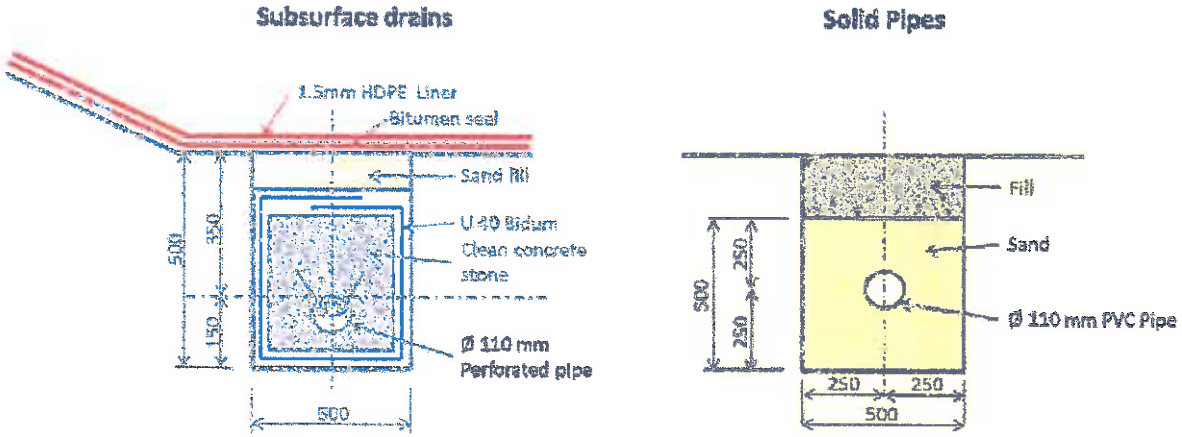


Figure 13: Layout of the drains and pipes

4] Metrological data:

The following metrological data were used to calculate the expected runoff volumes for the relevant areas and infrastructure:

- Rainstorm with a 1:50 year return period
- 2 hour storm duration
- Precipitation of 650mm per year
- Evaporation = 1.5 x Area x temperature / 20 in m^3 per year
- Average temperature is 18°C
- Runoff factor of 0.2 for the storm water due the agricultural nature for most of the catchment area
- Runoff factor of 0.4 for the dirty water runoff on the siding

5] Water runoff calculations:

5.1] Storm water catchment area:

The size of the catchment area according to Google Earth is about 49.6ha – see the blue shaded area on Figure 14.

Figure 14: Storm water catchment area

5.2] Dirty water catchment area for phase 1:

The size of the polluted area will be about 3.8ha – see purple shaded area on Figure 15.

Figure 15: Polluted area for phase 1

5.3] Dirty water catchment area for phase 2:

The size of the polluted area will be about 5.0ha see purple shaded area on Figure 16.

Figure 16: Polluted area for phase 2

5.4] Runoff calculations:

Table 1 gives the expected runoff figures for a 1:50 year rainstorm for the three different areas in question.

STORMWATER CALCULATIONS Arbor Siding					
INPUT DATA MACRO SYSTEM		(1 in 50yr Storm)			
Mean Annual Rainfall R		(mm/yr)	650		
Frequency F		(yr)	50		
Time lapse T		(minutes)	120		
Catchment Area A Total		(Ha)	50		
Area			Intensity(mm/hr)	Discharge Q (m³/s)	Volume V (m³)
Storm water	(Ha)	49.6	53.2	1.6	10,556
Runoff factor	%	20			
Dirty water phase 1	(Ha)	3.7	53.2	0.2	1,576
Runoff factor	%	40			
Dirty water phase 2	(Ha)	5	53.2	0.3	2,128
Runoff factor	%	40			
			Total Runoff (m³/s)		14,259

Table 1: Estimated 1:50 year water runoff figures

The following equation can be used to calculate the annual expected runoff volumes for each area:

Volume = Area x annual precipitation x runoff factor

For phase 1:

Dirty water volume = 37 000 x 0.65 x 0.4 ≈ 9 600m^3

For phase 2:

Dirty water volume = 50 000 x 0.65 x 0.4 ≈ **13 000m^3**

5.5] Water balance:

Estimated evaporation:

Assume that the water surface area in the PCD is 2 000m^2 and the evaporation calculation is also only valid for phase 2 then:

=> Water evaporation ≈ 1.5 x Area x Ave Temp/20 = 1.5 x 2 000 x 18/20 ≈ 2 **700m^3**/year.

Water balance:

As stated in item 3.3 the annual water need for recycling will be 27 000m^3.

Water balance = inflow – outflow = 13 000 – 2 700 – 27 000 = - 16 700m^3/year or a deficit of 55 700 liters per day (≈ 4 x Water bowsers per day).

The implications of having a negative water balance are:

- An additional water source will have to be identified. One option will be to divert some of the storm water runoff into the dam as well.
- The capacity of the PCD must therefore only cater for the 1:50 year rainstorm which will, according to Table 1, be in the order of 2 200m^3

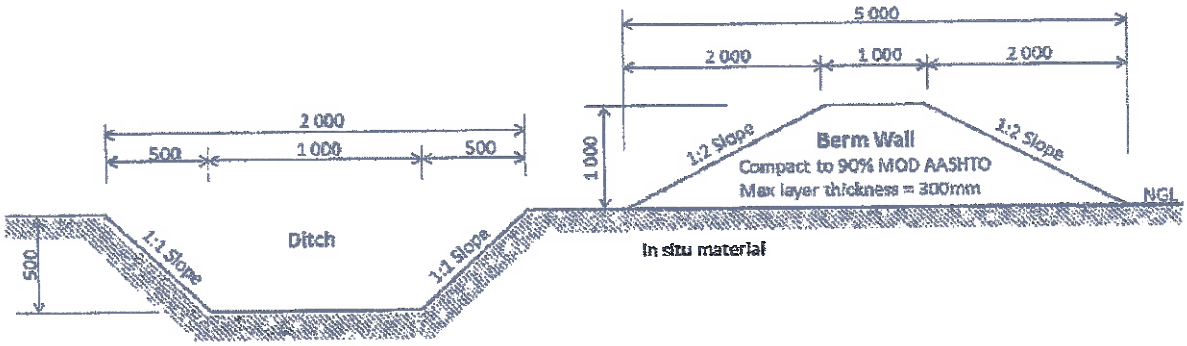
6] Water management infrastructure:

Currently the existing natural slope along the length of the siding is in the order of 1:45 and this figure will be used for the calculation of the size of the storm water drain.

However, the surface level of the siding for phase 2 will have to follow the level of the existing railway line which is sloping down towards the west at an angle of 1:100. This slope will be used to determine the sizes of the dirty water channels.

6.1] Storm water channel:

The channel falls about 16m over a distance of 930m. According the "channel size calculator" (Annexure A) for the expected water flow rate of 1.5m^3/s the required minimum size of the trench will be as shown in Figure 17



Cross section of the storm water ditch and the berm wall

Figure 17: Storm water drain and the berm wall

It is estimated that the ditch will flow at the 90% level with a 1:50 year rainstorm and the flow speed can reach up to 2.3m/s. Therefore some scouring of the sidewalls of the channel can be expected at the bends and it is suggested that the bends should be lined with hand stone.

6.2] Dirty water drains:

Most of the dirty water drains will be subsurface drains and the rate of filtration will determine the flow rate inside the drain. Refer to Figure 10 for the drain layout.

Only the drain between the loading area and the silt trap will be an open drain which will be lined with a HDPE membrane as discussed under item 3.4. It will have the following minimum dimensions: Refer to Annexure A for the calculations.

Figure 18: Layout for the dirty water drains

The channel will be 50% full at the design flow of 0.3m^3/s and the water speed will be 1.9m/s.

6.3] Culvert pipes:

Most of the existing pipe culverts on site were built with Ø 600mm concrete pipes and the same size will be used to construct the new culvert. According to Annexure A this pipe will flow at 60% depth for a discharge rate of 0.3m^3/s and at a speed of 1.9m/s.

Due to the fact that it will be a private road inside the siding, it will not be necessary to install concrete headwalls and simple stone pitching around the pipe inlet and outlet will suffice.

6.4] Silt trap:

The silt trap as described under item 3.4 will have a capacity of about 150m^3 which will give a retention time of about 10 minutes at the peak flow of 0.3m^3/s. This will remove most of the sediment but the suspended solids within the water body will spill over into the PCD.

6.5] PCD:

The site topography is of such a nature that it will be difficult to get water into the dam by gravity and still have enough height difference available to daylight the underfloor drainage system. Therefore it is foreseen that a relatively big but shallow dam will have to be constructed.

A dam capacity of 2 200m^3 converts to a dam size of 80m x 30m measured from centre of wall to centre of wall and a total depth of 2.3m (water depth=1.5m).

All the water inlet and outlet structures to be concrete lined.

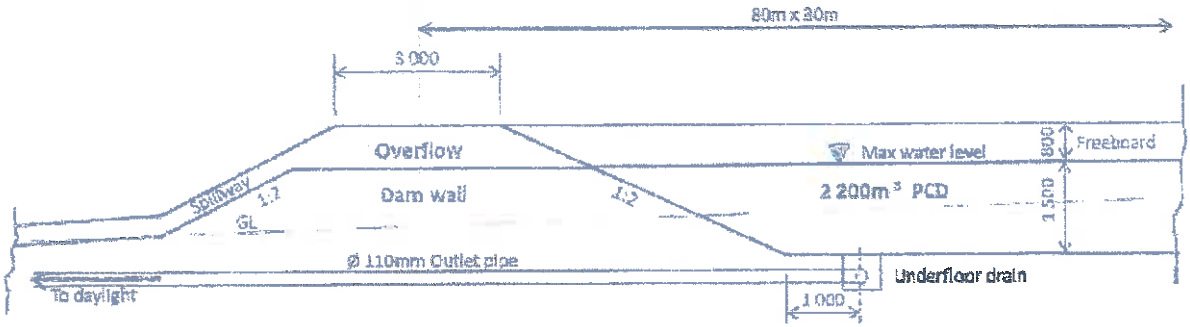


Figure 19: Layout of the PCD

Also refer to Figure 12 for the underfloor drainage layout.

6.6] Mobile Pump:

A mobile pump with a gooseneck outlet must be supplied to extract water from the PCD to fill the water bowsers.

7] Conclusion:

This is a simple and straight forward railway siding design in terms of the water management issues but it might become technically challenging to migrate from phase 1 to phase 2 without closing the siding for some period of time.

Annexure A

Channel Sizes

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Reference: PEC/ARB
Date: 2018-09-07

ERWAY
ENGINEERING
CONSULTING

Arbor Siding: Storm water channel @ 1:60 slope

Q (required) = 1.5 m³/s

CHANNEL FLOW	
Bottom Width (m)	1.000
Manning - N	0.013
Side Slope 1 :	1.0
Channel Length (m)	100
Height Difference (m)	1.67

Top B2 2.000
Depth 0.900
Slope 1 : 1.0
1.000
Bottom B1

Manning Values	
Metal, Plastic	0.011
Concrete	0.015
Corrugated Material	0.022
Earth Channel	0.025
Channel - Weedy	0.03

DATA:	B2	P	Area	R	S	V (m/s)	Q (m³/s)
Base (m) 1.000	2.800	2.414	0.750	0.311	0.017	2.41	1.81
Depth (m)							

Equations
V=1/N*R^2/3*S^0.5
Q = V A

Capacity for Partial Flow

Base	dH	Depth	d Depth	Slope	B2	p	Area	R	V	Q	% Q
1.000	0.1	0.500	0.05	1.000	1.100	1.141	0.050	0.044	0.67	0.04	1.96%
1.000	0.2	0.600	0.1	1.000	1.200	1.283	0.110	0.086	1.02	0.11	6.21%
1.000	0.3	0.500	0.15	1.000	1.300	1.424	0.175	0.121	1.28	0.22	12.27%
1.000	0.4	0.500	0.2	1.000	1.400	1.566	0.240	0.153	1.50	0.36	19.96%
1.000	0.5	0.500	0.25	1.000	1.500	1.707	0.313	0.182	1.68	0.53	29.29%
1.000	0.6	0.500	0.3	1.000	1.600	1.848	0.390	0.211	1.83	0.72	40.17%
1.000	0.7	0.500	0.35	1.000	1.700	1.990	0.473	0.237	2.01	0.95	52.86%
1.000	0.8	0.500	0.4	1.000	1.800	2.131	0.560	0.263	2.15	1.20	66.77%
1.000	0.9	0.500	0.45	1.000	1.900	2.273	0.653	0.287	2.26	1.48	82.54%
1.000	1.0	0.500	0.5	1.000	2.000	2.414	0.750	0.311	2.41	1.80	100.00%

Arbor Siding: Dirty water channel @ 1:100 slope

Q (required) = 0.3 m³/s

CHANNEL FLOW	
Bottom Width (m)	0.500
Manning - N	0.013
Side Slope 1 :	1.0
Channel Length (m)	100
Height Difference (m)	1.00

Top B2 1.500
Depth 0.500
Slope 1 : 1.0
0.500
Bottom B1

Manning Values	
Metal, Plastic	0.011
Concrete	0.015
Corrugated Material	0.022
Earth Channel	0.025
Channel - Weedy	0.03

DATA:	B2	P	Area	R	S	V (m/s)	Q (m³/s)
Base (m) 0.500	1.500	1.914	0.500	0.261	0.010	2.72	1.36
Depth (m)							

Equations
V=1/N*R^2/3*S^0.5
Q = V A

Capacity for Partial Flow

Base	dH	Depth	d Depth	Slope	B2	p	Area	R	V	Q	% Q
0.500	0.1	0.500	0.05	1.000	0.600	0.641	0.025	0.040	0.62	0.02	1.85%
0.500	0.2	0.500	0.1	1.000	0.700	0.783	0.060	0.077	1.20	0.07	5.30%
0.500	0.3	0.500	0.15	1.000	0.800	0.924	0.090	0.105	1.49	0.15	10.65%
0.500	0.4	0.500	0.2	1.000	0.900	1.066	0.140	0.131	1.72	0.26	17.70%
0.500	0.5	0.500	0.25	1.000	1.000	1.207	0.188	0.156	1.93	0.39	26.51%
0.500	0.6	0.500	0.3	1.000	1.100	1.349	0.240	0.178	2.11	0.51	37.18%
0.500	0.7	0.500	0.35	1.000	1.200	1.490	0.298	0.200	2.28	0.68	49.74%
0.500	0.8	0.500	0.4	1.000	1.300	1.631	0.360	0.221	2.43	0.88	64.34%
0.500	0.9	0.500	0.45	1.000	1.400	1.773	0.428	0.241	2.58	1.10	81.06%
0.500	1.0	0.500	0.5	1.000	1.500	1.914	0.500	0.261	2.72	1.36	100.00%

Arbor Siding: Culvert @ 1:100 slope

Q (required) = 0.3 m³/s

CHANNEL FLOW	
Bottom Width (m)	0.550
Manning - N	0.013
Side Slope 1 :	0.8
Channel Length (m)	100
Height Difference (m)	1.00

Top B2 0.950
Depth 0.550
Slope 1 : 0.8
0.550
Bottom B1

Manning Values	
Metal, Plastic	0.011
Concrete	0.015
Corrugated Material	0.022
Earth Channel	0.025
Channel - Weedy	0.03

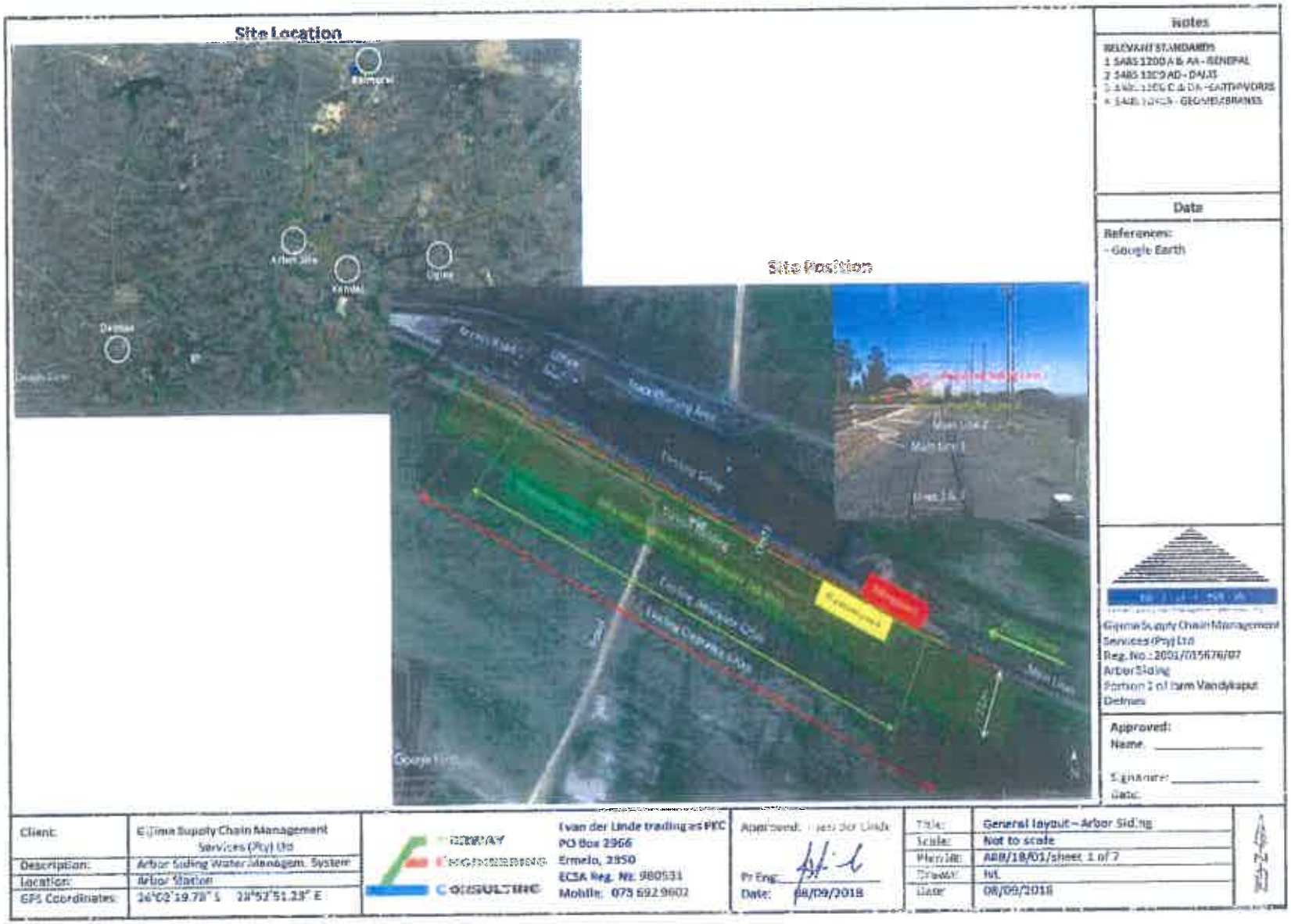
DATA:	B2	P	Area	R	S	V (m/s)	Q (m³/s)
Base (m) 0.550	0.950	1.650	0.385	0.183	0.010	2.45	0.93
Depth (m)							

Equations
V=1/N*R^2/3*S^0.5
Q = V A

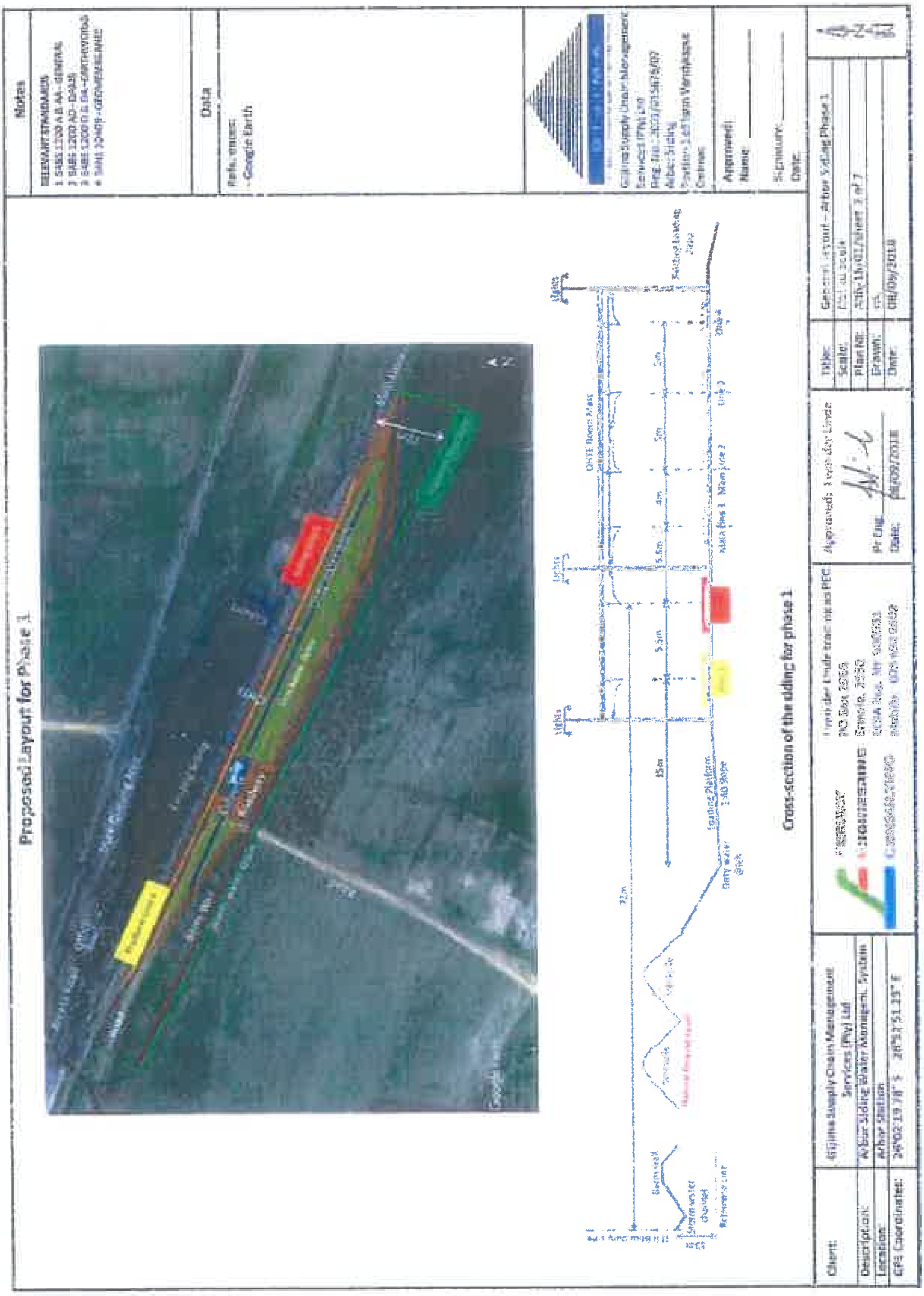
Capacity for Partial Flow

Base	dH	Depth	d Depth	Slope	B2	p	Area	R	V	Q	% Q
0.550	0.1	0.550	0.055	0.800	0.630	0.691	0.030	0.045	0.65	0.03	3.97%
0.550	0.2	0.550	0.11	0.800	0.710	0.782	0.070	0.089	1.22	0.07	11.37%
0.550	0.3	0.550	0.165	0.800	0.790	0.873	0.111	0.127	1.48	0.13	20.44%
0.550	0.4	0.550	0.22	0.800	0.870	0.964	0.151	0.157	1.64	0.20	30.52%
0.550	0.5	0.550	0.275	0.800	0.950	1.055	0.191	0.181	1.77	0.27	41.27%
0.550	0.6	0.550	0.33	0.800	1.030	1.146	0.232	0.203	1.93	0.34	52.46%
0.550	0.7	0.550	0.385	0.800	1.110	1.237	0.272	0.220	1.97	0.42	64.93%
0.550	0.8	0.550	0.44	0.800	1.190	1.328	0.312	0.235	2.04	0.49	75.84%
0.550	0.9	0.550	0.495	0.800	1.270	1.419	0.352	0.248	2.10	0.57	87.62%
0.550	1.0	0.550	0.55	0.800	1.350	1.510	0.393	0.260	2.15	0.65	100.00%

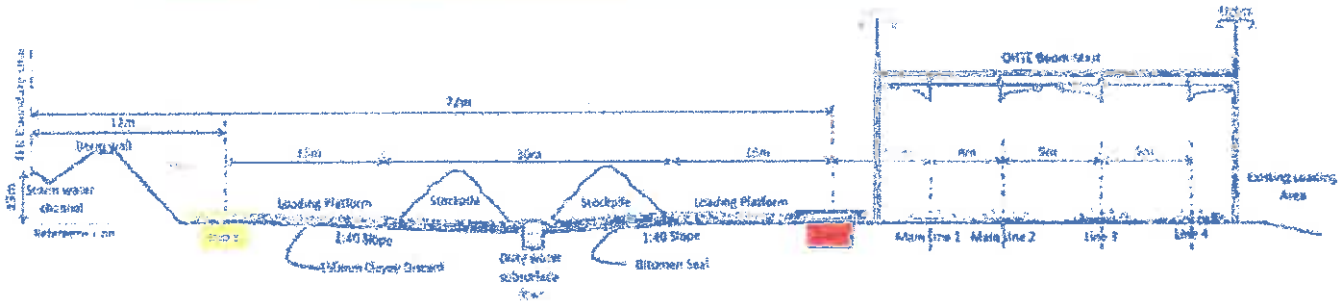
Drawings


Site Location
Site Position
Notes
RELEVANT STANDARDS
1 SABS 1200 A & AA - GENERAL
2 SABS 1200 AD - DAMS
3 SABS 1200 C & DA - EARTHWORKS
4 SABS 1200 G - GEOMEMBRANES
Data
References:
- Google Earth
Approved:
Name
Signature
Date
Client: Eljima Supply Chain Management Services (Pty) Ltd
Description: Arbor Siding Water Managem. System
Location: Arbor Station
GPS Coordinates: 26°02'19.78" S 28°52'51.28" E
Ivan der Linde trading as PEC
PO Box 2956
Ermelo, 2350
ECSA Reg. Nr. 980531
Mobile: 073 692 9602
Pr Eng:
Date: 08/09/2018
Title: General layout – Arbor Siding
Scale: Not to scale
Plan No: ARB/18/01/sheet 1 of 7
Drawn: NL
Date: 08/09/2018

PERWAY ENGINEERING CONSULTING



Proposed Layout for Phase 2



Cross-section of the siding for phase 2

Notes

RELEVANT STANDARDS
1. SABS 1200 A & AA - GENERAL
2. SABS 1200 AD - DRAIN
3. SABS 1200 D & DA - EARTHWORKS
4. SANS 10409 - GEOMEMBRANE

Data

References:
- Google Earth

Client: Sigma Supply Chain Management Services (Pty) Ltd
Reg. No.: 2001/021676/07
Arbor Siding
Portion 2 of Farm Vandyksput
Delmas

Approved:
Name: _____
Signature: _____
Date:

Client:	Sigma Supply Chain Management Services (Pty) Ltd	Van der Linde trading as PEC PO Box 2966 Cresta, 2150 VAT Reg. Nr 980551 Mobile: 073 692 9602	Approved: Van der Linde PrEng Date: 28/06/2018	Title:	General layout – Arbor Siding Phase 2
Description:	Arbor Siding Water Management System			Scale:	Not to scale
Location:	Arbor Station			Plan Nr:	3380/18/05/sheet 3 of 7
GPS Coordinates:	26°02'19.78"S 28°51'01.25"E			Drawn:	HC
				Date:	08/06/2018

Storm water catchment area

Dirty water catchment area for Phase 1

Dirty water catchment area for Phase 2

Notes

RELEVANT STANDARDS
1 SABS 1200 A & AA - GENERAL
2 SABS 1200 AD - DAMS
3 SABS 1200 D & DA - EARTHWORKS
4 SANS 10409 - GEOMEMBRANES

Date

References:
- Google Earth

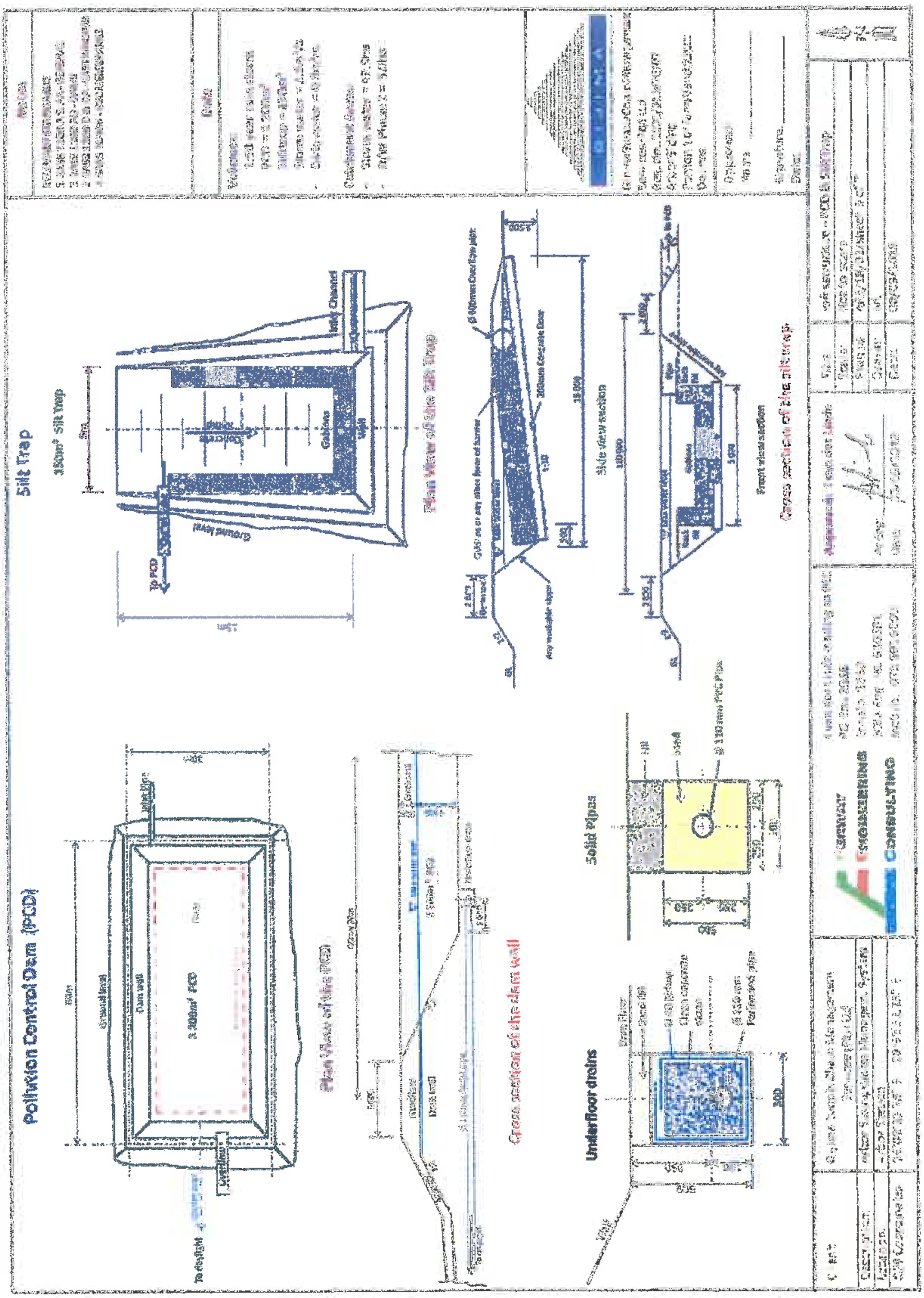
Catchment Areas:
Storm water = 40.6ha
D/W Phase 1 = 3.7ha
D/W Phase 2 = 5.0ha

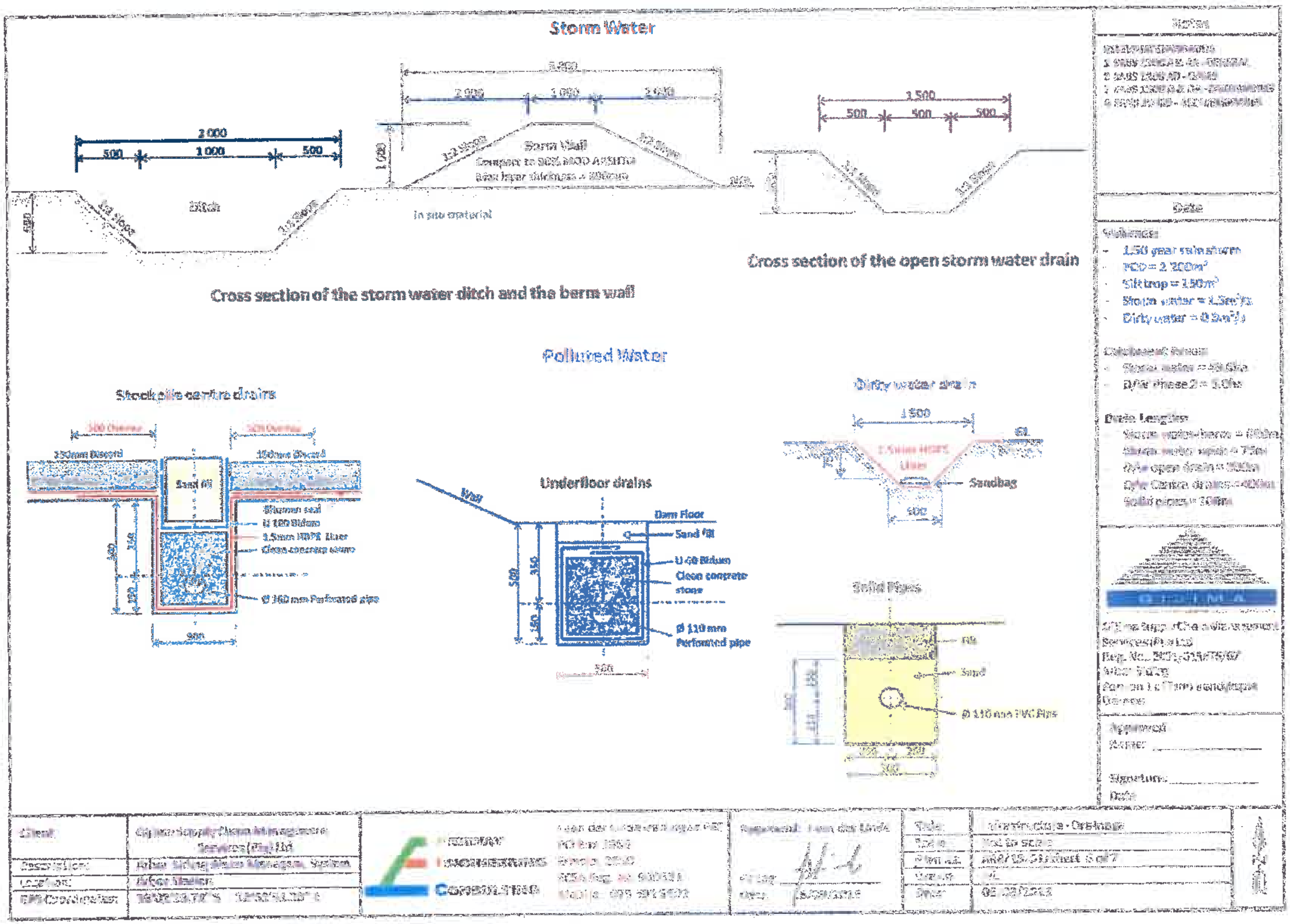
Gijima Supply Chain Management Services (Pty) Ltd
Reg. No.: 2001/015675/07
Arbor Siding
Portion 1 of farm Vendykspruit
Delmas

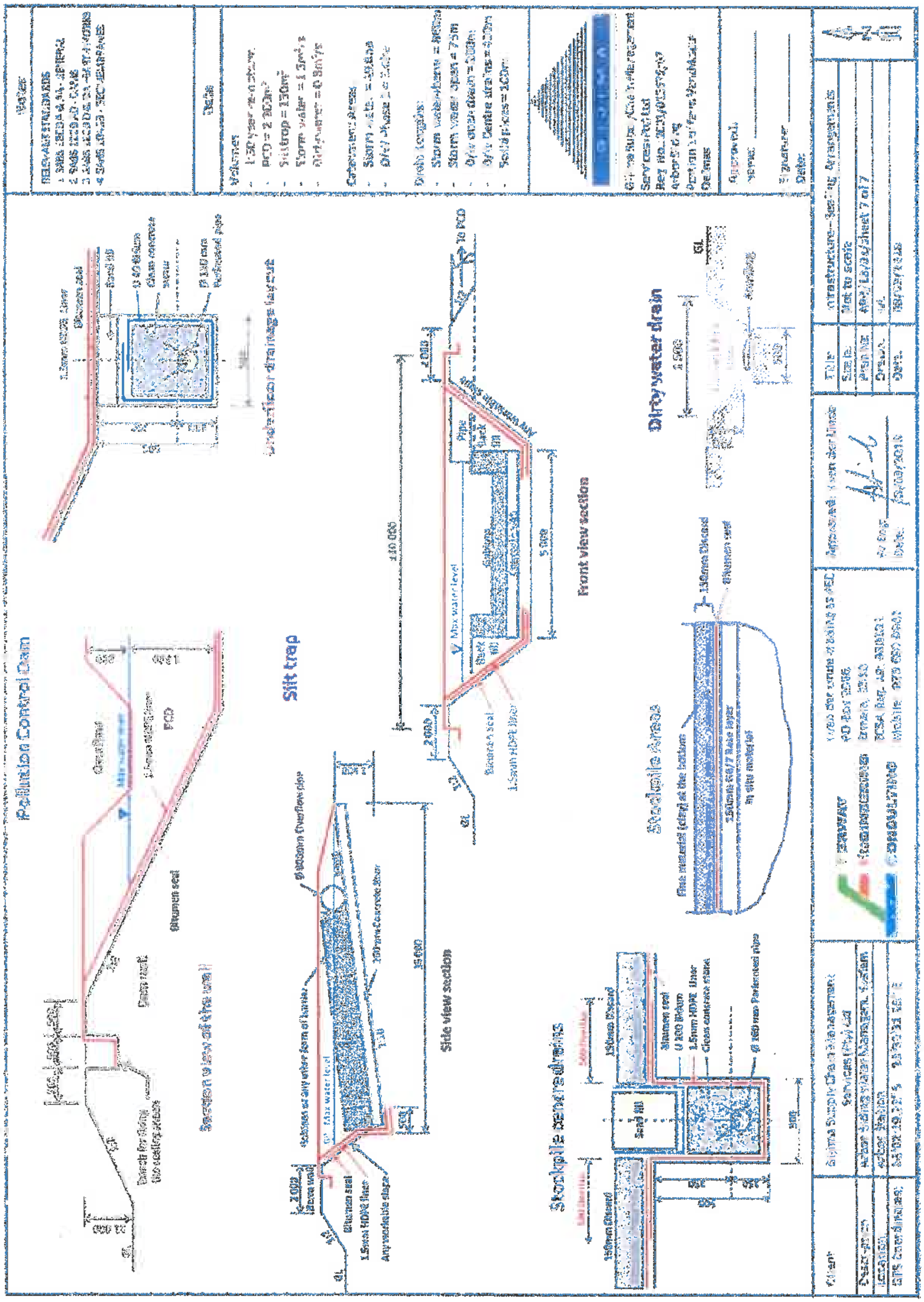
Approved:
Name: _____
Signature: _____
Date:

Client:	Gijima Supply Chain Management Services (Pty) Ltd	Ivan der Linde trading as PEC PO Box 2960 Ermelo, 2350 ECSA Reg. No: 980551 Mobile: 073 692 9602	Approved: Ivan der Linde Pr Eng: _____ Date: 05/09/2018	Title:	Catchment Areas
Description:	Arbor Siding Water Managem. System			Scale:	Not to scale
Location:	Arbor Station			Plan No:	ARB/18/01/sheet 4 of 7
GPS Coordinates:	26°02'19.78" S 28°52'51.23" E			Drawn:	IvL
				Date:	05/09/2018

Ferway Engineering Consulting




Storm Water
2 000
500
1 000
500
Ditch
1:2 Slope
2 000
1 000
Berm Wall
In situ material
1 500
500
Cross section of the open storm water drain
Cross section of the storm water ditch and the berm wall
Polluted Water
Stockpile centre drains
Sand fill
Underfloor drains
Wall
Dam Floor
Sand fill
Clean concrete stone
Ø 110 mm Perforated pipe
Dirty water drain
1 500
Sandbag
Solid Pipes
Notes
Date
Approved
Signature
Date
Title
Infrastructure - Drainage
Not to scale
Client
Description
Location
GPS Coordinates


Pollution Control Dam
Section view of the wall
Silt trap
Side view section
Front view section
Stockpile Areas
Dirty water drain
Stockpile sand drains

Annexure 16.2-2: Integrated Water and Waste Management Plan (IWWMP)

LETSOLO
WATER AND ENVIRONMENTAL SERVICES
"Engineered Solutions for Environmental Quandary"

Letsolo Water And Environmental Services cc
P.O. Box 19016
Pretoria West
0117
Reg: 2010/005979/23
Tax ref Number: 9170/262/18/3
Vat Number: 4380258477

Tel : (012) 321 0073
Cell : 082 821 6621
Fax : 0866 134 794
e-mail : ishmael@lwes.co.za
Website : www.lwes.co.za

Date: 22 January 2018

Gijima Supply Chain Management (Pty) Ltd
PO Box 71486
Bryanston East
2021.
South Africa

Attention: Mr Ramphele and Mr Cronje

TITLE: UPDATE – INTEGRATED WATER AND WASTEWATER MANAGEMENT PLAN FOR SUPPLY CHAIN MANAGEMENT (PTY) LTD, IN LINE WITH WATER USE LICENCE NUMBER 04/B20F/G/4009

Good day

The Integrated Water and Wastewater Management Plan (IWWMP) for Gijima Supply Chain Management (Pty) Ltd, Arbor Siding, in accordance to the conditions of Water Use Licence Number **04/B20F/G/4009**, dated 18 December 2015, bears reference.

Please see attached the Draft report for your attention and approval.

Please do not hesitate to contact me should you have any queries.

Best regards,

Ishmael Phalane,

Engineering Technologist – Civil Engineering (ECSA: 201480763)

LETSOLO
WATER AND ENVIRONMENTAL SERVICES
"Engineered Solutions for Environmental Quandary"

LETSOLO WATER AND ENGINEERING SERVICES CC

[INTERGRATED WATER AND WASTEWATER MANAGEMENT PLAN]

[Arbor Siding]

Reference: LWES 416

22 January 2018

Prepared By:	Prepared for:
Ishmael Phalane B-TECH; Civil Engineering (ECSA – Reg No: 201480763) Letsolo Water and Environmental Services cc 76 Phudufufu Street Atteridgeville Ext 25 Kalafong Heights 0008 Tel: (012) 321 0073 Cell : 082 821 6621 Fax : 0866 134 794 e-mail : ishmael@lwes.co.za Website : www.lwes.co.za	Mr Peet Cronje, and Mr Velile Ramphele Gijima Supply Chain Management (Pty) Ltd PO Box 71486 Bryanston East 2021. South Africa Tel: +27 (0) 11 658 0349 Fax: +27 (0) 11 658 1332 www.gijimasupplychains.co.za

EXECUTIVE SUMMARY

Letsolo Water and Environmental Services cc, hereafter referred to as Letsolo, was appointed to update the Integrated Water and Wastewater Management Plan for Gijima Supply Chain Management Services (Gijima) for Arbor Siding.

Gijima is located on Portion 1 of the Farm Van Dyksput 214 IR, approximately 5 km West of Kendal power station. The Siding falls within the Victor Khanye Local Municipality in the magisterial District of eMalahleni, Mpumalanga Province.

Gijima Supply Chain Management Services (Pty) Ltd is undertaking a coal loading operations, which includes haulage of coal from various mines, stockpile and load to railway wagons for transportation to the markets. The coal stock piling footprint of the activity covers approximately 9000 square meters.

No coal extraction/ mining activities as well as disposal of coal takes place on site.

Gijima was issued with Water Use Licence (Licence Number **04/B20F/G/4009**) on 18 December 2015.

The water uses applicable to the WUL and this Integrated Water and Waste Management Plan (IWWMP) are listed below.

- 21(a): Taking water from a water resource; and
- 21(g): Disposing of waste which may detrimentally impact on a water resource.

As part of the approved Water Use License (WUL), the Siding must update the IWWMP annually. The first update of the IWWMP after the issuance of the Water Use Licence was in 2016. This report is the second update of the IWWMP. This update takes into account the stresses in the Water Management Area (WMA) due to mining and related activities, commercial agricultural activities and other waste discharge and disposal activities. The IWWMP is therefore a living document that will be revised and updated throughout the life of the operations to accommodate additional information and improved technology. The annual update ensures that water and wastewater management is continually optimised and adapted to the changing needs of the water management area.

Table of Contents

List of Figures

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Glossary of Terminology

Catchment - The area from which any rainfall will drain into the watercourse or watercourses or part of the water course, through surface flow to a common point or common points

Constitution – Refers to the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996).

Environment – The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects. Environment means the surroundings within which humans exist and that are made up of-

(i) the land, water and atmosphere of the earth;

(ii) micro-organisms, plant and animal life;

(iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and

(iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental Impact Assessment - An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy which requires authorisation of permission by law and which may significantly affect the environment. The EIA includes an evaluation of alternatives. As well as recommendations for appropriate mitigation measures for minimizing or avoiding negative impacts, measures enhancing the positive aspects of the proposal and environmental management and monitoring measures.

Existing Lawful use - An existing lawful use means a water use which has taken place at any time during a period of two years immediately before the date of commencement of the National Water Act 1998, (Act 36 of 1998) or which has been declared an existing lawful water use under section 33 and which was authorized by or under any law which was in force immediately before the date of commencement of the National Water Act.

General Standards - These are quality standards for waste water or effluent arising in any area other than an area in which the Special standards area applicable. These standards were published in Government Gazette No. 9225, on 18 May 1984, Regulation No. 991, in terms of the Water Act (Act 54 of 1956).

Groundwater Recharge - The inflow of water into a groundwater reservoir from the surface, e.g. infiltration of precipitation and its movement to the water table.

Hydrogeological –The study of distribution and movement of groundwater.

Hydrological – The study of movement, distribution and quality of surface water and groundwater.

Public Participation Process – A process of involving the public in order to identify issues and concerns, and obtain feedback on options and impacts associated with a proposed project, programme or

development. Public Participation Process in terms of NEMA refers to: a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to specific matters.

Red Data Book (South African) – An inventory of rare, endangered, threatened or vulnerable species of South African plants and animals.

Reserve means the quantity and quality of water required -

(a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No. 108 of 1997), for people who are now or who will, in the reasonably near future, be -

(i) relying upon;

(ii) taking water from; or

(iii) being supplied from, the relevant water resource; and

(b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.

Special Standards - These are quality standards for waste water or effluent arising in the catchment area draining water to any river specified in Schedule 1, or a tributary thereof at any place between the source thereof and the point mentioned in the Schedule. These standards were published in Government Gazette No. 9225, on 18 May 1984, Regulation No. 991, in terms of the Water Act (Act 54 0f 1956).

The Act - The National Water Act, (NWA) (Act 36 of 1998)

The Department - Means the Department of Water and Sanitation

Tributaries - A stream or river which flows directly into a larger river or stream.

Mine risk - Mines are classified into three risk categories namely, categories A, B and C according to the perceived severity of the potential impacts on the water resources due to mining activity.

Watercourse means -

(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, and a reference to a watercourse includes, where relevant, its bed and banks.

Water quality means the physical, chemical, toxicological, biological (including microbiological) and aesthetic properties of water that determine sustained (1) healthy functioning of aquatic ecosystems and (2) fitness for use (e.g. domestic, recreational, agricultural, and industrial). Water quality is therefore

reflected in (a) concentrations or loads of substances (either dissolved or suspended) or micro-organisms, (b) physico-chemical attributes (e.g. temperature) and (c) certain biological responses to those concentrations, loads or physico-chemical attributes.

Water Resource - A water resource includes any watercourse, surface water, estuary or aquifer. Watercourses include rivers, springs, and natural perennial and non-perennial channels. Wetlands, lakes, dams, or any collection identified as such by the Minister in the Government Gazette.

Water use license - An authorisation from the Department to a designated water user to use water. The authorisation will provide details on the time-frames and conditions for the designated water use

Abbreviations

BPG	- Best Practice Guideline
DWS	- Department of Water and Sanitation
EC	- Electrical Conductivity
EIA	– Environmental Impact Assessment
EIS	- Ecological Importance and Sensitivity
ELWU	- Existing Lawful Water Use
GDP	- Gross Domestic Product
HDSA	- Historically Disadvantaged South Africans
ISP	– Internal Strategic Perspective
IWULA	– Integrated Water Use License Application
m^3	– Cubic Metres
MAR	- Mean Annual Runoff
mbgl	- Metres Below Ground Level
mg/l	– Milligrams Per Litre
MPRDA	– Mining and Petroleum Resources Development Act (Act 28 of 2002)
NEMA	– National Environmental Management Act 1998 (Act 107 of 1998)
NWRS	– National Water Resources Strategy

NWA	– National Water Act 1998 (Act 36 of 1998)
PES	- Present Ecological State
SS	– Suspended Solids
SWMP	- Storm Water Management Plan
TDS	– Total Dissolved Solids
WMA	– Water Management Area
WULA	– Water Use Licence Application

1 INTRODUCTION

Letsolo Water and Environmental Services cc, hereafter referred to as Letsolo, was appointed to update the Integrated Water and Wastewater Management Plan (IWWMP) for Gijima Supply Chain and Management Services (Gijima). It is a legal requirement to have an annual update of the IWWMP for Arbor Siding.

The Department of Water and Sanitation (DWS) published General Notice Number 267, Regulations regarding the procedural requirements for Water Use Licences (WUL) and Appeals, dated 24 March 2017. This regulation, together with the Best Practice Guidelines, also published by the DWS, was used for the compilation of this report in order to comply with the approved structure of the IWWMP.

It is emphasized that the IWWMP is site specific. The elements noted below are covered in this report:

- Quantitative impact assessment and prediction of future impacts
  - Pollution sources and receiving environment – refer to BPG G.4 on Impact Prediction
- Water supply
  - Water resource conservation and/or reuse and reclamation - see BPG H.3
  - Storm water management - see BPG G.1
  - Process water management - see BPG A.3
  - Pollution Control Dams - see BPG A.4
- Ground water management
  - Waste management (domestic waste and industrial residues)
  - Water and salt balances - see BPG G.2
  - Monitoring and auditing systems - see BPG G.3

Gijima was issued with Water Use Licence (Licence Number **04/B20F/G/4009,** File Number **27/2/2/B620/12/9**) on 18 December 2015.
The water uses applicable to the WUL and this Integrated Water and Waste Management Plan (IWWMP) are listed below.

- 21(a): Taking water from a water resource; and
- 21(g): Disposing of waste which may detrimentally impact on a water resource.

1.1 Activity Background

A siding, in rail terminology, is a low-speed track section distinct from a running line or through route such as a main line or branch line or spur. It may connect through track or to other sidings at either end. Sidings often have lighter rails, meant for lower speed or less heavy traffic, and few, if any, signals. Sidings connected at both ends to a running line are commonly known as loops.
Throughout history, coal has been used as an energy resource, primarily burned for the production of electricity and/or heat, and is also used for industrial purposes, such as refining metals. A fossil fuel,

coal forms when dead plant matter is converted into peat, which in turn is converted into lignite, then sub-bituminous coal, after that bituminous coal, and lastly anthracite.

Coal is the largest source of energy for the generation of electricity worldwide.

The objectives of the project includes the moving of high volume commodities from road to rail, supply local and export clients, create jobs and enhance entrepreneur potential in the area. It is to benefit the local economy through salaries paid to employees and tax revenues paid to Government.

The Arbor siding operation is expected to contribute positively towards development of opportunities within Victor Khanye Local Municipality. The local economy will be boosted through provision/creation of employment opportunities for the local community. These opportunities will have a positive effect on the broader value chain extending to suppliers of goods and services from nearby towns.

The operation will contribute positively on livelihoods leading to an increase in the standards of living while causing a reduction in poverty. The coal beneficiation industry has a positive impact of regional and local economic setup. The local economy will benefit through salaries paid to employees and tax revenues paid to Government.

1.2 Regional setting and location of activity

The location of the project site falls within Victor Khanye Local Municipality on the farm Van Dyksput 214, located in the magisterial District of eMalahleni, Mpumalanga Province. Arbor siding is approximately 5 km West of Kendal power station along R555 as Shown in the Figure1-1 below.

Emalahleni falls within the Nkangala District Municipality (NDM). NDM consists of 160 towns and villages and shares the western side of its borders with the economic hub of South Africa, Gauteng. NDM has the following local municipalities under its jurisdiction:

- Victor Khanye LM (previously Delmas LM);
- Emalahleni LM;
- Steve Tshwete LM;
- Emakhazeni LM;
- Thembisile LM; and
- Dr JS Moroka LM.

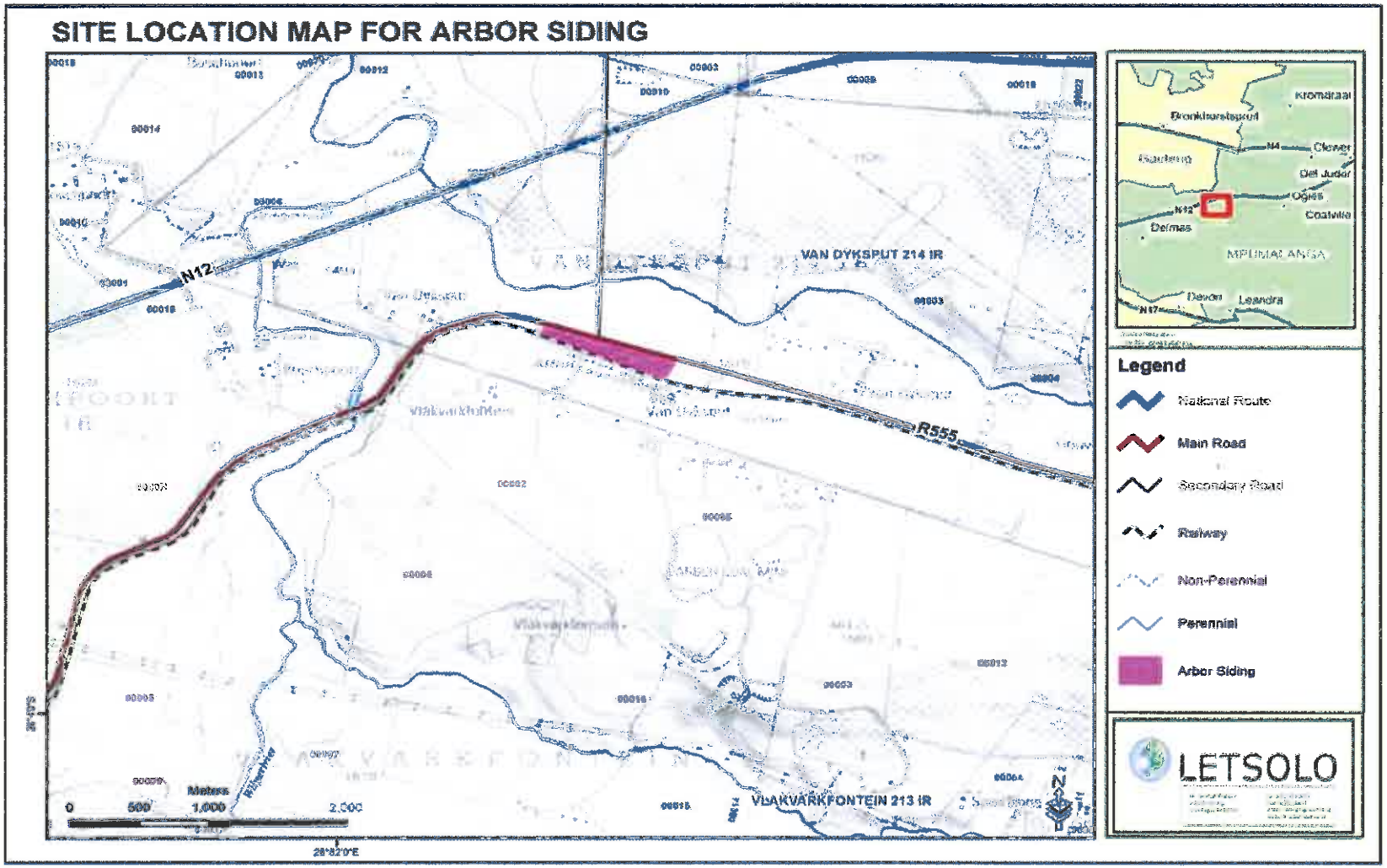


Figure 1-1: Site Location Map

1.3 Property description

Gijima Supply Chain Management (Pty) Ltd is leasing the property from Transnet Freight Rail. This property falls within Water Management Area 2 (Olifants Water Management Area), in the quaternary catchment B20F. The area drains northerly towards the tributary of the Wilge River and the most reliable rainfall station near the study area is SAWB-0477602.

The property details are summarized in the table (Table 1-1) below:

Table 1-1: Property Information

Property detail	Title deed property owner
Portion 1 of the farm Van Dyksput 214 IR.	Transnet Freight Rail

1.4 Purpose of IWWMP

The IWWMP takes into account the stressors in the Water Management Area (WMA) due to mining and related activities, commercial agricultural activities and other waste discharge and disposal activities. The IWWMP is therefore a living document that will be revised and updated throughout the life of the operations to accommodate additional information and improved technology to ensure that water and wastewater management is continually optimised and adapted to the changing needs of the water management area.

The main purpose of the IWWMP is to consolidate all the various site specific programmes (e.g. water, storm water management plans, water reuse and reclamation plans, water conservation and demand management plans and waste minimization and recycling, into a simple implementable management plan. In order to develop an effective IWWMP, Letsolo considered the commercial, environmental, social and operational details at Gijima and developed a plan for existing water use activities. The secondary purpose of this report is to update and clarify the content of the IWWMP to the DWS.

2 Conceptualization of activity

2.1 Description of activity

The activities at Arbor siding include the offloading, stockpiling and removal of coal. Coal is trucked in from various mines and therefore no mining activities occur on site. There is a culvert crossing, which allows clean runoff from the upstream catchment as well as railway track to freely flow northerly towards the Wilge River System. Existing infrastructures include a Coal stockpile area, Weighbridge and Office structure.

Rail freight economics also indicate that transportation by rail is cheaper than by trucks due to a number of wagons and the amount of coal that can be loaded per wagon.

2.2 Extent of activity

The extent of the siding is limited to Portion 1 of the farm Van Dyksput 214 IR.

2.3 Activity life description

A Railway siding does not have a life of operation like mining companies, because there is no extraction and depletion of commodities taking place. However the span depends much on the lease agreement granted by the property owner which can always be renewed.

2.4 Activity infrastructure description

The following existing infrastructures are on site:

- Railway line;
- Coal stockpiles;
- Weighbridge;
- Water management facilities; and
- Offices.

2.5 Key water uses and waste streams

2.5.1 Water Uses

2.5.1.1 Portable Water Supply

Portable water is trucked in by an external source and stored in Jojo Tank.

2.5.1.2 Pollution Control Dam, Clean and Dirty water management

A pollution control dam exists at the most downstream point of the siding. The PCD is designed to contain 1:50 year flood volume as in accordance with GN 704. There is also a freeboard of 0.8 m added to act as a safety barrier, in case there are a few extreme events in a short period of time, to give some extra leeway. The PCD is designed in a square shape, for ease of conceptualization, with walls of less than 5 m to comply with the NWA. The PCD is designed to hold 47 000 m^3, however it is usually empty due to the low stormwater volumes from the dirty water catchment.

A culvert crossing, allows clean runoff from the upstream catchment as well as railway track to freely flow northerly towards the Wilge River System. A dirty water channel also exists to capture contaminated water in to the PCD.

2.5.2 Sewage facilities and waste management

Toilet facilities have been constructed at the Gijima site as per mining regulation requirements. The toilet facilities are linked to a septic tank sewage system. A service contract with a supplier has been negotiated to ensure that the sewage system is properly operated to achieve the requirements as determined by DWS.

2.5.3 Waste Streams

Waste is categorized as either general or hazardous. Within these two categories, waste is categorized according to its source, namely domestic, commercial and industrial. General waste is sub-divided into paper, metals, glass, plastic, organic, and inert materials (which include builder's rubble). Due to its composition and characteristics, general waste does not pose a significant threat to public health or the environment, if managed properly.

2.5.3.1 Waste stream characterization

Waste is characterized as follows:

a) Hazardous Waste

Hazardous waste is generated primarily through the servicing and maintenance of vehicles and equipment on site. The waste to be managed includes:

- Oils or other material containing hydrocarbons. An external entity is appointed to collect oil for recycling.
- Residual chemicals and chemical containers from cleaning materials and other chemicals used on site.
- Mercury containing waste such as fluorescent tubes.
- Material containing polychlorinated biphenyls (PCB's) such as transformer oils.

b) Industrial Waste

Industrial waste on site includes various consumables from servicing activities including used tyres and scrap metal (not contaminated by hydrocarbons). The waste includes:

- Scrap metal
- Used tyres

c) Domestic Waste

Domestic waste is generated on site, primarily in the temporal office associated with the consumption of food or drink on site. Normal office type waste is also generated. Typical general waste includes: General compactable and non-compactable waste being primarily cans, paper, plastic packets, food scraps and packaging materials.

2.6 Organizational structure of activity

Gijima's workforce composition is summarized in Figure 2-1 below:

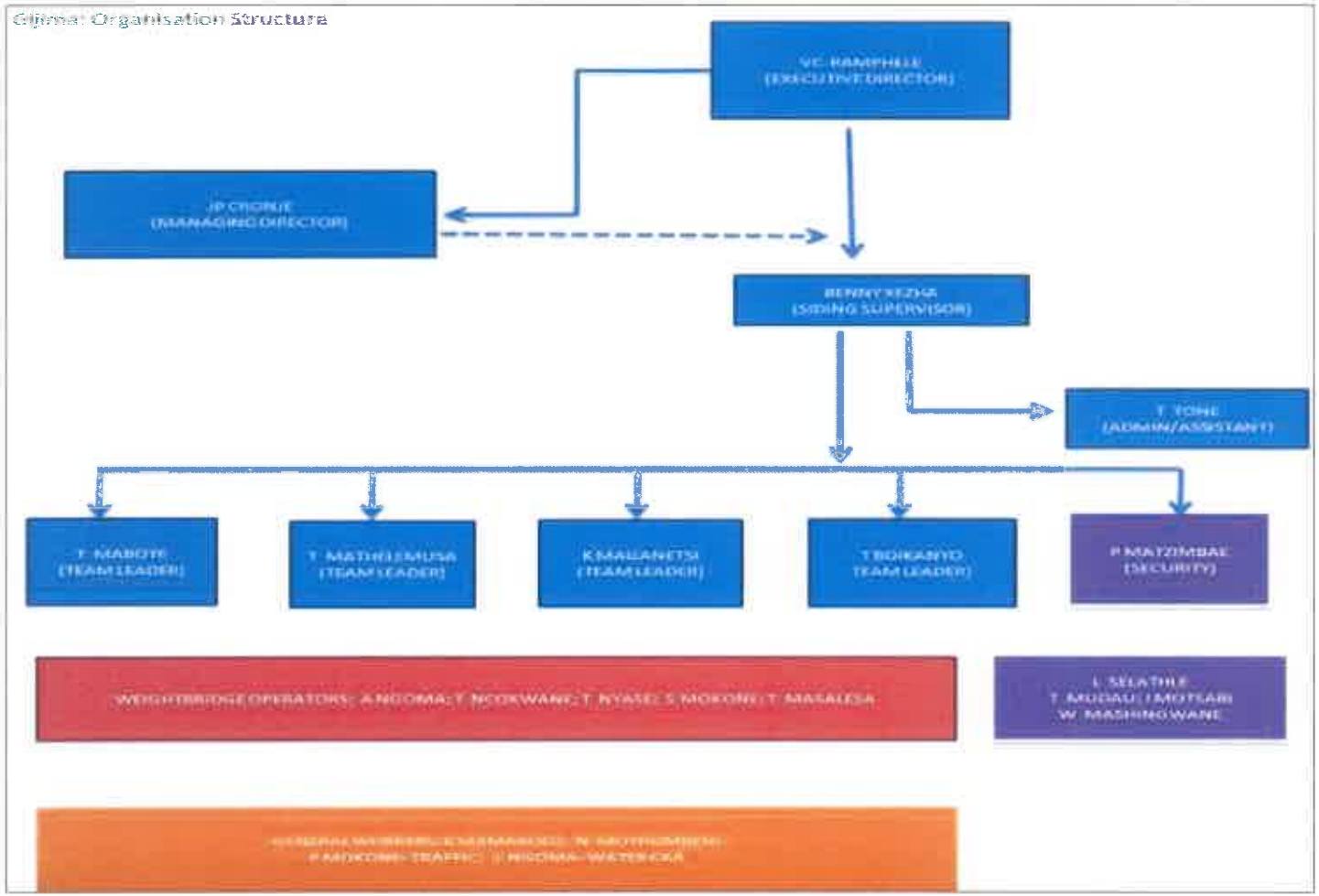


Figure 2-1: Gijima's workforce composition

2.7 Education and Training

Gijima recognizes the importance of its employees in the achievement of its business objectives and that skills development is the foundation for developing competent and productive employees who are able to participate in meeting the business objectives. The following objectives have been identified to support the skills development drive:

- Assess employees' skills and qualities as and when required;
- Provide training that is accessible to all employees;
- Invest in training interventions and assessments that will promote productivity and employability as dictated by economic conditions and within Gijima's financial ability;
- Establish a mentorship programme designed to address the operation's developmental needs, whilst facilitating the transferral of skills, knowledge and competence to employees;
- Re-skill employees if feasible and economically viable when contemplating retrenchments; and
- Utilise the Work Place Skills Plan as a vehicle to align skills development with both business growth strategies and employment equity plans.

The purpose of the Skills Development Plan is to provide Gijima with the required mechanisms and opportunities for identifying and developing the skills needed by the Siding and thereby ensuring that employees achieve their full growth potential. In addition, the Skills Development Plan will provide employees with the opportunity to further their capacity within the industry as well as equipping them with alternative skills. Gijima and the Core Contractor will each develop Skills Development Plans for their businesses as a whole. In agreement with the contractor, skills development plans will be in line with the principles of Human Resource Development Programme. There is a commitment to skills development that has an impact beyond the organization and provides a basis for sustained employability through portable skills and development that is linked to the National Qualifications Framework (NQF).

2.8 Internal and external communication

Internal and external communication processes within Gijima are defined. Environmental information, aspects, impact control measures, requirements, performance and other environmental matters are communicated to employees, contractors, I&AP's, authorities, business partners and other relevant organizations.

2.9 Business and corporate policies

Arbor established a management system for environment, health, safety and community (HSEC) in a format consistent with ISO14001 and ISO18001 but will not necessarily seek certification of the management system.

3 Regulatory water and waste management framework

3.1 Summary of all water uses

As mentioned, Gijima was issued with a Water Use Licence (Licence Number **04/B20F/G/4009,** File Number **27/2/2/B620/12/9**), by the Department of Water and Sanitation on the 18 December 2015.

The table below (Table 3-1), indicates the authorized water uses within the siding falling in Portion 1 of Van Dyksput farm 214 IR.

Table 3-1: Summary of water uses

Development	Water use	Capacity/ volume	Property information
Dust suppression with water emanating from the PCD	Section 21 (g)	14 432 m^3 /annum	Portion 1 of Van Dyksput Farm 214 IR
Pollution Control Dam	Section 21 (g)	14 4432 m^3/annum	Portion 1 of Van Dyksput Farm 214 IR
Control Stockpiles	Section 21 (g)	5 000 000 m^3	Portion 1 of Van Dyksput Farm 214 IR

3.2 Existing lawful water uses

An existing lawful water use (ELWU) is a water use that lawfully took place in the period of two years before the commencement of the NWA. This allows any water use that lawfully took place to continue until such time as it can be converted into a licence.

Prior to the approval of the IWUL, there were no water use activities which were authorized as existing lawful uses. The current water uses are considered as an entitlement due to the approval of the IWUL for Arbor Siding.

3.3 Waste Management Activity (NEMWA)

Waste management is regulated under the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA), the Waste Classification and Management Regulations, 2013 (published under Government Notice R634 in Government Gazette 36784 of 23 August 2013) (Regulations) require under regulation 4(2), that all waste generated by waste generators, be classified in accordance with SANS 10234 within one-hundred-and-eighty (180) days of generation.

It is however not applicable to the Gijima activities and there were no general authorizations issued to the siding regarding the NEMWA terms.

3.4 Waste related authorizations

No waste related authorizations applicable for Arbor Siding, however Gijima has made it a mandate to ensure waste is properly managed on site. Hazardous wastes that cannot be re-used or recycled are disposed of to a permitted hazardous waste facility through a contract with an approved waste management company. Industrial waste is also removed and disposed at a licensed waste disposal site. Domestic waste is removed by a contractor and disposed of at a waste disposal site.

4 Present Environmental Situation

4.1 Climate

The mean daily maximum temperature exceeds 25 °C between November and March, the hottest months. Average maximum temperatures in the winter months (May-August) range from 18.0°C to 21.3°C. The mean minimum summer temperatures range from 11.7°C (March) to 14.2°C (January) with

winter mean minima ranging from –1.6°C to 2.9°C. An extreme maximum temperature of 33.8°C was recorded at Ogies, on 12 November 1990 and an extreme minimum temperature of –8.8°C on 9 June 1988; please see Table 4-1 below.

Table 4-1: Maximum, Minimum and Mean Monthly Temperature

Month	Mean Daily Temp (°C)		
	Max	Min	Mean Monthly Temp (°C)
January	27.0	14.2	20.6
February	26.0	13.6	19.8
March	25.7	11.7	18.7
April	23.3	8.1	15.7
May	21.3	2.9	12.1
June	18.0	- 0.5	8.8
July	18.8	- 1.6	8.6
August	20.9	1.2	11.1
September	23.4	6.0	14.7
October	24.7	10.0	17.4
November	25.0	12.0	18.5
December	26.3	13.8	20.1
Annum	23.4	7.6	15.5

4.2 Regional Climate Rainfall

When the rate of rainfall influx exceeds the absorption capacity of the soil, the excess water flows over the surface as overland flow. Rainfall runoff responds differently to variations in topography, soil and characteristics of precipitation, and indirectly to variations in climate, vegetation and land use. Therefore runoff flow controls the volume, periodicity and chemical characteristics of contributions to receiving streams and lake basins.

Many different rainfall data sources and consequent data sets exist for rainfall representation over S.A. Each data source and data set has its own unique advantages as well as disadvantages. Different hydrological rainfall-runoff simulation and peak flow estimation models exist as well as different methods for estimations which require different rainfall parameters with specific required detail and accuracy. Water Research Commission collects Rainfall, Runoff and Evaporation data. This data is herein referred to as WR2005 data. WR2005 includes most data sets all over the country but is currently limited up to and including the year 2004, starting from 1920. Data sets have a record period of 85 years. Major and extensive research efforts and modelling exercises have been conducted to obtain WR2005 rainfall data.

The maximum annual rainfall for the available record of 1907-2003 occurred in 1999 and was 1400 mm. The maximum monthly rainfall occurs in November to January. The maximum recorded is 474 mm, which occurred in November 1999.

The nearest most reliable rainfall station is station 0478093_W (Ogies), and is located 8.5 km southeast of Arbor Siding. The Mean Annual Rainfall for the study area is 739 mm; this has been clearly shown in table 4-2 and figure 4-1 below.

4.3 Evaporation

As in the case of rainfall and runoff it is also necessary to analyse the Mean Annual Evaporation (MAE). Much less evaporation data exists than data for rainfall and runoff. Evaporation is measured at dams and mostly stations that are operated by DWS; these stations provide such data. Again, as in the case with rainfall and runoff, much effort has been placed to incorporate evaporation data into the Pitman model and consequently the WR2005 dataset (WRC, 2008). A previous version of WR2005 is also available with evaporation data; this data set is called the WR90 data set (WRC, 1990). The site MAE is estimated at 1517.8 mm as shown in figure 4-1 below.

Evaporation data for site was obtained using the WR90 manual. The Mean Annual Evaporation (Based on S-pan data) is 1517.8 mm. The high evaporation rates will result in high losses of water from the storage dams and the pollution control dams within the site.

Table 4-2: MAP and MAE (mm)

Description	October	November	December	January	February	March	April	May	June	July	August	September	Annual
Average Monthly Rainfall (mm)	77.1	115	125.2	143.8	84.8	96.6	43	15	7.5	2.7	8	20.3	739
Average Monthly Evaporation (mm)	165.8	162.5	176.9	167.1	143.5	133.6	103.3	83.3	65.1	72.4	102.6	141.7	1517.8

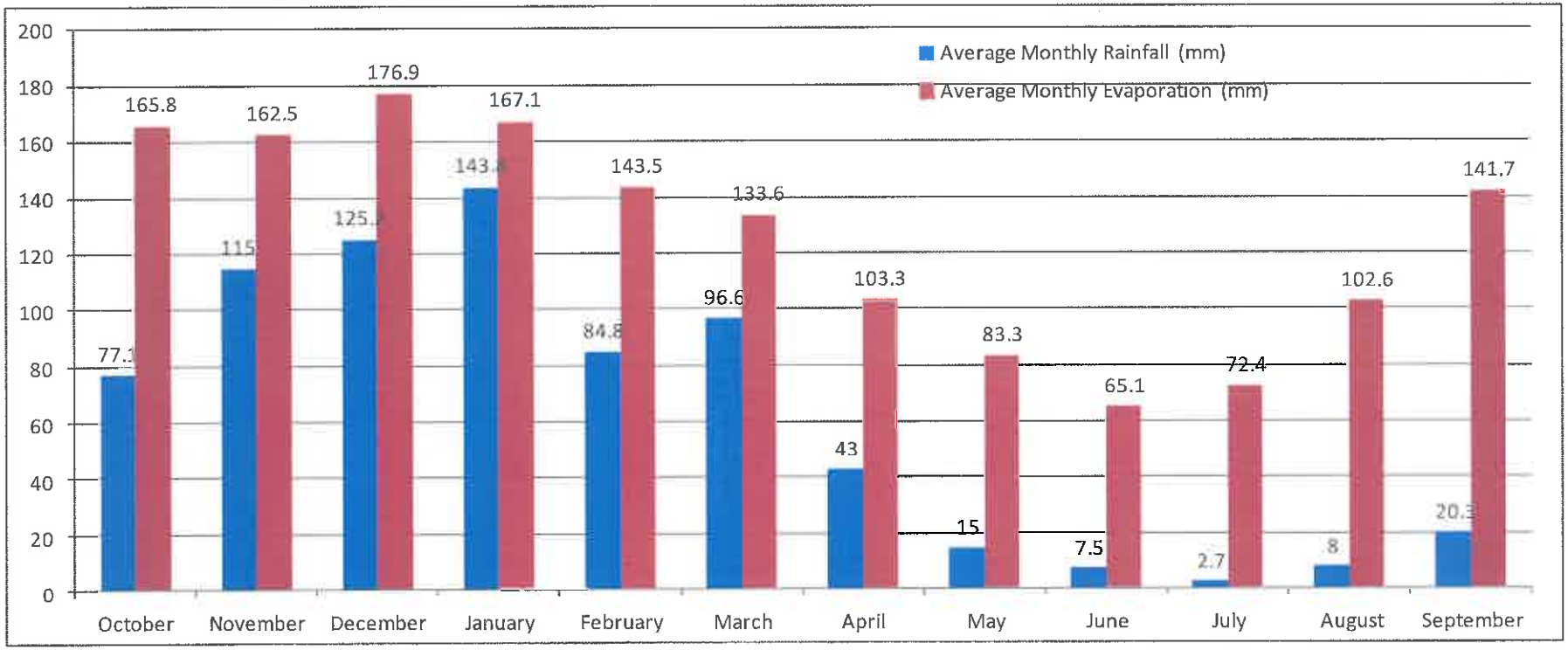


Figure 4-1: MAP and MAE (mm)

4.4 Surface Water

Gijima is situated in quaternary catchments B20F. According to the WRC (1994), this catchment has a Mean Annual Precipitation (MAP) of 657mm/a.

The river systems in relation to the study area are categorized in 4 Tiers as follows:

- Tier 1 : Water Management Area 2 (Olifants River)
- Tier 2 : Upper Olifants
- Tier 3 : Quaternary Catchment (B20F)
- Tier 4 : Site Specific Catchments

These areas are discussed below and later in this document.

4.5 Water Management Area (WMA 2)

The study area falls within Water Management Area 2 (WMA2), Olifants, specifically along the watershed between the quaternary catchments B20F (Wilge River). The Olifants River is the most significant River in WMA2 and one of the main tributaries of the Limpopo River. The Olifants Catchment covers about 54 570 km^2. The upper reaches of the Olifants River Catchment are characterized mainly by mining, agricultural and nature conservation activities.

The mean annual runoff (MAR) for the WMA4 is 2 042 million m^3/a.

4.6 Quaternary Catchment (B20F)

A catchment or water shed is derived from the topographical landscape. It is sectioned by a water divide, a high land separating two or more water systems. A quaternary catchment is the land and water surface area that contributes to the discharge at the system outlet. The study area falls within the B20F Catchment. B20F would be interpreted as follows:

- "B" denotes the primary catchment region;
- The number 2 denotes the secondary drainage region of Primary B;
- The number 0 denotes Tertiary sub-drainage region 2; and
- "F" denotes the quaternary region.

The site is located across the boundaries of both the B20F quaternary catchments. The Olifants River basin upstream of the Loskop Dam is a government water-controlled catchment. Future growth in water requirements in the Olifants water management area will mainly be in the power generation, mining, urban and industrial sectors, with the largest impact on the Upper-Olifants sub-area. Of the total of water being transferred into the Olifants WMA, the upper Olifants sub-area constitutes about 22%.

4.7 Surface Water Hydrology

4.7.1 Olifants River

The Olifants River originates near Bethal in the Highveld of Mpumalanga, initially flowing northwards before curving eastwards and reaching Mozambique via the Kruger National Park.

In Mozambique, the Olifants River joins the Limpopo River before discharging into the Indian Ocean. The Olifants WMA falls within portions of Gauteng, Mpumalanga and Limpopo. The main tributaries are the Wilge, Elands and Ga-Selati Rivers on the left bank and the Steelpoort, Blyde, Klaserie and

Timbavati Rivers on the right bank (Olifants WMA – Overview of Water Resources Availability and Utilisation, 2003).

The Gijima Siding occurs within the upper parts of the Wilge River, within the greater Olifants River Basin. The Klipspruit River transects the northern part of the site. The Olifants River Basin is divided into five regions, each of which consists of a number of quaternary catchments.

4.7.2 Wilge River

The Wilge River holds high significance for this project. The Wilge River flows in a northerly direction. The Wilge River has its origin about 15 km West North West of Leandra, in the Highveld grasslands. It flows roughly northwards until it is joined by its main tributary, the Bronkhorstspruit, that joins it's left bank about 25 km downstream of Bronkhorstspruit town. Then it flows in a north-eastern direction until it joins the Olifants about 12 km upstream from the head of the Loskop Dam reservoir.

4.8 Surface Water Quality

One of the conditions of the WUL is that Gijima must provide the Department of Water and Sanitation with a Water Quality Monitoring Program for surface points. Surface water quality is conducted on monthly based at Arbor siding to determine and assess any potential impacts from the activities taking place. Significant data is available to draw conclusions regarding the water quality trends. Annual surface water quality data, for a period starting on March 2016 and ending on February 2017, obtained from the Arbor Siding Water Quality Database, was used to determine the annual average water quality.

4.8.1 Sampling Method

All samples will be collected utilizing sterilized bottles. Before a sample can be collected, a prescribed sampling bottle will be labelled in correspondence with the borehole identity from which sampling will take place. The bottle will then be rinsed at least three times with water to be sampled, before it is filled. Sampling date and time will also be recorded on each sample bottle. Care will be taken to ensure that each sample bottle is correctly identifiable, filled accordingly and does not leak. After samples have been collected, they will be stored in a cooler box at a temperature of 40^0C and then transported to the Laboratory within 48 hours of sampling for screening.

4.8.2 Location of monitoring points

The location of monitoring points was strategically selected in order to monitor and assess upstream and downstream water quality. As indicated in Table 4-3 below, three (3) surface water quality monitoring points are located in the water resource. The fourth monitoring point serves a purpose of monitoring the quality of water collected from the siding area into a PCD.

Table 4-3: Surfacewater Monitoring Points

ID	LABEL	X (Decimal Degrees)	Y (Decimal Degrees)	Frequency of monitoring
1	SW1	28.92417436	-26.04450349	Monthly
2	SW2	28.88386559	-26.03501712	Monthly

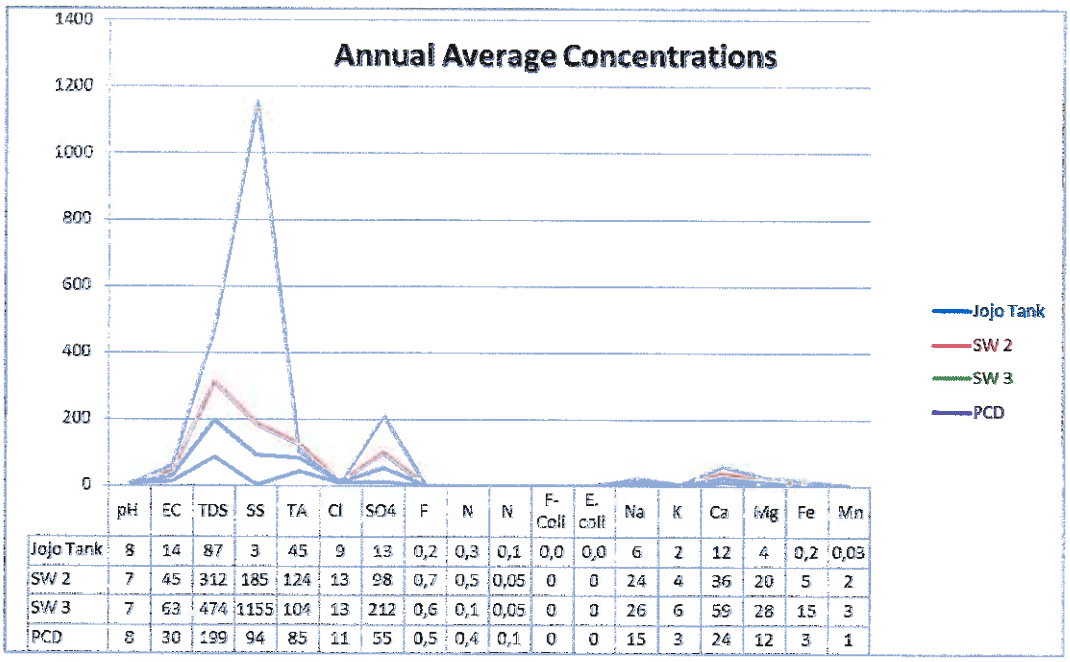
3	SW3	28.8735138	-26.02875944	Monthly
4	PCD	28.88166875	-26.03907795	Monthly

4.8.3 Surfacewater Quality Interpretation

The water quality water findings were compared to the criterion limits specified by the Water Quality Guidelines (DWA SAWTV).

- The annual average concentration for the Jojo Tank indicates good water quality; no excessive contaminations analysed throughout the year and water quality strictly fall within the standards set for domestic usages.
- The concentration for all surface monitoring points is slightly acidic, neutral and slightly alkaline, ranging from 6 to 8. The South African Water Quality Guideline for Domestic Use shows the targeted water quality range is between 6.0 - 9.0 and 6.5 - 8.4 for Irrigational Use.
- Any form of deterioration analysed in monitoring points SW 2 and SW 3 is not associated with the ongoing activities at Arbor Siding, due to their location.

The Figure below (Figure 4-2) illustrates the comparison of all the average concentration for all the sampled surface water monitoring points.



	pH	EC	TDS	SS	TA	Cl	SO4	F	N	N	F-Coli	E. coli	Na	K	Ca	Mg	Fe	Mn
Jojo Tank	8	14	87	3	45	9	13	0,2	0,3	0,1	0,0	0,0	6	2	12	4	0,2	0,03
SW 2	7	45	312	185	124	13	98	0,7	0,5	0,05	0	0	24	4	36	20	5	2
SW 3	7	63	474	1155	104	13	212	0,6	0,1	0,05	0	0	26	6	59	28	15	3
PCD	8	30	199	94	85	11	55	0,5	0,4	0,1	0	0	15	3	24	12	3	1

Figure 4-2: Annual Average Concentrations for all Surface Water Monitoring Points

4.9 Groundwater Quality

Groundwater quality does not change as rapid as surface water quality. Groundwater contains minerals dissolved from soil particles, sediments, and rocks as the water flows at different directions along aquifers. Some other forms of ground water contaminations come from improper disposal of chemical wastes, leachates from solid waste disposal sites and infiltration of stormwater discharges. Samples

were collected from both the Upstream and Downstream Boreholes for analysis of the quality. These boreholes supply portable water to the communities around the Arbor siding.

4.9.1 Location of Groundwater monitoring points

Two (2) boreholes were identified from upstream and downstream of the Arbor Siding, the exact location is show in the table (Table 4-4) below.

Table 4-4: Groundwater monitoring points

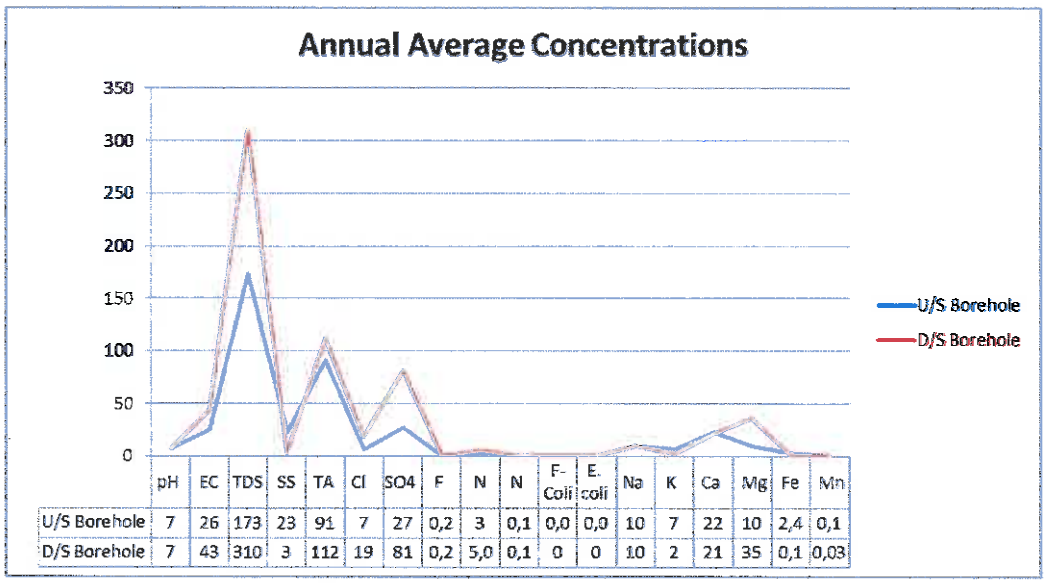
ID	LABEL	X (Decimal Degrees)	Y (Decimal Degrees)	Frequency of monitoring
1	Upstream Borehole	28.8803240	-26.04391319	Quarterly
2	Downstream Borehole	28.87344723	-26.03807939	Quarterly

4.9.2 Groundwater Quality Interpretation

The water quality water findings were compared to the criterion limits specified by the Water Quality Guidelines (DWA SAWTV).

- The water quality from both boreholes is very good, there is no contamination related to activities at the Siding.
- All variables analysed to determine the water quality fall within the standards set by the Department of Water Affairs and Forestry (DWAF) South African Water Quality Guidelines.
- The average pH concentration is neutral to slightly alkaline for the two boreholes ranging between 6.2 to 8.2 mg/l, falling within standards set for domestic, agricultural and livestock use.

The Figure below (Figure 4-3) simply illustrates the comparison of all the average concentration for both boreholes. As shown below the Downstream Borehole has an increase in concentration of Total Dissolved Solids recorded as annual average.



	pH	EC	TDS	SS	TA	Cl	SO4	F	N	N	F-Coli	E. coli	Na	K	Ca	Mg	Fe	Mn
U/S Borehole	7	26	173	23	91	7	27	0,2	3	0,1	0,0	0,0	10	7	22	10	2,4	0,1
D/S Borehole	7	43	310	3	112	19	81	0,2	5,0	0,1	0	0	10	2	21	35	0,1	0,03

Figure 4-3: Annual Average Concentration for all Groundwater Monitoring Points

The Figure 4-4 below shows the location for both groundwater and surface water monitoring points.

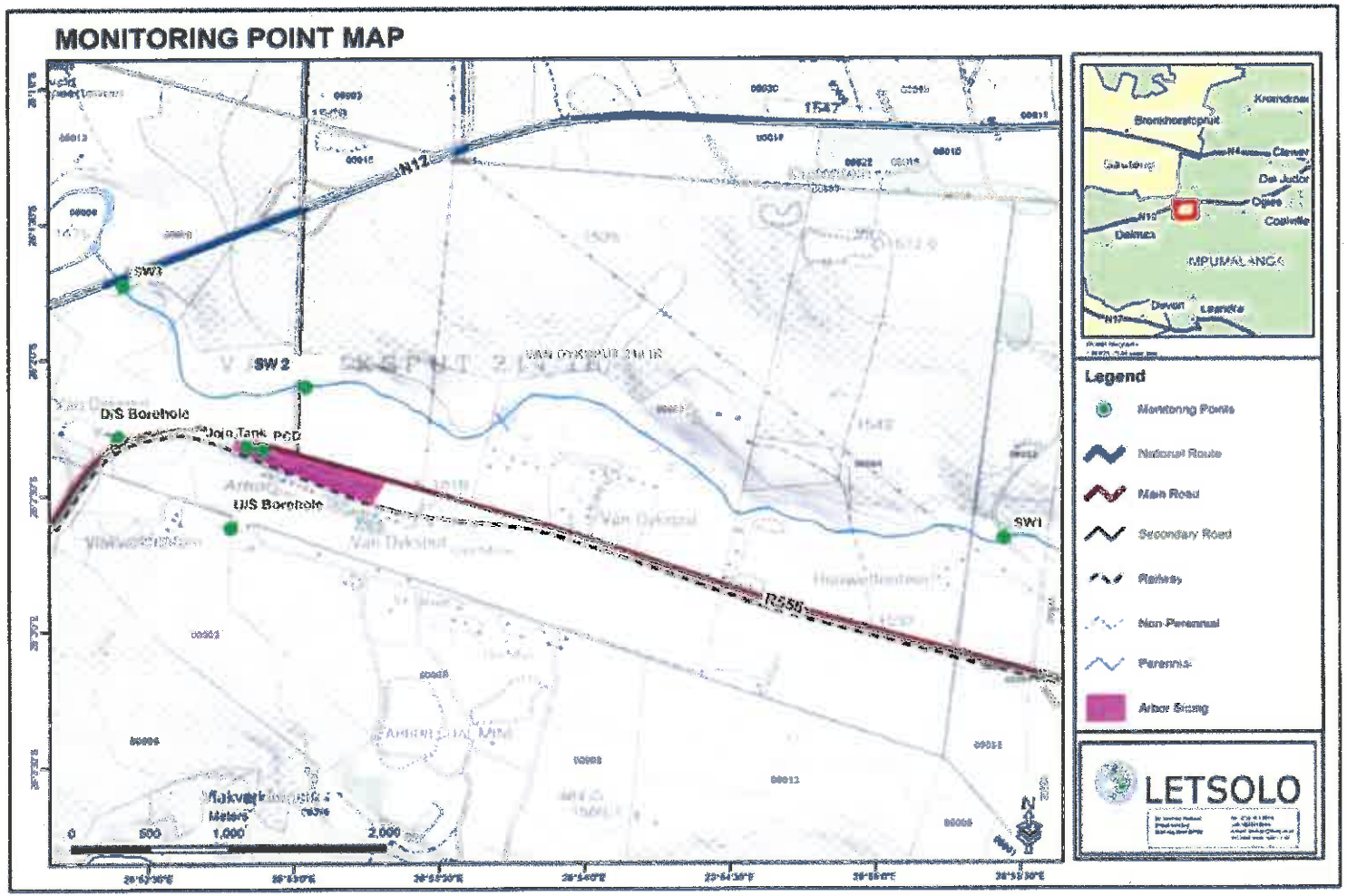


Figure 4-4: Water Quality Monitoring Points

4.10 Mean Annual Runoff (MAR)

Runoff is the result of precipitation (rainfall) falling on a catchment and eventually running off from the catchment. The amount of rainfall that runs off is dependent on the catchment characteristics.

Due to the complex nature of rainfall-runoff modelling it is not deemed necessary to set up specific models for small catchments (BPGs). Letsolo Water adopts a holistic approach and methodology whereby WR2005 quaternary catchment runoff data is downscaled to site specific runoff data by making use of area and volume relationships as well as a rainfall reduction factor.

The Mean Annual Runoff (MAR) calculations are highly dependent on the surface area. Runoff figures were analysed statistically in a similar manner as rainfall. The MAR for the study area was sourced from the Water Research Commission database (WR2005). **Table 4-5** provides activity based MAR and the quantified impact on the Effective and Quaternary Catchment Areas.

According to *National Water Resource Strategy* (2004), the mean annual rainfall is in the range of 500mm to 800mm over most of the WMA 2. Most surface runoff originates from higher rainfall southern and mountainous areas and is controlled by several large dams.

Table 4-5: Mean Annual Runoff

Effective Catchment Names	Effective Catchment Area (km2)	Catchment MAR (mm/annum)	Calculated MAR (m^3/annum)
B20F Quaternary Catchment	506	33.3	16 845 558
SW 1	25.08	33.3	835 164
SW 2	37.62	33.3	1 252 746
SW 3	41.8	33.3	1 391 940

4.11 Resources Class and River Health Receiving Water Quality Objectives and Reserve

4.12 Surface Water User Survey

Most activities surrounding the siding involve agricultural and mining activities. There are small communities in close proximity.

The main water users around the study area are as follows:

- Semi-urban related water users in the farms and communities;
- Irrigation.

4.13 Sensitive Areas Survey

Sensitive areas may be regarded as water resources identified in the close proximity of the project area with an assumption that the siding would have an impact or may affect the environment. There are no sensitive areas within and around the Arbor Siding.

4.14 Groundwater

The rail siding site is located adjacent to open cast coal mining operations, namely the Vlakvarkfontein and Intibane Collieries. These open cast operations have not intersected the local groundwater table. However, there are localized groundwater seepages and these occur at depths in excess of 20m from the ground surface. The presence of dolerite intrusions in this area is however likely to also give rise to groundwater seepage. In addition to the above, seepages from localized perched water tables can be expected.

4.15 Socio- economic environment

The employment rate of the communities in the project area and immediate surrounds (< 50 households) is 47% with employment predominantly on mines in the area, but also as domestic workers and general labourers further afield. Their dwellings vary between self-built traditional mud houses (two informal settlements) and houses developed by the individual landowners that have subsequently been extended. Subsistence agricultural activities are also associated with these communities with predominant activities being vegetable farming and the rearing of chickens and livestock. Unemployment in the Mpumalanga province is currently 27.7% according to Statistics South Africa in the year 2017.

The agricultural industry is of a relatively high significance to the employment structure in Mpumalanga Province, providing employment to 18% of the population, and is followed by community and social services, which provide employment to approximately fifteen percent (15%) of the economically active population. In 2016, the mining sector provided employment to approximately 22% of the economically active population. Mining employment is anticipated to have risen from this figure in recent years as a result of an increase in mining in the area. In the Municipalities concerned, there is less employment provided by agriculture and additional provided by the mining sector.

Integrated development planning (IDP) promotes inter-governmental co-ordination by facilitating a system of communication and co-ordination between local, provincial and national spheres of government. Local development priorities, identified in the IDP process, constitute the backbone of the local governments' budgets, plans, strategies and implementation activities. Hence, the IDP forms the policy framework on which service delivery, infrastructure development, economic growth, social development, environmental sustainability and poverty alleviation rests.

5 Analysis and characterization of the water use activity

5.1 Water and waste management

The use of water is managed in accordance with the Best Practice Guidelines listed below:

- Stormwater Management Plan (BPG G1) ;
- Groundwater Management Plan (BPGs H1 and A5);
- Water reuse and optimization plan (BPG H3).

5.2 Water Supply

The portable water is trucked in by an external suppler and stored in a Jojo Tank.

5.3 Storm water

Clean storm water is diverted by using berms. A berm of approximately 2 m high by 2-3 m wide is constructed between the clean and dirty water catchment.

Dirty storm water management measures comprise of drainage channels and pollution control dam sized to comply with Regulation 704.

5.4 Waste Management

Gijima have a colour coded system using separate bins for different waste types and thus separating waste at source. To avoid the need for licensing of the storage of waste, collection occurs at intervals of less than 90 days.

5.4.1 Hazardous Waste

Hazardous wastes that cannot be re-used or recycled are disposed of to a permitted hazardous waste facility (Holfontein) through a contract with an approved waste management company.

5.4.2 Domestic Waste

Domestic waste is removed by a contractor and disposed of at a waste disposal site.

5.5 Waste recovery and Reduction

Correct storage of a particular waste type reduces the risk of environmental impacts and limits the risks of pollution. The current waste collection contract is managed by a waste company. The methodology employed is as follows:

- The waste company is contacted when a container is close to full.
- The waste is collected within 48 hours of notification. The full container is replaced with an empty one.
- The contractor separates the waste and transports it to the appropriate licensed facility for disposal. Domestic waste is separated on site and recyclable materials are removed.

5.6 Water Balance

The Water Balance (WB) presented in this was reported by Letsolo (October 2017, Reference LWES 304). It illustrates the cumulative flow of water through the system throughout the year. Two (2) WB components were defined, the Stockpile area and the Pollution Control Dam.

Water Balance findings were summarised as follows:

- The Stockpile area has only rainfall as source of inflow water. It is assumed that some volumes of water will be retained into coal material.
- The PCD is expected to have an approximate 218m^3/a of rainfall and water will be lost through evaporation and dust suppression.

The figure 5-1 below indicates a sketch of how water is distributed within the Arbor Siding.

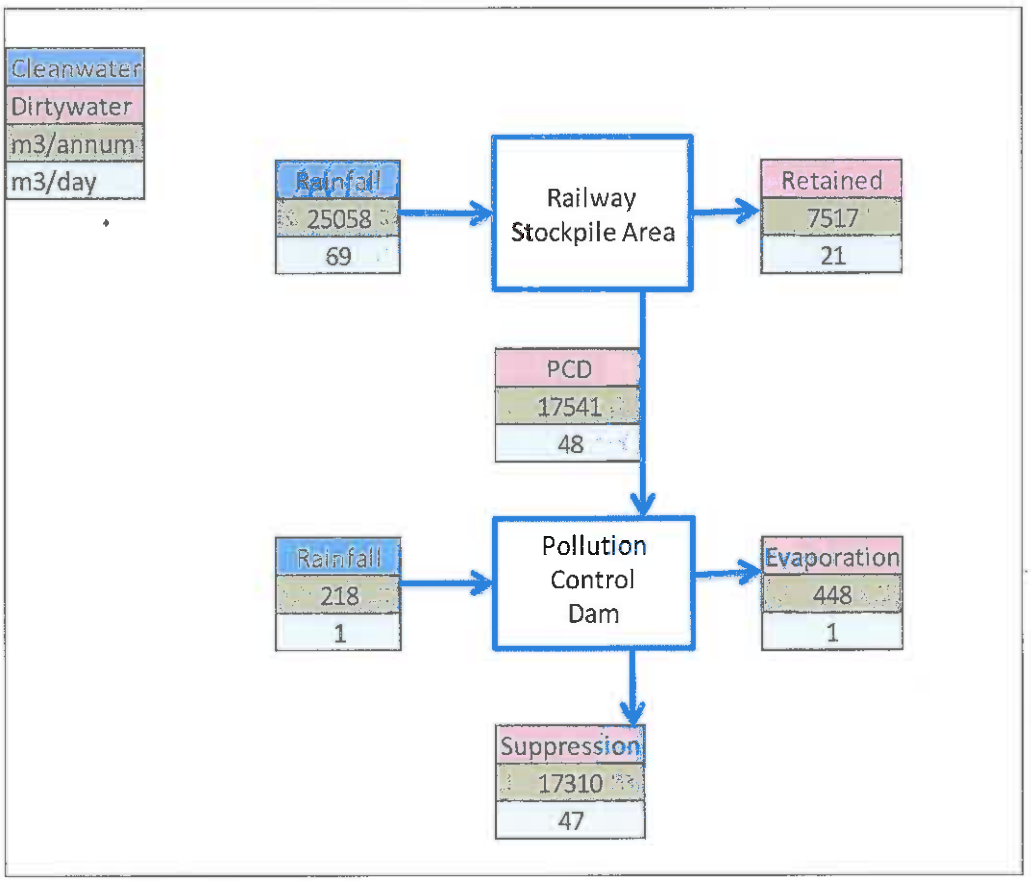


Figure 5-1: Arbor Siding Water Balance Sketch

5.7 Monitoring and control

5.7.1 Surface water monitoring

Surface water monitoring is an on-going programme as discussed in paragraph 4.8.1 and table 4-3 above.

5.7.2 Groundwater monitoring

Groundwater monitoring is conducted quarterly from both boreholes.

5.8 Risk assessment / Best Practice Assessment

Arbor established a management system for environment, health, safety and community (HSEC) in a format consistent with ISO14001 and ISO18001 but will not necessarily seek certification of the management system.

A risk-based assessment was undertaken. This Risk Assessment was conducted in line with the Best Practice Guidelines (***BPG G4: Impact Prediction***)

Please refer to the paragraphs below for the criteria and rating.

5.8.1 Surface Water Risk rating criteria

The impacts were rated and ranked based on the system as described below:

- Magnitude: is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and was classified as none/negligible, low, moderate or high. The categorisation of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards were to be used as a measure of the level of impact.
- Scale/Geographic extent: refers to the area that could be affected by the impact and was classified as site, local, regional, national, or international.
- Duration: refers to the length of time over which an environmental impact may occur: i.e. transient (less than 1 year), short-term (1 to 5 years), medium term (5 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent.
- Probability of occurrence: is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).
- The Impact significance was rated by the specialist using the scoring/ranking system shown in the impact assessment matrix below:

Table 5-1: Scaling Risk

Magnitude		**Duration**		**Scale**		**Probability**	
10	Very high/don't know	5	Permanent	5	International	5	Definite/don't know
8	High	4	Long-term (impact ceases after closure)	4	National	4	High probability
6	Moderate	3	Medium term (5-15 years	3	Regional	3	Medium probability
4	Low	2	Short Term (0-5 years)	2	Local	2	Low probability
2	Minor	1	Transient	1	Site only	1	Improbable
1	None					0	None

5.8.1.1 Scoring system

Scoring system for assessment of significance:
SP (significance points) = (magnitude + duration + scale) x probability

Where;

- SP>75 has high environmental significance;
- SP 30 to 75 Moderate environmental significance; and
- SP<30 Low environmental significance.

5.8.1.2 *Risk Identification and Consequences*

The following potential risks were identified and further assessed:

Soil Erosion

Erosion occurs at the clean water catchment areas due to removal of vegetation for access roads. The potential for erosion is increased as loose soil particles are not protected by vegetation cover.

Water quality deterioration

Water quality impacts are due to a change in natural conditions and enhancement of pollution from sources. On a regional scale, due to a decrease in runoff, the dilution of other pollution sources is affected. Therefore, a reduction in runoff could result in a more pronounced pollution effect.

Catchment yield and hydrology

The nearby stream will be affected due to a reduction in runoff. Polluted water that would naturally flow to the stream will be retained in the pollution control dam.

5.8.1.3 Risk Estimation

The following sections contain the information on the risk assessment for surface water impacts.

Table 5-2: Soil Erosion

Nature: The side slopes of the stockpile must not be too steep.		
	Without mitigation	**With mitigation**
Magnitude	Moderate (6)	Low (4)
Duration	Medium term (3)	Transient (1)
Scale	Local (2)	Site (1)
Probability	High (4)	Low (2)
Significance	**Moderate (44)**	**Low (12)**
Status (positive or negative)	Negative – The impacts are already visible on site.	
Mitigation: A slope of not more than 1:3 is recommended to avoid the formation of erosion gullies and the transportation of sediments to the downstream areas.		

Table 5-3: Water Quality Deterioration

Nature: Spills from the pollution control Dams pose a risk to the pollution of surface water resources.		
	Without mitigation	**With mitigation**
Magnitude	Moderate (6)	Low (4)
Duration	Medium term(3)	Medium (3)
Scale	Regional (3)	Site (1)
Probability	High (4)	Medium (3)
Significance	**Moderate (48)**	**Low (24)**
Status (positive or negative)	Negative – Deterioration in Water Quality denies the rights of downstream water users to an environment which is not harmful to their well being.	
Mitigation: Storm Water Management measures must be in place in order to protect the environment..		

Table 5-4: Hydrological Yield

Nature: This results in the siding area being declared as a dirty water catchment. Direct rainfall that comes in contact with coal is channelled to the Pollution Control Dam. This volume was allowed to flow to the environment prior to the commencement of this activity. This activity results in a reduction in catchment yield.		
	Without mitigation	**With mitigation**
Magnitude	Moderate (6)	Moderate (6)
Duration	Medium term (3)	Moderate (3)
Scale	Regional (3)	Site (1)
Probability	High (3)	Low (2)
Significance	**Moderate (36)**	**Low (20)**
Status (positive or negative)	Negative – The amount of water made available to downstream users is reduced.	
Mitigation: The dirty water Catchment must be managed as small as possible and all disturbed areas must be rehabilitated in such a way that the topography blends in with the surrounding topography in order to allow for free flow.		

6 Water and Waste Management

6.1 Water and waste management philosophy (process water, stormwater, and waste)

6.1.1 Process Water

Gijima updates the water balance report annually to create a system that can be used as a management tool to assist the environmental manager to achieve the objectives as outlined in the Integrated Water and Wastewater Management Plan (IWWMP).

6.1.2 Stormwater

The Arbor Siding manages the stormwater separating clean water from dirty water, using channels and berms as stated in Paragraph 2.5.1.2 above.

6.1.3 Waste

Gijima have a colour coded system using separate bins for different waste types and thus separating waste at source. To avoid the need for licensing of the storage of waste, collection occurs at intervals of less than 90 days. The current waste collection contract is managed by a waste company.

6.1.4 Groundwater

Groundwater quality monitoring is conducted quarterly to assess any potential impact from the activities associated with the Siding.

6.2 IWWMP Action Plan

The following activities are ongoing as part of the IWWMP action plan.

- Monthly monitoring of surface water;
- Quarterly monitoring of borehole;
- Update of Water and Salt Balance;
- Management of the stormwater.

6.3 Control and monitoring

6.3.1 Monitoring of change in baseline (environment) information (Surface water and Groundwater)

The monitoring of both groundwater and surface is on-going in accordance with the Arbor Siding Monitoring Programme. Quarterly reports are submitted to the Department of Water and Sanitation (DWS) as required in the Intergrated to Water Use License (IWUL).

6.4 Audit and report on performance measures

The Integrated Water Use License is audited internally by Gijima Officials and by an external auditor to check the compliance level to all conditions mentioned in license.

6.5 Audit and report on relevance of IWWMP action plan

The Integrated Water and Wastewater Management Plan action plan will be updated annually as required.

7 REHABILITATION MANAGEMENT PLAN

An overview of all aspects of rehabilitation that will be considered as part of the project, are discussed below.

7.1 Rehabilitation objectives

The objectives are summarized as follows:

- The newly created topography should contribute to and blend in with the natural surrounding environment to ensure self-sustaining, stable systems with alternative utilisation potential.
- Rehabilitation designs are developed so that the least possible amount of material has to be shifted so as not to affect the structure of topsoil and overburden material to be used.

- Careful selection of indigenous plant species, adapted to the climatic conditions, will be used to ensure a low cost, low maintenance and speedy recovery of disturbed areas. Where possible, self-seeding will be encouraged from the natural seedbed in the topsoil.
- Soil amelioration will only be undertaken to the extent that would bring disturbed soils into equilibrium with the natural environment and not to reach agricultural levels.
- Available material will be used as a cover layer, even if amelioration is required, to avoid further destruction of land by creating borrow pits.

The area will be divided into rehabilitation units as part of the development of the Final Closure Pan. A detailed rehabilitation plan will be developed for each unit, including a terrain analysis, soil and vegetation survey and designs of earthworks and cross sections through each area. A summary of the volumes of material to be shifted at each unit will be provided. A general plan of the area will be prepared at an appropriate scale and indicating the surface topography to accurate interval spacings.

Gijima Supply Chain has an amount of R50 000 secured for Environmental Rehabilitation.
(See Appendix B below)

8 Conclusion

Integrated Water and Wastewater Management Plans (IWWMP) is a logical process whereby the industry considers all the various factors that have a bearing on water and waste management and integrate them spatially and over the life-cycle of the operation. This document must be amended on an annual basis.

8.1 Regulatory status of activity

Gijima Supply Chain Management (Pty) Ltd holds an Integrated Water Use License (IWUL) which was issued on the 18 December 2015.

8.2 Statement of water uses requiring authorisation, dispensing with licensing requirement and possible exemption from regulation

The Siding is authorised for the following water uses as defined in Section 21 of the National Water Act (Act 36 of 1998):

- 21(a): Taking water from a water resource; and
- 21(g): Disposing of waste which may detrimentally impact on a water resource.

9 References

a) Department of Water Affairs and Forestry, 2007. Best Practice Guideline;
b) Republic of South Africa, Department of Water Affairs and Forestry, 2006: Integrated Water Resources Management Plan;
c) DEA, 2010. Framework for Management of Contaminated Land, Department of Environmental Affairs, May 2010.
d) DMR, 2005. Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine, dated January 2005.
e) Letsolo Water and Environmental Services cc (2017); Arbor Siding Water and Salt Balance Report (Ref: LWES 417).

APPENDIX A: BBBEE

FURTER CARSTENS & VENNOTE/PARTNERS
J.C. CARSTENS, B.Comm.(Rek), Hons, STR. G.R.(S.A.)
V.VIVIER,B.Comm.(Rek),Hons,B.Compt.(Rek),Hons.G.R.(S.A.)
Geoktrooieerde Rekenmeesters (S.A.) ***Chartered Accountants (S.A.)***
Geregistreerde Ouditeure *Registered Auditors*
Posbus / P.O.Box 997 Krugersdorp 1740
1 ste Vloer / Jorisgebou *1 st Floor : Joris Building*
h/v Rissik & Joubertstr *c/o Rissik & Joubert st*
TEL: 011-953 3873
Faks / Fax 011- 660 3821
fcw@mweb.co.za

Broad-Based Black Economic Empowerment
Verification Certificate

GIJIMA SUPPLY CHAIN MANAGEMENT SERVICES (PTY) LTD

Certificate Number: M01/B-BBEE: QSC09/07/2015/013

Registration Number	2001/015676/07
VAT No (if applicable)	4340225868
Address/Location	Arbor Siding, Portion 1 of Farm Vandyksput, Delmas, Mpumalanga, South Africa

Verification Standard Applied	Codes of good practice of 2007
Sector specific	Transport Sector Charter Gazetted on 21 August 2009
Issue Of The Rating Standard Applied	Section 9 of the B-BBEE Act 53 of 2003
Scorecard Applied	*Qualifying Small Enterprise Scorecard (< R 35 million)*

Broad Based BEE Status Level **LEVEL TWO**

ELEMENT	WEIGHTING	POINTS
Ownership	25	25.00
Management Control	25	24.95
Employment Equity	27	22.82
Skills Development	25	N/A
Preferential Procurement	25	25.00
Enterprise Development	25	N/A
Socio Economic Development	25	N/A
TOTAL	102	97.77

BEE Procurement Recognition Level	125%	Evaluation Period	1/05/2014 - 31/05/2015
Black Ownership	55.25%	Version Number	One
Black Women Ownership	5.25%	Enterprise Development Beneficiary	Category B
Value Adding Supplier	No		

Although the abovementioned is the current level of turnover/income and is closely related to the economic indicators, it may be more or less in future. Consequently, this Certificate does not serve as a guarantee that the income reflected will continue at the same levels.

Based on our work performed, we have no reason to believe that the B-BBEE status reflected in this Certificate has not been calculated in all material respects, in accordance with the Codes of Good Practice on Black Economic Empowerment, gazette on 9 February 2007, and in terms of the Broad-Based Black Economic Empowerment Act 53 of South Africa. Our limited assurance report dated 9 July 2015 is available for inspection at the registered office of Gijima Supply Chain Management Services (Pty) Ltd together with the accompanying detailed B-BBEE Scorecard and should be referred to for an understanding of our limited assurance engagement and the extent of work performed. This Certificate has been determined on the basis of information provided by management. We do not accept or assume responsibility to anyone other than Gijima Supply Chain Management Services (Pty) Ltd, for our work, for this report, or for the conclusion we have reached.

V. Vivier / J.C Carstens
IRBA Registration Number: 901962A
B-BBEE Approved Registered Auditor
Tel. no. (011) 953-3873 Email: fcw@mweb.co.za

Date of Issue: 09 July 2015
Expiry Date: 08 July 2016
Period of validity: 12 months

Furter Carstens & Vennote/Partners
Verification Analyst: M. Dietzsch Cell: 083 357 0845

FURTER CARSTENS & VENNOTE/PARTNERS

J.C. CARSTENS, B.Comm.(Rek), Hons, STR, G.R.(S.A.)
V.VIVIER,B.Comm.(Rek),Hons,B.Compt.(Rek),Hons.G.R.(S.A.)
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Broad-Based Black Economic Empowerment
Verification Certificate

GIJIMA SUPPLY CHAIN MANAGEMENT SERVICES (PTY) LTD

Certificate Number: M01/B-BBEE: QSE09/07/2015/013

Registration Number	2001/015676/07
VAT No (if applicable)	4340225368
Address/Location	Arbor Siding, Portion 1 of Farm Vandyksput, Delmas, Mpumalanga, South Africa

Verification Standard Applied	Codes of good practice of 2007
Sector specific	Transport Sector Charter Gazetted on 21 August 2009
Issue Of The Rating Standard Applied	Section 9 of the B-BBEE Act 53 of 2003
Scorecard Applied	*Qualifying Small Enterprise Scorecard (< R 35 million)*

Broad Based BEE Status Level LEVEL TWO

ELEMENT	WEIGHTING	POINTS
Ownership	25	25.00
Management Control	25	24.95
Employment Equity	27	22.82
Skills Development	25	N/A
Preferential Procurement	25	25.00
Enterprise Development	25	N/A
Socio Economic Development	25	N/A
TOTAL	102	97.77

BEE Procurement Recognition Level	125%	Evaluation Period	1/06/2014 - 31/05/2015
Black Ownership	55.25%	Version Number	One
Black Women Ownership	5.25%	Enterprise Development Beneficiary	Category B
Value Adding Supplier	No		

Although the abovementioned is the current level of turnover/income and is closely related to the economic indicators, it may be more or less in future. Consequently, this Certificate does not serve as a guarantee that the income reflected will continue at this same levels.

Based on our work performed, we have no reason to believe that the B-BBEE status reflected in this Certificate has not been calculated in all material respects, in accordance with the Codes of Good Practice on Black Economic Empowerment, gazette on 9 February 2007, and in terms of the Broad-Based Black Economic Empowerment Act 53 of South Africa. Our limited assurance report dated 9 July 2015 is available for inspection at the registered office of Gijima Supply Chain Management Services (Pty) Ltd together with the accompanying detailed B-BBEE Scorecard and should be referred to for an understanding of our limited assurance engagement and the extent of work performed. This Certificate has been determined on the basis of information provided by management. We do not accept or assume responsibility to anyone other than Gijima Supply Chain Management Services (Pty) Ltd, for our work, for this report, or for the conclusion we have reached.

V. Vivier / J.C Carstens
IRBA Registration Number: 901962A
B-BBEE Approved Registered Auditor
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Date of Issue: 09 July 2015
Expiry Date: 08 July 2016
Period of validity: 12 months

Furter Carstens & Vennote/Partners
Verification Analyst: M. Dietzsch Cell: 083 357 0845

APPENDIX B: PROVISION FOR REHABILITATION

VERITAS Chartered Accountants

VERITAS CA (SA) Incorporated
Chartered Accountants (S.A.)
Registered Accountants & Auditors
Unit 10 Sunpark | 178 Smit Street | Fairland
Suite 345 | Private Bag X1 | Northcliff | 2115
Tel: (011) 476 2247 | Fax: (011) 476 2245

To: Myezo Environmental Management Services

Date: 17 November 2016

Dear Sir/ Madam

GIJIMA SUPPLY CHAIN MANAGEMENT SERVICES (PTY) LTD: PROVISION FOR REHABILITATION

We hereby confirm that Gijima Supply Chain Management Services (Pty) Ltd has an amount of R50 000 (fifty thousand Rand) secured for environmental rehabilitation when required.

Should you require any additional information, please do not hesitate to contact us.

Yours sincerely

Jaco Neveling

Accountant

Veritas CA (SA) Inc

Annexure 16.2-3: Rehabilitation Strategy Implementation Programme (RSIP)

LETSOLO
WATER AND ENVIRONMENTAL SERVICES
"Engineered Solutions for Environmental Quandary"

Letsolo Water And Environmental Services cc
P.O. Box 19016
Pretoria West
0117
Reg: 2010/005979/23
Tax ref Number: 9170/262/18/3
Vat Number: 4380258477
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Website : www.lwes.co.za

Date 22 January 2018

Gijima Supply Chain Management (Pty) Ltd
PO Box 71486
Bryanston East
2021.
South Africa

Attention: Mr Ramphele and Mr Cronje

REHABILITATION STRATERGY AND IMPLEMENTATION PROGRAMME (RSIP) FOR GIJIMA SUPPLY CHAIN MANAGEMENT (PTY) LTD, IN LINE WITH WATER USE LICENCE (LICENSE NO: 04/B20F/G/4009)

The above mentioned project is herein referred to.

Please find enclosed the Rehabilitation Strategy and Implementation Programme (RSIP) for Arbor Siding in line with the requirements of the Water Use Licence Application.

Please do not hesitate to contact us should you have any queries.

Best regards,

Ishmael Phalane,
Engineering Technologist – Civil Engineering (ECSA: 201480763)

LETSOLO
WATER AND ENVIRONMENTAL SERVICES
"Engineered Solutions for Environmental Quandary"

ARBOR SIDING

REHABILITATION STRATERGY AND IMPLEMENTATION PROGRAMME (RSIP)

Reference: LWES 417

Prepared by:	Prepared for
Ishmael Phalane B-TECH; Civil Engineering (ECSA – Reg No: 201480763) Letsolo Water and Environmental Services cc 76 Phudufufu Street Atteridgeville Ext 25 Kalafong Heights 0008 Tel: (012) 321 0073 Cell : 082 821 6621 Fax : 0866 134 794 e-mail : *ishmael@lwes.co.za* Website : *www.lwes.co.za*	Mr Peet Cronje, and Mr Velile Ramphele Gijima Supply Chain Management (Pty) Ltd PO Box 71486 Bryanston East 2021. South Africa Tel: +27 (0) 11 658 0349 Fax: +27 (0) 11 658 1332 www.gijimasupplychains.co.za

EXECUTIVE SUMMARY

The Department of Water and Sanitation (DWS) issued the Water Use Licence (WUL) for activities at Arbor Siding. As part of the WUL conditions, Gijima Supply Chain Management (Pty) Ltdmust compile a Rehabilitation Strategy and Implementation Programme (RSIP) to ensure efficient water use activities.

Gijima Supply Chain Management Services (Pty) Ltd is undertaking a coal loading operations on Portion 1 of the Farm Van Dyksput 214 IR also known as Arbor siding, located approximately 5 km West of Kendal power station. The operations include haulage of coal from various activities, stockpile and load to railway wagons for transportation to the markets. The coal stock piling footprint of the activity covers approximately 9000 square meters.

Letsolo Water and Environmental Services cc was appointed to compile the Rehabilitation Strategy and Implementation Programme (RSIP) for Arbor Siding.

For this Report, the principal act of relevance is the National Water Act, 1998 (Act 36 of 1998) which provides for the protection, usage, development, conservation, management and control of the country's water resources in an integrated manner. The Act provides the legal basis, upon which to develop tools and means to give effect to the protection of water resources.

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GLOSSARY OF TERMINOLOGY

Integrated Resource Management: A way of analyzing the change in demand and operation of water institutions that evaluates a variety of supply-side and demand-side management measures to determine the optimal way of providing water services.

Demand-side management: Any measure or initiative that will result in the reduction of the expected water usage or water demand.

Supply-side management: Any measure or initiative that will increase the capacity of a water resource or water supply system to supply water.

Distribution management: Any function relating to the management, maintenance and operation of any system of structures, pipes, valves, pumps, meters or other associated equipment, including all mains, connection pipes and water installations that are used or intended to be used in connection with the supply of water.

Unaccounted for water: The difference between the measured volume of water put into the supply and distribution system and the total volume of water measured to authorized consumers whose fixed property address appears on the official list of water services authorities.

Water Institutions: Water institutions include both Water Management Institutions and Water Services Institutions as defined in the National Water Act and the National Water Services Act respectively.

Water Wastage: Water lost through leaks or water usage which does not result in any direct benefit to a consumer or user. Inefficient use of water: Water used for a specific purpose over and above the accepted and available best practises and benchmarks or water used for a purpose where very little benefit is derived from it.

ABBREVIATIONS

WSA	Water Services Authorities
WSI	Water Services Institutions
WSDP	Water Services Development Plans
UAW	Unaccounted for water
IRP	Integrated Resource Planning
IWRM	Integrated Water Resource Management
CMA	Catchment Management Agency
NWA	National Water Act
NWSA	National Water Services Act

1. INTRODUCTION

Letsolo Water and Environmental Services cc was appointed to compile a Rehabilitation Strategy and Implementation Programme (RSIP) for Arbor Siding. The Department of Water and Sanitation (DWS) issued the Water Use Licence (WUL) for activities at Arbor Siding (Licence No: 04/B20F/G/4009). As part of the WUL conditions, Gijima Supply Chains Management (Pty) Ltd must compile the Rehabilitation Strategy and Implementation Programme (RSIP) to ensure efficient water use activities.

By definition, Rehabilitation is the recovery of a disturbed area to the land form and productivity that it enjoyed before the disturbance took place. Therefore this report summarises a strategy that may need to be reviewed on an annual basis to ensure that:

- The rehabilitated site is safe for both humans and animals.
- The site is physically, chemically and biologically stable.
- The remaining impacts are of an acceptable nature without deteriorating over time.
- The closure is achieved in as efficient and cost-effective manner possible and with minimal socio-economic upheaval.

The activities are undertaken within the Victor Khanye Local Municipality, in Mpumalanga Province. The surrounding area can be characterised as Residential, Industrial and Agricultural as follows:

- Residential - Arbor community exist on the southern side of the siding;
- Industrial – There is another mining house which is not associated with Arbor Siding. This siding is located on the northern side of the siding; and
- Agricultural - Farming activities take place on the eastern side of the siding.

The following elements were considered in the preparation of the RSIP:

- Land: The establishment of stable land, profiled to prevent erosion and the migration of clean surface water through rehabilitated land, and capable of achieving the pre-determined post-industrial actvity.
- Water: The establishment of a water management system, which will prevent erosion and contamination of fresh water sources. Ensure compliance with the water quality management objectives for the specific catchment area.
- Air: The prevention of the dissemination of any form of air pollution emanating from site by re-vegetating rehabilitated land.
- Cover: The appropriate cover design is usually determined by the nature of the activity. Topsoil cover system is designed to maximise run-off of precipitation, while minimising infiltration and preventing ponding. A stable cover should be established, capable of natural survival.

The RSIP must be able to prevent air and water pollution in accordance with the requirements of the relevant regulations and with good international practice. The intended end use should take into consideration the prior land use and the location with respect to current and potential future socio-economic development.

This report must be amended annually to :

- Protect the environment and public health and safety by using safe and responsible closure practice.
- Establish a self-sustaining solution with a minimum of on-going maintenance.
- Minimise off-site impacts.
- Create safe and stable landforms.
- Return the site to beneficial land use.
- Reduce the needs for long-term monitoring and maintenance.
- Meet all regulatory requirements.

1.1. **Legal Aspects**

1.1.1. South African Legal Framework

For this RSIP, the principal Act of relevance is the National Water Act, 1998 (Act 36 of 1998) (NWA) which provides for the protection, usage, development, conservation, management and control of the country's water resources in an integrated manner. The Act provides the legal basis, upon which to develop tools and means to give effect to the protection of water resources.

1.1.2. Water Use Authorisation

Gijima was issued with Water Use Licence (Licence Number 04/B20F/G/4009) on 18 December 2015. The water uses include a coal stockpile area, a dirty water catchment and two pollution control dams to comply with Section 21 (g) of the National Water Act.

1.2. **Site location**

The location of project falls within Victor Khanye Local Municipality on the farm Van Dyksput 214, located in the magisterial District of Witbank, Mpumalanga Province. Arbor siding is approximately 5 km West of Kendal power station along R555.

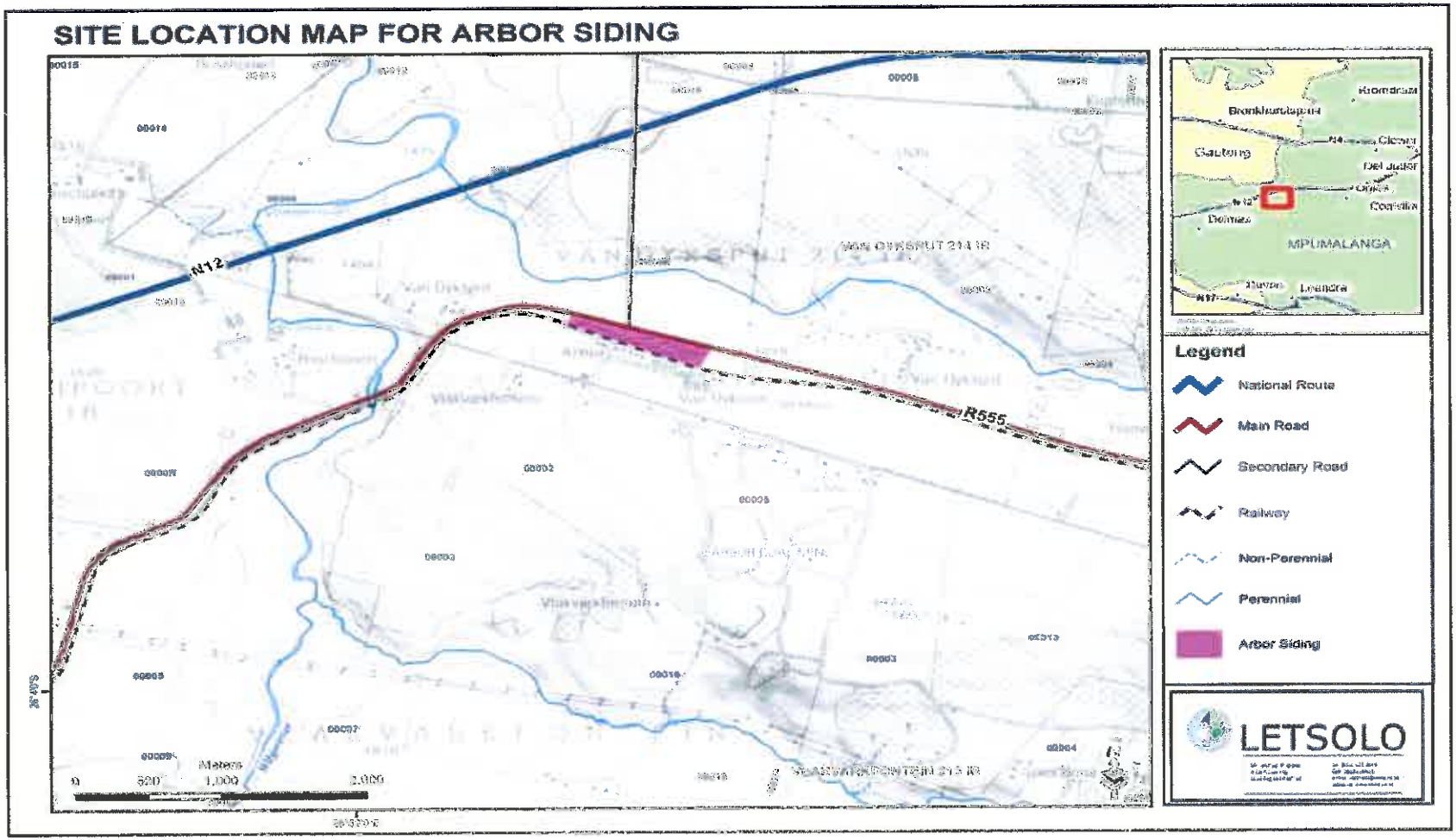

Figure 1-1: Site Location

1.3. **Declaration of independence:**

I, Ishmael Phalane, act as the independent specialist. I declare that there are no circumstances that may compromise my objectivity in performing such work. I have expertise in conducting the Water Conservation, Demand and Supply Strategy (WCDSS) and report relevant to the environmental authorisation applications. I confirm that I have knowledge of the relevant environmental Acts, Regulations and Guidelines that have relevance to the proposed activity and my field of expertise and will comply with the requirements therein.

I have no, and will not engage in, conflicting interests in the undertaking of the activity.

I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has, or may have, the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

All particulars furnished by me in this report are true and correct. I realise that a false declaration is an offence in terms of regulation 48 of the National Environmental Management Act, 107 of 1998 (NEMA) and is punishable in terms of section 24F of the Act.

1.4. **Scope of Work**

The scope of work allows for compilation of the RSIP in line with the requirements of the National Water Act, 1998 (Act 36 of 1998) as prescribed by the Department of Water Affairs. The scope of work allows for the following:

- Rehabilitation Objectives
- Rehabilitation Strategy
- Rehabilitation management Plan
- Planning Instruments
- Final Landform
- Rehabilitation procedure

2. METHODOLOGY FOLLOWED FOR THIS REPORT

In order to ensure that a practical methodology for the rehabilitation strategy is compiled, the following was undertaken:

- a site visit during which time the conditions of the study area were assessed;
- Compile a report comprising of a systematic procedure to rehabilitate the storm water dam.

2.1. Project Details

Gijima is operating as railway siding on Portion 1 of the Farm Van Dyksput 214 IR, also known as Arbor siding, located approximately 5 km West of Kendal power station. The activities at Arbor siding entails the offloading, stockpiling and removal of coal. Coal will be trucked in from a mine and therefore no mining activities are anticipated on site. Suitably scaled topographical maps were used to delineate the relevant catchments, which may be impacted on by the proposed activities. The following GIS information was used:
1:50 000 Topographical maps (2628bb), Raster as well as Vector;

- Contour maps (2 meter height difference); and
- Quaternary catchment boundaries.

The study area falls within Water Management Area 4 (Olifants Water Management Area), in the quaternary catchment B20F. The area drains northerly towards the tributary of the Wilge River and the most reliable rainfall station near the study area is SAWB-0477602.

Gijima is a 55.25% BB-BEE South African based supply chain management company (level 2 BBBEE), with its primary focus on the rail-reliant bulk commodity market. Gijima has established strong relationships and alliances with important role players in the Mining Industry and in particular with Transnet Freight Rail. The core business of Gijima since it was founded in 2004 is the development and management of multi-modal logistic solutions within Southern Africa. The TFR/Eskom current strategy of Road to Rail migration is strongly supported by Gijima, and as such, Gijima will contribute to the success of this strategy, with an efficient, cost effective and safe logistic solution, for the provision of coal loading and material handling services at Arbor siding.

3. REHABILITATION STRATEGY AND IMPLEMENTATION PROGRAM

3.1. Facility Description

A siding, in rail terminology, is a low-speed track section distinct from a running line or through route such as a main line or branch line or spur. It may connect to through track or to other sidings at either end. Sidings often have lighter rails, meant for lower speed or less heavy traffic, and few, if any, signals. Sidings connected at both ends to a running line are commonly known as loops.

Throughout history, coal has been used as an energy resource, primarily burned for the production of electricity and/or heat, and is also used for industrial purposes, such as refining metals. A fossil fuel, coal forms when dead plant matter is converted into peat, which in turn is converted into lignite, then sub-bituminous coal, after that bituminous coal, and lastly anthracite.

Coal is the largest source of energy for the generation of electricity worldwide.

The objectives of the project includes the moving of high volume commodities from road to rail, supply local and export clients, create jobs and enhance entrepreneur potential in the area. It is to benefit the local economy through salaries paid to employees and tax revenues paid to Government.

The Arbor siding operation is expected to contribute positively towards development of opportunities within Victor Khanye Local Municipality. The local economy will be boosted through provision/creation of employment opportunities for the local community. These opportunities will have a positive effect on the broader value chain extending to suppliers of goods and services from nearby towns. The operation will employ approximately 5 people excluding the already employed truck drivers and Gijima employees. The operation will contribute positively on livelihoods leading to an increase in the standards of living while causing a reduction in poverty. The coal beneficiation industry has a positive impact of regional and local economic setup. The local economy will benefit through salaries paid to employees and tax revenues paid to Government.

3.1.1. Current and proposed infrastructure

Existing infrastructure is listed below:

- Access road
- Fencing and trenching

- Stockpiling
- Buildings - offices
- Water use, reticulation and supply
- Dirty water management systems.

3.1.1.1. Access roads

Existing access roads is used for access to site.

3.1.1.2. Fencing and trenching

A fence is established around the perimeter of the pollution control dam.

3.1.1.3. Stockpile

Coal is trucked in and stockpiled on site. These stockpiles are removed by means of front end loaders for loading into the train wagon.

3.1.1.4. Temporary services during rehabilitation phase

The following will be provided for temporary services:

- Chemical toilets will be made available on site for ablution. These toilets will be serviced as required, by a contractor.
- A diesel generator will be installed to provide electricity if the need arises.
- Waste skips will be used for waste collection and any domestic waste will be removed from the site to a licenced waste facility by a contractor.
- Water requirements relating to ablutions and drinking water are expected to be minimal and if water cannot be sourced on site it will be brought in by a tanker.

3.1.1.5. Demolition of offices, workshops and other facilities

The contractor yard will be constructed by levelling the area. The contractor yard will accommodate offices, workshops, diesel storage facilities for the appointed contractor.

3.1.1.6. Demolition of the pollution control dam, clean and dirty water management channels

A pollution control dam exists at the most downstream point of the dirty water catchment area.

The catchment area for the siding and associated infrastructure has been minimised though the use of clean water cut off drains and berms. These drains are used to intercept any water entering the dirty water area and diverting it to lower soak away points where the water will re-enter the environment.

4. ENVIRONMENTAL DESCRIPTION

4.1. Climate

4.1.1. Temperature

The mean daily maximum temperature exceeds 25 °C between November and March, the hottest months. Average maximum temperatures in the winter months (May-August) range from 18.0°C to 21.3°C. The mean minimum summer temperatures range from 11.7°C (March) to 14.2°C (January) with winter mean minima ranging from –1.6°C to 2.9°C. An extreme maximum temperature of 33.8°C was recorded at Ogies, on 12 November 1990 and an extreme minimum temperature of –8.8°C on 9 June 1988.

Table 4-1: Maximum, Minimum and Mean Monthly Temperature

Month	Mean Daily Temp (°C)		
	Max	Min	Mean Monthly Temp (°C)
January	27.0	14.2	20.6
February	26.0	13.6	19.8
March	25.7	11.7	18.7
April	23.3	8.1	15.7
May	21.3	2.9	12.1
June	18.0	- 0.5	8.8
July	18.8	- 1.6	8.6
August	20.9	1.2	11.1
September	23.4	6.0	14.7
October	24.7	10.0	17.4
November	25.0	12.0	18.5
December	26.3	13.8	20.1
Annum	23.4	7.6	15.5

4.1.2. Rainfall

When the rate of rainfall influx exceeds the absorption capacity of the soil, the excess water flows over the surface as overland flow. Rainfall runoff responds differently to variations in topography, soil and characteristics of precipitation, and indirectly to variations in climate, vegetation and land use. Therefore runoff flow, controls the volume, periodicity and chemical characteristics of contributions to receiving streams and lake basins.

Many different rainfall data sources and consequent data sets exist for rainfall representation over S.A. Each data source and data set has its own unique advantages as well as disadvantages. Different hydrological rainfall-runoff simulation and peak flow estimation models exist as well as different methods for estimations which require different rainfall parameters with specific required detail and accuracy. Water Research Commission collects Rainfall, Runoff and Evaporation data. This data is herein referred to as WR2005 data. WR2005 includes most data sets all over the country but is currently limited up to and including the year 2004, starting from 1920. Data sets have a record period of 85 years. Major and extensive research efforts and modelling exercises have been conducted to obtain WR2005 rainfall data.

Mean Annual Precipitation (MAP) is representative of the average rainfall that occurs over an area during any given year. This rainfall is obtained by taking the total rainfall received over time at a specific point including any extreme periods and/or events and averaging it.
The site MAP is estimated at 739 mm.

4.1.3. Evaporation

As in the case of rainfall and runoff it is also necessary to analyse the Mean Annual Evaporation (MAE). Much less evaporation data exists than data for rainfall and runoff. Evaporation is measured at dams and mostly stations that are operated by DWS; these stations provide such data. Again, as in the case with rainfall and runoff, much effort has been placed to incorporate evaporation data into the Pitman model and consequently the WR2005 dataset (WRC, 2008). A previous version of WR2005 is also available with evaporation data; this data set is called the WR90 data set (WRC, 1990). The site MAE is estimated at 1517.8 mm.

The main areas where evaporation can be found are at open water storage. In this instance, evaporation losses occur at the PCD.

4.2. **Geology**

The site is located on the western side of the Witbank Coalfield and is underlain by soils and rocks of the Vryheid Formation of the Ecca Group and typically comprises siltstones, shales and sandstones. The area also appears to be liberally intruded by dolerite. The Vryheid Formation is, in turn, underlain by dwyka tillite of the Dwyka Formation. The upper portion of the overburden is invariably made up of highly weathered to partially weathered overburden consisting of clayey soils, siltstone and sandstone.

4.3. **Surface Water**

4.3.1. Water Management Area (WMA 2)

The study area falls within the Olifants water Management Area (WMA 2). The WMA 2 lies in the north-eastern part of South Africa (*National Water Resources Strategy*, 2016). The Water Management Area hosts four (4) major rivers, namely the Elands, Wilge, Steelport and Olifants; however the Colliery occurs within the upper parts of the Wilge River, within the Olifants River Basin.

4.3.2. Quaternary catchments

A catchment or water shed is derived from the topographical landscape. It is sectioned by a water divide, a high land separating two or more water systems. A quaternary catchment is the land and water surface area that contributes to the discharge at the system outlet.

4.3.3. Quaternary Catchment B20F

Arbor siding falls within B20F. This Catchment hosts the downstream of the Wilger River as a main stream. It has an area of 506km^2 with MAR 33.3mm/a and MAP of 666.79mm.

4.3.4. Surface Water Monitoring

The monitoring points are summarised as follows:

Table 4-2: Monitoring Points Location

ID	LABEL	X (Decimal Degrees)	Y (Decimal Degrees)	Frequency of monitoring
1	SW1	28.92417436	-26.04450349	Monthly
2	SW2	28.88386559	-26.03501712	Monthly
3	SW3	28.8735138	-26.02875944	Monthly
4	PCD	28.88166875	-26.03907795	Monthly
5	Jojo Tank	28.88116947	-26.03881167	Monthly
6	U/S Borehole	28.8803240	-26.04391319	Quarterly
7	D/S Borehole	28.87344723	-26.03807939	Quarterly

Please take note of the following monitoring point naming criterion:

- SW - Surface Water
- PCD - Pollution Control Dam
- U/S - Upstream
- D/S - Downstream

4.3.4.1. Variables

Surface water and Groundwater samples were collected and the Lab analysis was conducted for the following variables:

- pH-Value at 25 ° C
- Conductivity at 25° C in mS/m
- Total Dissolved Solids
- Suspended Solids
- Nitrate & Nitrite as N
- Chlorides as Cl
- Total Alkalinity as CaCO3
- Fluoride as F
- Sulphate as SO4
- Calcium as Ca
- Magnesium as Mg

- Sodium as Na
- Potassium as K
- Iron as Fe
- Manganese as Mn
- Aluminium as Al

4.3.4.2. Sample storage and transportation

After samples were collected, they were stored in a cooler box and then transported to the Laboratory within 24 hours of sampling, for screening.

4.3.4.3. Guidelines

The following guidelines were used for the compilation of the report:

- SANS 241 (2015) Aesthetic
- SANS 241 (2015) Acute
- Health SANS 241 (2015) Chronic Health

5. REHABILITATION OBJECTIVES

5.1. Objectives of the RSIP

The primary objective of the RSIP is to protect the water resource (including the water quality, water quantity and the aquatic ecosystem) after closure. This is achieved through adherence to the hierarchy of decision-taking, which is based on a precautionary approach and includes the following:

- Pollution prevention and minimisation of impacts.
- Water reuse and reclamation; and
- Discharge or disposal of waste and/or waste water.

To achieve this primary objective, the water management infrastructure must be rehabilitated with the following specific objectives in mind:

- To ensure that water management measures take account of and fit into the broader regional water management context;
- To ensure that water of different quality (i.e. clean and dirty water) is kept separate, and managed separately, as far as possible. This will ensure that the contact

between water of different quality, and the potential for unnecessary water quality deterioration, is minimized;

- To ensure that the water management measures are sustainable (durable) over the long term,

The aim of the rehabilitation strategy is to commit to the conditions within the Environmental Principles which states, but is not limited to the following:

- Clear all infrastructure and re-vegetate the areas to near pre-mining conditions;
- Compaction will be managed to protect the soil structure (i.e. ripping of 500 mm). Fertiliser will be applied at the required rate as determined by soil laboratory analysis;
- Topsoils will be replaced and the affected areas will be rehabilitated using indigenous vegetation common to the area. The rehabilitation of the soils will play a significant role in the rehabilitation of vegetation;
- The rehabilitated areas will be ameliorated and seeded with the recommended seed mix and the planted area will be watered thoroughly and regularly; and
- Monitoring will be undertaken to ensure that the rehabilitated areas are self-sustaining and that weed / alien plants are under control. Monitoring will only cease once this has been confirmed.

The objective is to ensure that any long-term residual water quality impacts are identified and adequately managed in the closure scenario. The practical implications of these water management regulations are as follows:

- In the case of temporary cessation, management team must:
    - Review and update the closure plan, where required,
    - Identify all water management measures that need to be put in place to ensure effective operations and maintenance of the pollution control measures during the temporary cessation period, and
    - Identify and implement the required monitoring programmes.
- In the case of permanent cessation of mining, i.e. closure, management team must:
    - Ensure that the required rehabilitation of pollution control measures is undertaken in accordance with the closure objectives and the closure plan.

6. REHABILITATION STRATEGY

The strategy for Arbor Siding is summarised as follows:

6.1. Berms

Clean and dirty water cutoff berms should be rehabilitated with low permeability material containing no carbonaceous formation.

Water drainage paths should be designed to maximise flow without erosion

Cognisance should be taken of materials erodeability when designing flow path gradients

The berm material could be re-used as the mining window advances. Unlevelled spoil piles should be kept to a minimum. A maximum of three cut widths of unlevelled spoil is recommended to reduce rainfall ingress

Low wall ramps should periodically be backfilled to reduce rainfall ingress.

Rehabilitation growth must be maximised to facilitated erosion control and maximise evapotranspiration.

6.1.1. Hard parks, vehicle and machinery bays

Topsoil, subsoil and soft weathered overburden should be used for rehabilitation, to provide a good foundation vegetation layer. These materials should be stockpiled for reuse after closure.

Dirty water from these areas will contain oils and greases and need to be channelled into the operational system for collecting oils and greases.

7. REHABILITATION MANAGEMENT PLAN

In order to ensure that a systematic methodology for the rehabilitation, the aspects requiring rehabilitation is compiled into a report and the necessary actions and responsible parties are detailed.

The timeframes mentioned in the table hereafter assumes the following:

- Prior to rehabilitation – will include the site clearing and the removal of all foreign infrastructure (approximately one week);
- During rehabilitation – will include the activities associated with the shaping of the area and the establishment of the pre-construction environment (approximately 1 month); and
- After rehabilitation – will include the activities which will be undertaken to monitor the success of the rehabilitation activities (approximately 6 months).

Table 7-1:Rehabilitation Management Plan

Aspect requiring rehabilitation	Actions Required	Responsible Person	Timeframes
General	All rehabilitation activities must be limited to the already disturbed area.	Construction Manager and Environmental Manager	Prior, during and after rehabilitation activities.
	No further removal of vegetation would be allowed without obtaining the necessary permits from the Department of Water and Sanitation.	Construction Manager and Environmental Manager	Prior, during and after rehabilitation activities.
	Any vehicles on the site should be operated with low tyre pressure (as low as possible) in order to minimise soil compaction.	Construction Manager	During rehabilitation activities.
	Particular attention must be given to any possible contaminants (for example vehicle fuel, cleaning chemicals, any waste products) since the soil is very permeable. All potential contaminants must be stored off site and any spills remediated immediately by removal and correct disposal of the soil contaminated.	Construction Manager and Environmental Manager	Prior, during and after rehabilitation activities.
Topography	All foreign material must be removed and disposed of at a licensed site.	Construction Manager and	Prior to rehabilitation activities.

Aspect requiring rehabilitation	Actions Required	Responsible Person	Timeframes
		Environmental Manager	
	All other material (such as the berms) must be monitored for contamination. Should the samples prove that the material has been contaminated, the material must be remediated and be utilised in the reshaping of the land.	Construction Manager and Environmental Manager	Prior and during rehabilitation activities.
	The area must be reshaped to ensure that the natural contours of the area are reinstated and the area is free draining. This is of particular importance for the natural run of the flood plain.	Construction Manager and Environmental Manager	During rehabilitation activities.
Soils	The soils must be analysed to ensure that the soils have not become contaminated.	Environmental Manager	Prior to rehabilitation activities.
	Should the samples indicate that the soils have been contaminated the contaminated soils must be treated for reuse in the rehabilitation procedures.	Environmental Manager	Prior to rehabilitation activities.
	As part of the reshaping activities the compacted soils must be ripped to a depth of 500 mm.	Construction Manager and Environmental Manager	During rehabilitation activities.

8. PLANNING INSTRUMENTS

8.1. Mechanical Reshaping and Vegetation

The concept of reshaping consists of flattening the rehabilitated area from their current slope in a balanced cut to fill earthworks operation. The rationale for reshaping is that erosion is reduced, which results in improved vegetation sustainability. Through engineering, the deposit can be re-shaped to a more natural geometry, which will allow it to blend in to the surrounding topography.

Unfortunately, reshaping requires the movement of large quantities of material, an expense that would not have been necessary had the dam been constructed differently. Large volumes of dust are likely to be generated and the exercise should preferably be carried out during a suitable climatic period in the year such as late summer.

Mechanical re-shaping would be performed in a balanced cut to fill operation using earth-moving equipment.

These methods introduce some bio-diversity and with the reduced erosion and slope angle, it may be possible that other species could colonise this site. It is also more likely that animals could use the site.

Dust and noise will be generated during the reshaping process but the deposit could become a more visually pleasing extension to the adjacent ridge and will be more stable.

8.2. Pollution control dam

According to the Best Practices, topsoil removal and stockpiling is required before the erection of any new infrastructure. If this was done before the dam was built then this soil should be used for rehabilitation of the site, if soil was not stockpiled then an alternative source of suitable cover will need to be identified (e.g. removal from a borrow pit or other soil stockpiles).

It is important to use a soil source with properties as close to the original soil as possible in order to prevent other problems developing such as contamination of water resources.

Guidelines for removal of existing infrastructure:

- Any vehicles on the site should be operated with low tyre pressure (as low as possible) in order to minimize soil compaction.
- Particular attention must be given to any possible contaminants (for example vehicle fuel, cleaning chemicals, any waste products) since the soil is very permeable.

- All potential contaminants must be stored off-site and any spills remediated immediately by removal and correct disposal of the contaminated soil.

Guidelines for rehabilitation of the soil at the dam site:

- Replace the removed topsoil to a depth of 300mm if possible. Or to a similar depth of the surrounding soils (the soils of the area are typically shallow). If soil was not stockpiled then a new source will need to be identified as discussed above.
- Best Practice Guidelines recommends testing and fertilization of the replaced soil. This should be undertaken, but with a high degree of caution and to a limited extent. Any fertilizer introduced to these permeable soils on a flood plain will leach into the ground/surface water resources with the first irrigation/rains.
- Composted cattle manure can be used to increase the organic matter content of the soil in order to boost plant growth but again should be used with caution to prevent contamination of the water resources by leaching. A soil test result is required in order to accurately determine application rates.
- As per guidelines in the EMPR, an appropriate seed mixture can be used to re-establish the vegetation.
- Advice from a botanical specialist is recommended to ensure that the correct species are planted.

9. REHABILITATION PROCEDURE

9.1. Schedule of Quantities

The information contained in the rehabilitation plan must be used to develop a Schedule of Quantities (SOQ) for inclusion in the contractor scope of work. In addition, it will be recommended that the rehabilitation plan / specifications be appended to tender.

9.2. Costing Specifications

Based on the details of the rehabilitation plan, Gijima must provide a guideline cost for the implementation of the rehabilitation specifications. The costing must be based on accepted industry rates for various tasks, equipment and materials but will not be a formal quotation and must be viewed as an estimate.

9.3. Preliminary list of items for consideration

The following items should be considered during rehabilitation phase:

- Site visit
- Soil

  - Substrate samples and analysis
  - Pre-mining soil type (EMPR; land capability)
  - Texture
  - Chemical constituents
  - Fertility
  - Compaction tests
  - Vegetation samples and analysis
  - Sampling of vegetation in benchmark
  - Obtaining and reviewing existing data
- End land use
  - Type (grazing?)
  - Reintroduction of animals
  - Protection from grazing
- Surveying
  - Existing survey plans
  - Additional survey requirements
  - Final topography
  - Contouring and Shaping
- Chemical amelioration
  - Acidic conditions
  - Fertility
  - Salininty / sodicity
- Physical amelioration
  - Compaction
- Climatic considerations
- Temperature
- Rainfall (esp. high intensity and drought)
- Evaporation
- Erosion
  - Maintenance requirements
  - Maintenance fertiliser requirements
  - Mowing or cutting of vegetation
  - Potential long-term problems
- Treating pollution hot spots

These Items are tabulated below:

Table 9-1: Provisional List Considerations for the Rehabilitation Specifications

• Final topography	• Post-mining topography • Backfilling and contouring • Shaping requirements • Drainage requirements (free-draining) • Convex / concave
• Capping materials	• Sources of material • Volumes • Locality • Availability
• Climatic considerations	• Temperature • Rainfall (esp. high intensity and drought) • Evaporation
• Erosion	• Potential sites • Actual sites • Methods of repair and prevention / control • Runoff control structures
• Plant material	• Seed or sod • Mix ratio • Species type • Application rates • Application method
• Watering	• Frequency • Volume
• Ongoing (follow-up) Monitoring	• Procedure • Frequency • Results and interpretation • Maintenance requirements • Maintenance fertiliser requirements • Mowing or cutting of vegetation • Potential long-term problems

Table 9-2: Monitoring Systems

Monitoring of Environmental Impacts and Management	Recommendations and/or comments
Surface Water	Arbor Siding will initiate and implement an extensive surface-water monitoring programme consisting of strategically placed surface water monitoring points to monitor water quality within the affected streams and the dirty water areas. Water monitoring samples will be taken on a monthly basis. The following constituents i.e. pH, TDS, EC, Alkalinity, Suspended solids, Ca, Na, K, Mg, Cl, SO4, Fe, Mn, and Al will be monitored at the different monitoring points. A water quality report will be compiled on a quarterly basis. This report will show all risk areas and areas showing diversion to the current background water quality. Recommendations will also be included in this water quality report.
Groundwater	To determine if any groundwater quality deterioration is occurring, the following constituents (pH, TDS, EC, Alkalinity, Suspended Solids, Ca, Na, Mg, K, Cl, SO4, Fe, Mn, and Al) will be measured. To determine if any groundwater level lowering is taking place, static groundwater levels will be monitored. Monitoring of both groundwater quality and static water levels will be conducted on a quarterly basis. This will ensure that any decline in the quality and yield of groundwater of legitimate groundwater users in the area is detected in time, while also providing a necessary database for future disputes. If it can be proven that the quality of groundwater available to certain users is being adversely affected to a point where it is no longer suitable for the intended use, Gijima will compensate the affected parties.

Air Quality	During the construction, operational and decommissioning phases the machinery movement, blowing wind and blasting will generate dust. The dust will migrate to the prevailing wind direction. Due to the presence of a number of farm houses to the east and the informal settlements to the west, north west and south west of the mining area it will be necessary to conduct ambient dust monitoring.
Noise & Vibration	Noise will be generated during blasting. A monitoring programme for the purpose of monitoring the noise and vibration levels during blasting and machinery movements will be developed.
Interested and Affected Parties	Any additional or new parties that would like to be included the list will be included in the list. Arbor Siding will apply an open-door policy with all I&AP. This will allow the project to pro-actively react to any perceived complaint from its neighbors thus ensuring that the situation is resolved timeously. A complaints register will also be kept at the offices. All complaints and response to the complaints will be kept in the complaints register.

10. CONCLUSION AND RECOMMENDATIONS:

Arbor Siding is still operational. Therefore this report must be updated annually. Other practical implications in terms of Rehabilitation Strategy and Implementation Plan are as follows:

- All water management infrastructures should be designed and managed to facilitate closure. This includes the following considerations:
    - The durability and longevity of water management designs, e.g. provision of erosion protection for long-term control of erosion,
    - The consideration of active versus passive care of the water management infrastructure post-closure, and
    - The consideration of the final land use and final land forms should be incorporated into the design of the water management measures for closure.
- The post-closure water use should be considered in the design process
- The final topography should be planned, as far as possible, to be free-draining.

The physical parameters, and more importantly to the backfill of the open cast pits, the chemical composition of the materials need to be assessed in terms of the potential for the liberation of acid drainage from the site.

In addition, the liability for potential pollution needed to be understood before any long term decision was taken.

11. RECOMMENDATIONS

The RSIP emphasise that the current pit does not become abandoned in the future and that the site is either returned to its original state or that the community can make use of the site for other economically viable activities. Where it is not possible to return the site to its original state or to develop it for other purposes, it is essential that:

- The site is made safe for both humans and animals.
- The site is physically, chemically and biologically stable.
- The remaining impacts are of an acceptable nature without deteriorating over time.
- The closure is achieved in as efficient and cost-effective manner possible and with minimal socio-economic upheaval.

12. SCHEDULE OF REFERENCE

- Alexander, W.J.R. (2002). The standard design flood. Journal of the South African Institution of Civil Engineering. Volume 44, No 1. SAICE.
- Smithers, J.C. and Schulze, R.E. (2002). Design Rainfall Estimation in South Africa. Water Research Commission. Report no. K5/1060. Pretoria.
- Midgley, D.C. (1972). Design flood determination in South Africa. Hydrological Research Unit Report No 1/72. University of the Witwatersrand. Department of Civil Engineering.

Annexure 16.2-4: Soil Chemistry Report

ARBOR SIDING SOIL IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

The monitoring of soil resources at the Arbor Coal Siding was conducted as part of ensuring compliance with the Water Use Licence for the management of a coal siding on the property. The property is situated a little more than 20 km, west of the town Ogies, in the western part of the Mpumalanga Province. Three samples were collected at intervals of approximately 200 m at the train loading zone and a 4th sample was collected at the mid-point of the gravel haul route. Analysis results revealed that the samples returned acceptable parameter levels for pH, EC and Na levels. The results showed the samples to have either mildly acid or neutral pH, moderate electrical conductivity and sodium levels. Continuous monitoring of the water quality in pollution control dams and the treatment thereof if necessary will have to be carried out and corrective measures adopted if anomalies are detected in the quality.

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APPENDICES

1. INTRODUCTION

Letsolo Water and Environmental Services was appointed by Gijima Supply Chain Management Services Pty Ltd to undertake a soils analysis of the coal siding at Arbor, 20 km west of the Ogies town in the central part of the Mpumalanga Province. This was meant to ensure compliance with the issued Water Use Licence for the coal siding. The sampling was carried out in November 2017. The site is comprised of a coal stock pile, block of offices, railway route, weighbridge, pollution control dam and a gravel haul route.

Gijima Supply Chain Management Services (Pty) Ltd is undertaking a coal loading operations on Portion 1 of the Farm Van Dyksput 214 IR also known as Arbor siding, located approximately 5 km West of Kendal power station. The operations include haulage of coal from various mines, stockpile and load to railway wagons for transportation to the markets. The coal stock piling footprint of the activity covers approximately 9000 square meters.

The objectives of the survey are to:

- Provide a soil chemistry map depicting levels of pH, Electrical Conductivity and sodium on site
- Provide a report discussing findings in relation to chemistry of soils at the Arbor siding.

2. LEGISLATIVE REQUIREMENTS

The act of relevance to this study is the National Water Act, 1998 (Act 36 of 1998) which emphasises the need to conduct activities that ensure compliance with the requirements of the Water Use Licence. Gijima was issued with Water Use Licence (Licence Number 04/B20F/G/4009) on 18 December 2015. Soil samples were collected for chemical analysis and a soil chemistry map drawn which should show levels of:

- pH
- Electrical Conductivity
- Sodium.

Over and above the above recommended variables, it was deemed necessary to also include other variables for the chemical assessment in order to make informed recommendations. In order to ensure that when the operation ceases, the environment is left in a condition which favours re-vegetation. Therefore, additional variables are checked in line with plant requirements. These additional variables include:

- Potassium (K) - Potassium rivals nitrogen as the nutrient absorbed in greatest amounts by plants. Like nitrogen, crops take up a relatively large proportion of plant-available potassium each growing season. The slow release of potassium from native soil minerals and from fixed forms in clays can replenish some of the potassium lost by crop removal and leaching. This ability, however, is limited and variable. Fertilization is often necessary to maintain optimum yields.
- Calcium (Ca) - Calcium is essential for proper functioning of plant cell walls and membranes. Sufficient calcium must also be present in actively growing plant parts, especially in fruits and roots. Properly limed soils with constant and adequate moisture will normally supply sufficient calcium to plants
- Magnesium (Mg) - Magnesium acts together with phosphorus to drive plant metabolism and is part of chlorophyll, a vital substance for photosynthesis. Like calcium, magnesium is ordinarily supplied through liming. If magnesium levels are low and lime is required.

3. STUDY AREA

The study area falls within Portion 1 of the farm Van Dyksput farm located in the Mpumalanga Province. The site is cleared of vegetation, is relatively flat with slopes of that do not exceed 1% and has a rail track cutting through the property with coal stock piles along the length of the rail loading zone as well as a gravel haul route, pollution control dam, weighbridge and administration complex. The town of Ogies is located approximately 20 km to the east of Arbor Siding (Figure 3-1).

Figure 3-1: Location Map of Arbor Coal Siding

4. METHODOLOGY

4.1. Sampling Depth

It is vital to collect samples from appropriate depths because a core taken deeper or shallower will generate erroneous results.

The soils were sampled at 400 - 500 mm beneath the surface. This sample depth was determined to be just beneath the compacted sacrificial layer which is usually compacted and made to be 300 mm thick.

4.2. Sampling Tools

A hand-held soil auger was used and approximately 1 kg of soil sample collected for chemical analysis. Three soil samples were collected approximately 200 m apart along the stock pile area and one soil sample was collected in the middle of the gravel haul route. These were marked A1-4 (Figure 2).

4.3. Sampling location

At every observation point, a gps point was noted. The soils were analysed at the Aquatico laboratory for the following in accordance to the standard prescribed methods (Non-Affiliated Soil Analysis Work Committee, 1990):

- pH(KCl);
- Cation Exchange Capacity (CEC) and exchangeable cations;
- Phosphorus (Bray 1);
- Electrical Conductivity (EC);
- Acid saturation

4.4. Sample Identification

Along with each soil sample, sampling information sheets were filled out that describe the identity of the sample.

Figure 4-1: Soil Sample Points At Map of Arbor Coal Siding

5. SOIL ANALYSIS RESULTS

The primary goal of soil testing is to inform efficient and effective resource management. Soil testing is the most accurate way to determine lime and nutrient needs. Soil testing is also useful for identifying contaminated sites.

The results provided in this report reflect the properties of the sample submitted to the Laboratory. As seen in Table 5-1 below, the purpose of report is to provide a brief explanation of each of the values provided on the lab soil test report and how they are used to generate recommendations.

Table 5-1: Soil Analysis Results

Sample Site	A 1	A 2	A 3	A 4	Optimum Range
GPS Coordinate	-26.0394S 28.8818E	-26.0397S 28.8828E	-26.0403S 28.8844E	-26.0396S 28.8833E	
Lab Ref	93575	93576	93577	93578	
Exch Cat cmol(+).kg^{-1}					
Ca	15.23	12.14	17.255	11.59	
Mg	1.713	1.450	1.573	3.516	
K	0.0664	0.0485	0.0511	0.0166	
Na	0.06956	0.1	0.1086	0.1086	
S value	17.07	13.7	18.988	53.38	
pH_{KCl}	6,74	7,35	6,32	6,09	6.2-7.3
P (Bray 1) (mg/kg)	6	4	4	8	30+
EC (mS.m^{-1})	249	194	241	170	< crop threshold

5.1. pH

Coal is generally associated with sulphide bearing minerals. Coal mining thus exposes the sulphide minerals to the environment which leads to the oxidation of these minerals and the creation of acidic conditions through the following process:

$$2FeS2 + 7O2 + 2H2O \rightarrow 2Fe2+ + 4SO-4 + 4H+$$

One of the most valuable pieces of information you can get from soil testing is a measure of soil acidity. Soil pH is an indicator of the soil's acidity which is a primary factor controlling nutrient availability, microbial processes, and plant growth.

Soil pH refers to the relationship between H+ and OH- ions. These ions relate to each other in a definite ratio and it is therefore common to ignore one of them. By convention, the H+ ions are usually considered even in the case of a strong base. Soil pH ranges are commonly described as in Table 5-2:

Table 5-2: Soil pH Ranges (After Fertilizer Handbook, 2007)

Description	Acid			Neutral 7	Alkaline
	Very ----------Slight				Slight ---------- Very
pH (KCl)	<4.0	4,5 - 4.9	5.0 - 6.7	6.8 - 7.2	7.3 - 8.0 ---------- >8.5

From the analysis results provided, the pH(KCl) range for samples 1 and 2 is neutral. Samples 3 and 4 are mildly acid. These samples returned acceptable pH levels for all four points. A pH map for the Arbor site is shown in Appendix A.

(Please Refer to Appendix A for Soil pH map)

5.2. Electrical Conductivity

The Chamber of Mines specifies that for a soil to be defined as arable, it must have an EC of less than 400 mS/m at 25°C. The samples showed EC figures way below the 400mS/m mark. It should be noted that the 400 mS/m ECe value provided is arbitrary and that EC values should rather be based on the yield levels where various plant crop species first reduce below the full yield potential (threshold levels) (Table 3). Samples 1 and 3 returned EC values generally above threshold levels for salt sensitive crops whereas samples 2 and 4 returned EC levels suited to salt sensitive crops indicating acceptable levels of EC. Various salt tolerance levels for various crops are shown in Table 5-3.

Although these are values associated with cropping in agriculture, they give a perspective of salt loading emanating from various environmental activities in relation to the arbitrary figure of 400 mS/m.

Table 5-3: Salt tolerance of common agricultural crops (USDA, 2009), expressed as electrical conductivity of the soil saturation extract at the threshold when crop yield first reduces below the full yield potential (ECe, threshold).

Crop	ECe threshold ($mS.m^{-1}$)
a. Small Vegetables	
Cabbage	100 - 180
Spinach	200 - 320
b. Roots and Tubers	
Potato	170
Sweet Potato	150 - 250
c. Legumes	
Beans	100
Peas	150
d. Forages	
Alfalfa	200
Clover	150

(Please Refer to Appendix B for Electrical Conductivity Map

5.3. Exchangeable Cations - sodium

The amounts of exchangeable cations normally follow the trend Ca>Mg>K>Na. The analysis yielded high levels for Ca, extremely low levels of Mg and low levels of K and Na. The high Ca levels suggest that there could have been lime applied to the area in the past or possibly a high base status of the parent materials prevalent in the area. It should be noted though that despite this base status in the environment, acidity levels are high for samples 2 and 3 and measures need to be put in place to correct the very low soil pH.

The general ratio of cations in soils follows the following general ratio for calcium, magnesium, potassium and sodium:

Ca:	Mg:	K:	Na
65:	25:	8:	2

The cation ratios for the 4 sites sampled is as follows:

Table 5-4: Cation Ratio for Sampled Sites

Site	Ca	Mg	K	Na
Arbor 1	89	10	<1	<1
Arbor 2	88	11	<1	<1
Arbor 3	91	8	<1	<1
Arbor 4	75	23	1	<1

Table 5-4 shows that sodium levels in the soils analysed fall below the threshold levels in relation to the other cations. Magnesium levels for samples 1, 2 and 3 fall way below the required levels in the soil with sample 4 returning Mg levels close to the recognized threshold levels. Calcium levels for all the samples are generally high hinting at possible lime application over the past periods over the life span of the siding.

(Please Refer to Appendix C for Sodium Concentration Map)

6. RECOMMENDATIONS

When soil pH is maintained at the proper level, plant nutrient availability is optimized, solubility of toxic elements is minimized, and beneficial soil organisms are most active.

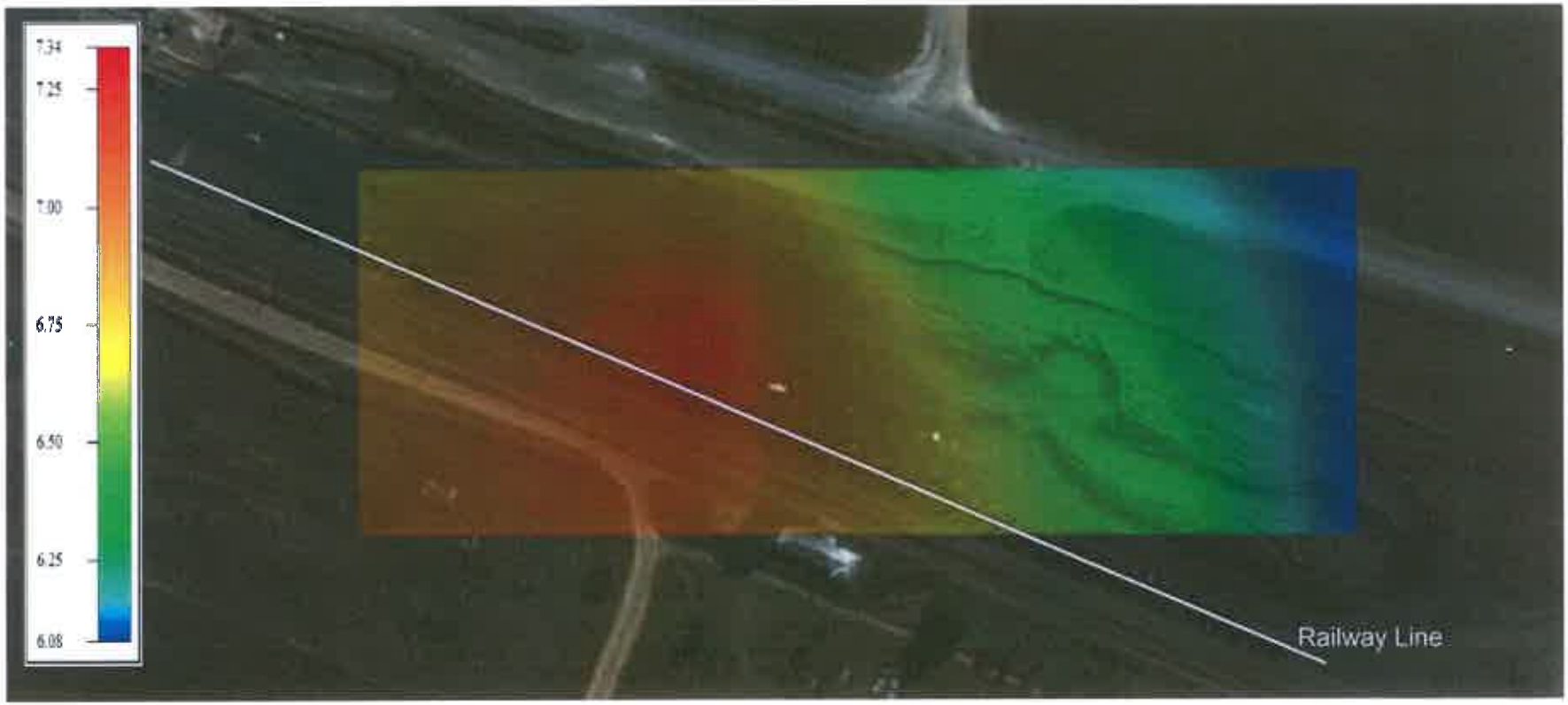
The pH, EC and Na levels show acceptable levels and therefore no mitigation measures are required.

It is recommended that annual soil sample be conducted in order to monitor the improvements and/or deterioration of soil chemistry.

7. CONCLUSION

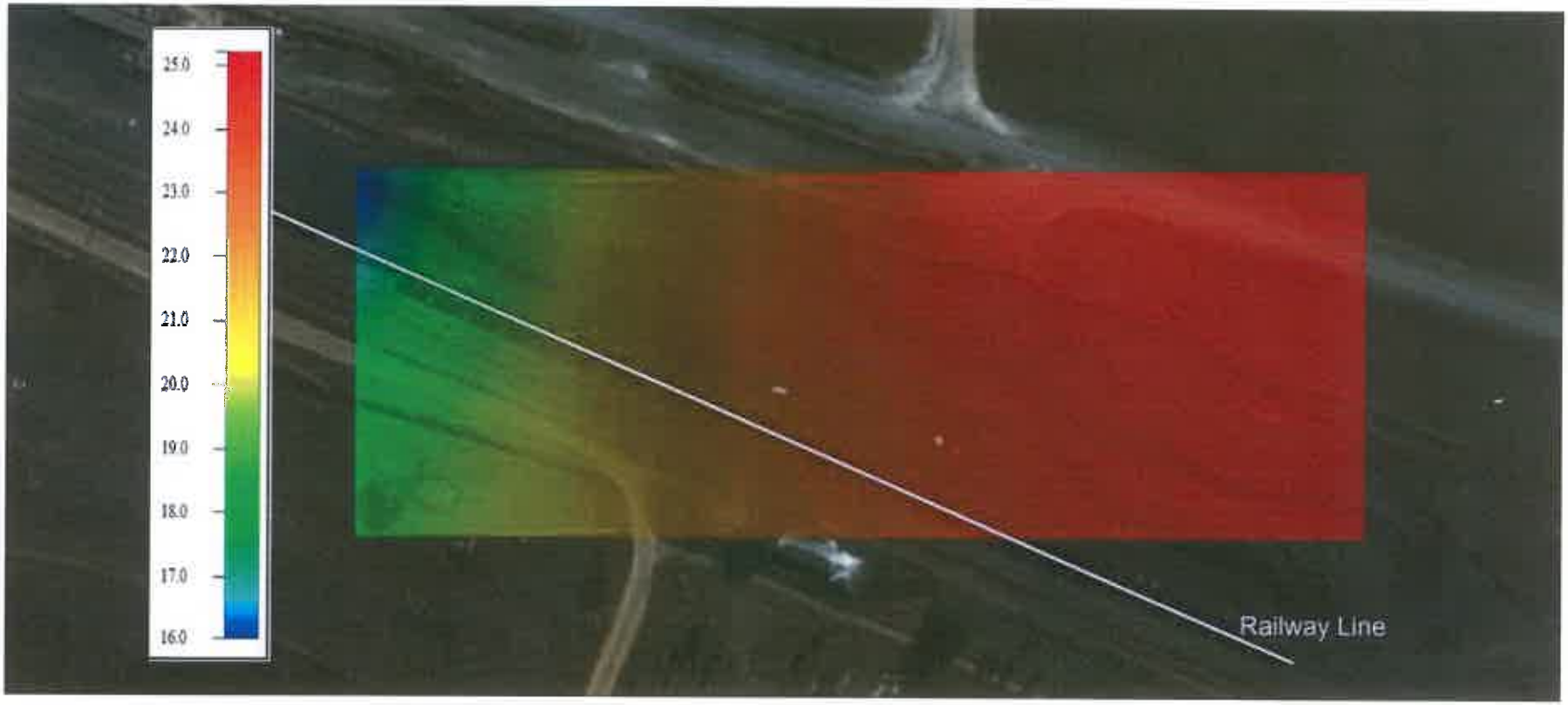
The soil sample results returned acceptable acidity levels that are only mildly acid or neutral and therefore do not need liming for pH regulation. The electrical conductivity of all the samples returned results that generally are acceptable with reasonable salt levels for all samples. The sodium levels recorded for all the samples fall below the threshold levels and are acceptable.

APPENDIX A : SOIL PH MAP)



APPENDIX B : ELECTRICAL CONDUCTIVITY MAP

APPENDIX C : SODIUM CONCENTRATION MAP



APPENDIX D : LABORATORY RESULTS

Annexure 16.2-5: Heritage Impact Assessment

Phase 1 Cultural Heritage Impact Assessment:

THE PROPOSED UPGRADE AND INCREASE IN THE SCOPE OF ACTIVITIES AT THE EXISTING ARBOR RAILWAY SIDING, DELMAS REGION, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

Prepared for:
Myezo Environmental Management Services: Ms D Kotane

- Address: 645 Jacqueline Drive, Garsfontein, 0181, Pretoria; Tel: 012 998 7642; E-mail: dineo@myezo.co.za

Prepared by:
J A van Schalkwyk (D Litt et Phil),

- Heritage Consultant: ASAPA Registration No.: 164 - Principal Investigator: Iron Age, Colonial Period, Industrial Heritage.
- Postal Address: 62 Coetzer Avenue, Monument Park, 0181; Tel: 076 790 6777; E-mail: jvschalkwyk@mweb.co.za

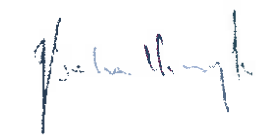
Report No: 2019/JvS/019

- Status: Final
- Date: March 2019
- Revision No: -
- Date: -

Copy Right:

Specialist competency:

Johan A van Schalkwyk, D Litt et Phil, heritage consultant, has been working in the field of heritage management for more than 40 years. Originally based at the National Museum of Cultural History, Pretoria, he has actively done research in the fields of anthropology, archaeology, museology, tourism and impact assessment. This work was done in Limpopo Province, Gauteng, Mpumalanga, North West Province, Eastern Cape Province, Northern Cape Province, Botswana, Zimbabwe, Malawi, Lesotho and Swaziland. Based on this work, he has curated various exhibitions at different museums and has published more than 70 papers, most in scientifically accredited journals. During this period, he has done more than 2000 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.



J A van Schalkwyk
Heritage Consultant
March 2019

SPECIALIST DECLARATION

I, J A van Schalkwyk, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist

J A van Schalkwyk
March 2019

EXECUTIVE SUMMARY

Phase 1 Cultural Heritage Impact Assessment:
THE PROPOSED UPGRADE AND INCREASE IN THE SCOPE OF ACTIVITIES AT THE EXISTING ARBOR RAILWAY SIDING, DELMAS REGION, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

Gijima Supply Chain Management Services (Pty) Ltd propose the expansion of their scope of activities so as to meet the demand and maximise its operational capacity at Arbor Railway Siding, Delmas region, Nkangala District Municipality, Mpumalanga Province.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Myezo Environmental Management Services (Pty) Ltd* to conduct a cultural heritage assessment to determine if the expansion of the scope of activities at the railway siding would have an impact on any sites, features or objects of cultural heritage significance.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The HIA consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region are made up of a pre-colonial element consisting of very limited Stone Age and Iron Age occupation, as well as a much later colonial (farmer) component, which also gave rise to an industrial (mining) component.

Identified sites

During the physical survey, the following sites, features or objects of cultural significance were identified:

- 7.3.1: Old station building. According to its style and the material used in its construction, this building probably dates to the 1940s. It is similar in style, layout and material as other stations on the same line, e.g. Dryden and Argent. The structure is fenced off and well protected by an alarm system.

Impact assessment

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Station building					
7.3.1	Built structures	Section 34	High significance Grade 4-A	60 //	(1) Avoidance/Preserve; (2) Archaeological investigation

Legal requirements

The legal requirements related to heritage specifically are specified in Section 3 of this report. For this proposed project, the assessment has determined that no sites, features or objects of heritage significance occur in the study area. If heritage features are identified during construction, as stated in

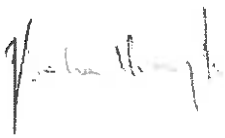
the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view, it is recommended that the proposed development be allowed to continue on acceptance of the conditions proposed below.

Conditions for inclusion in the environmental authorisation:

- The Palaeontological Sensitivity Map (SAHRIS) indicate that the study area has a moderate sensitivity of fossil remains to be found and therefore a palaeontological desktop study of the area is required.
- Should archaeological sites or graves be exposed in other areas during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.



J A van Schalkwyk
Heritage Consultant
February 2019

TECHNICAL SUMMARY

Project description	
Description	Expansion of scope of activities at Arbor Railway Siding
Project name	Arbor Railway Siding Expansion

Applicant
Gijima Supply Chain Management Services (Pty) Ltd

Environmental assessors
Myezo Environmental Management Services
Ms D Kotane

Property details						
Province	Mpumalanga					
Magisterial district	Delmas					
District municipality	Nkangala					
Topo-cadastral map	2628BB					
Farm name	Van Dyksput 214 IR					
Closest town	Delmas					
Coordinates	Centre point (approximate)					
	No	Latitude	Longitude	No	Latitude	Longitude
	1	S 26,04055	E 28,88314	2		

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	No
Construction of bridge or similar structure exceeding 50m in length	No
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	No
Development involving three or more erven or divisions that have been consolidated within past five years	No
Rezoning of site exceeding 10 000 sq m	No
Any other development category, public open space, squares, parks, recreation grounds	No

Land use	
Previous land use	Railway station
Current land use	Railway station

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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Bioturbation: The burrowing by small mammals, insects and termites that disturb archaeological deposits.

Cumulative impacts: "Cumulative impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Debitage: Stone chips discarded during the manufacture of stone tools.

Factory site: A specialised archaeological site where a specific set of technological activities has taken place – usually used to describe a place where stone tools were made.

Historic Period: Since the arrival of the white settlers - c. AD 1830 - in this part of the country.

Holocene: The most recent time period, which commenced c. 10 000 years ago.

Iron Age (also referred to as **Early Farming Communities):** Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Later Iron Age	AD 1300 - AD 1830

Midden: The accumulated debris resulting from human occupation of a site.

Mitigation, means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

National Estate: The collective heritage assets of the Nation.

Pleistocene: Geological time period of 3 000 000 to 20 000 years ago.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 500 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Later Stone Age	30 000 - until c. AD 200

Tradition: As used in archaeology, it is a seriated sequence of artefact assemblages, particularly ceramics.

ACRONYMS and ABBREVIATIONS

ASAPA	Association of Southern African Professional Archaeologists
BCE	Before the Common Era (the year 0)

BP	Before Present (calculated from 1950 when radio-carbon dating was established)
CE	Common Era (the year 0)
ESA	Early Stone Age
EIA	Early Iron Age
HIA	Heritage Impact Assessment
I & AP's	Interested and Affected Parties
LIA	Late Iron Age
LSA	Later Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Front page Page i Addendum Section 6
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7.3
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4.2.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Addendum Section 5; Figure 16
g) an identification of any areas to be avoided, including buffers;	Section 8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 16 Addendum Section 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
k) any mitigation measures for inclusion in the EMPr;	Section 9 & 10
l) any conditions for inclusion in the environmental authorisation;	Section 10
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 10 Section 8, 9, 10
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	-
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
q) any other information requested by the competent authority.	-
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	-

Phase 1 Cultural Heritage Impact Assessment:
THE PROPOSED UPGRADE AND INCREASE IN THE SCOPE OF ACTIVITIES AT THE EXISTING ARBOR RAILWAY SIDING, DELMAS REGION, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

1. INTRODUCTION

1.1 Background

Gijima Supply Chain Management Services (Pty) Ltd propose the expansion of their scope of activities so as to meet the demand and maximise its operational capacity at Arbor Railway Siding, Delmas region, Nkangala District Municipality, Mpumalanga Province.

Myezo Environmental Management Services (Pty) Ltd was contracted by *Gijima Supply Chain Management Services (Pty) Ltd* as independent environmental consultant to undertake the Basic Assessment process for the proposed expansion of the Arbor Railway Siding.

South Africa's heritage resources, also described as the 'national estate', comprise a wide range of sites, features, objects and beliefs. However, according to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Myezo Environmental Management Services (Pty) Ltd* to conduct a cultural heritage assessment to determine if the expansion of the scope of activities at the railway siding would have an impact on any sites, features or objects of cultural heritage significance.

This report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and is intended for submission to the South African Heritage Resources Agency (SAHRA).

1.2 Terms and references

The aim of a full HIA investigation is to provide an informed heritage-related opinion about the proposed development by an appropriate heritage specialist. The objectives are to identify heritage resources (involving site inspections, existing heritage data and additional heritage specialists if necessary); assess their significances; assess alternatives in order to promote heritage conservation issues; and to assess the acceptability of the proposed development from a heritage perspective.

The result of this investigation is a heritage impact assessment report indicating the presence/ absence of heritage resources and how to manage them in the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, on condition of successful implementation of proposed mitigation measures.

1.2.1 *Scope of work*

The aim of this study is to determine if any sites, features or objects of cultural heritage significance occur within the boundaries of the area where the expansion of the scope of activities at the railway siding is to take place. This included:

- Conducting a desk-top investigation of the area;
- A visit to the proposed development site.

The objectives were to:

- Identify possible archaeological, cultural and historic sites within the proposed development areas;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

1.2.2 *Assumptions and Limitations*

The investigation has been influenced by the following factors:

- It is assumed that the description of the proposed project, provided by the client, is accurate.
- The unpredictability of buried archaeological remains.
- No subsurface investigation (i.e. excavations or sampling) were undertaken, since a permit from SAHRA is required for such activities.
- It is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is sufficient and that it does not have to be repeated as part of the heritage impact assessment.

2. LEGISLATIVE FRAMEWORK

2.1 Background

Heritage Impact Assessments are governed by national legislation and standards and International Best Practise. These include:

- South African Legislation
  - National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA);
  - Mineral and Petroleum Resources Development Act, 2002 (Act No. 22 of 2002) (MPRDA);
  - National Environmental Management Act 1998 (Act No. 107 of 1998) (NEMA); and
  - National Water Act, 1998 (Act No. 36 of 1998) (NWA).
- Standards and Regulations
  - South African Heritage Resources Agency (SAHRA) Minimum Standards;
  - Association of Southern African Professional Archaeologists (ASAPA) Constitution and Code of Ethics;
  - Anthropological Association of Southern Africa Constitution and Code of Ethics.
- International Best Practise and Guidelines
  - ICOMOS Standards (Guidance on Heritage Impact Assessments for Cultural World Heritage Properties); and
  - The UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972).

2.2 Heritage Impact Assessment Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, Section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority.

The National Heritage Resources Act (Act No. 25 of 1999, Section 38) provides guidelines for Cultural Resources Management and prospective developments:

"38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as:

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
(b) the construction of a bridge or similar structure exceeding 50m in length;
(c) any development or other activity which will change the character of a site:
(i) exceeding 5 000 m2 in extent; or
(ii) involving three or more existing erven or subdivisions thereof; or
(iii) involving three or more erven or divisions thereof which have been consolidated within he past five years; or
(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
(d) the re-zoning of a site exceeding 10 000 m2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."

And:

"38 (3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(a) The identification and mapping of all heritage resources in the area affected;
(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
(c) an assessment of the impact of the development on such heritage resources;
(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development."

3. HERITAGE RESOURCES

3.1 The National Estate

The National Heritage Resources Act (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-

  - ancestral graves;
  - royal graves and graves of traditional leaders;
  - graves of victims of conflict;
  - graves of individuals designated by the Minister by notice in the Gazette;
  - historical graves and cemeteries; and
  - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
  - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
  - objects to which oral traditions are attached or which are associated with living heritage;
  - ethnographic art and objects;
  - military objects;
  - objects of decorative or fine art;
  - objects of scientific or technological interest; and
  - books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that "cultural significance" means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature's uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

A matrix (see **Section 2 of Addendum**) was developed whereby the above criteria were applied for the determination of the significance of each identified site. This allowed some form of control over the application of similar values for similar identified sites.

4. STUDY APPROACH AND METHODOLOGY

4.1 Extent of the Study

This survey and impact assessment covers all facets of cultural heritage located in the study area as presented in Section 5 below and illustrated in Figures 3 & 4.

4.2 Methodology

4.2.1.1 Survey of the literature
A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted – see list of references in Section 11.

- Information on events, sites and features in the larger region were obtained from these sources.

4.2.1.2 Survey of heritage impact assessments (HIAs)
A survey of HIAs done for projects in the region by various heritage consultants was conducted with the aim of determining the heritage potential of the area – see list of references in Section 11.

- Information on sites and features in the larger region were obtained from these sources.

4.2.1.3 Data bases
The *Heritage Atlas Database,* various SAHRA databases, the *Environmental Potential Atlas*, the *Chief Surveyor General* and the *National Archives of South Africa* were consulted.

- Database surveys produced a number of sites located in the larger region of the proposed development.

4.2.1.4 Other sources
Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

- Information of a very general nature were obtained from these sources

The results of the above investigation are presented in Figure 1 below – see list of references in Section 11 – and can be summarised as follows:

- Historic structures, inclusive of buildings and monuments occur sporadically throughout the region;
- Structures and features relating to the development of infrastructure occur sporadically throughout the region.
- Informal cemeteries occur sporadically throughout the region.

Based on the above assessment, the probability of cultural heritage sites, features and objects occurring in the study area is deemed to be **probable**.

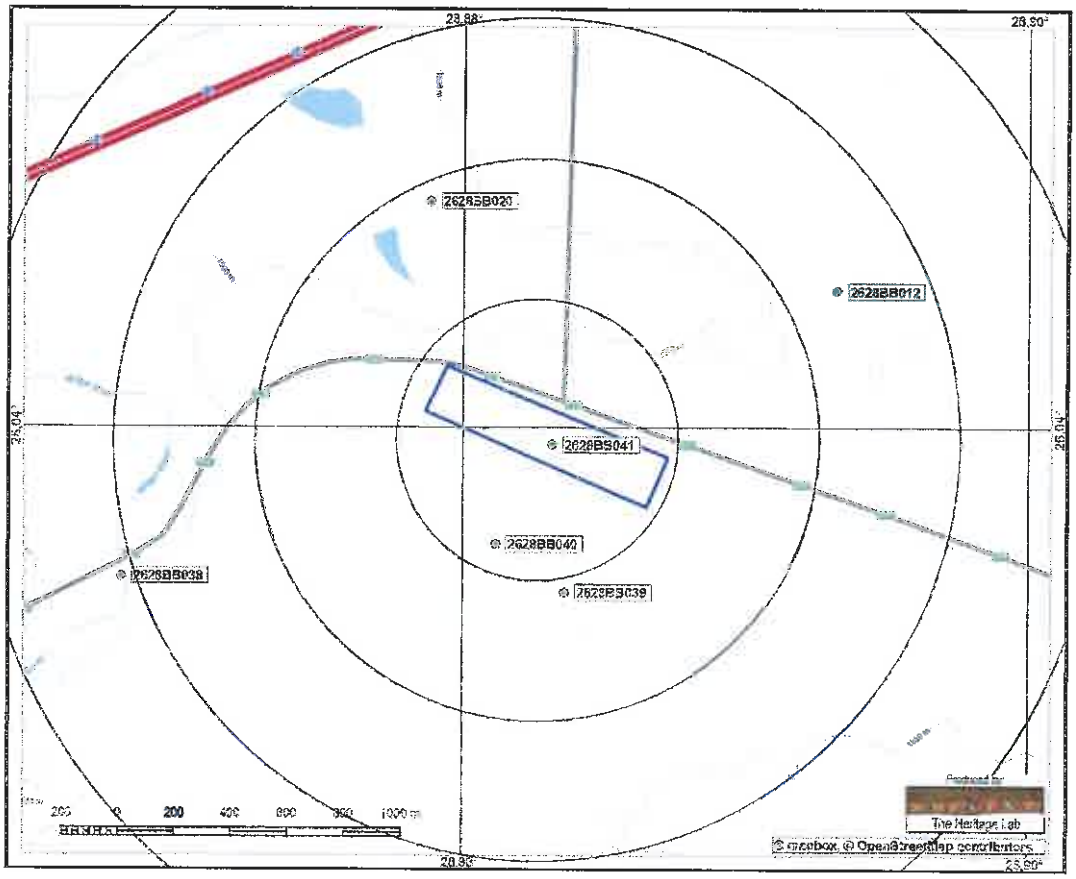

Figure 1. Location of known heritage sites and features in relation to the study area
(Circles spaced at a distance of 0,5km: heritage sites = coded green dots)

4.2.2 *Field survey*

The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible sites, objects and structures. The area that had to be investigated was identified by the *Myezo Environmental Management Services (Pty) Ltd* by means of maps and *.kml* files indicating the development area. This was loaded onto an ASUS digital device and used in Google Earth during the field survey to access the areas.

The site was visited on 28 February 2019 and was investigated by walking transects where the development is to take place – see Fig. 2 below. During the site visit, archaeological visibility was limited in some areas due to the grass cover, as well as the occurrence of building rubble.

During the site visit, Mr Benny Xesha, the site manager, pointed out the site boundaries as well as explaining the proposed development. Local people were interviewed as to the existence of graves in the study area, but they confirmed only one large burial site located well to the south.

4.2.4 *Documentation*

All sites, objects and structures that are identified are documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual localities are determined by means of the *Global Positioning System* (GPS) and plotted on a map. This information is

added to the description in order to facilitate the identification of each locality. Map datum used: Hartebeeshoek 94 (WGS84).

The track log and identified sites were recorded by means of a Garmin Oregon 550 handheld GPS device. Photographic recording was done by means of a Canon EOS 550D digital camera.

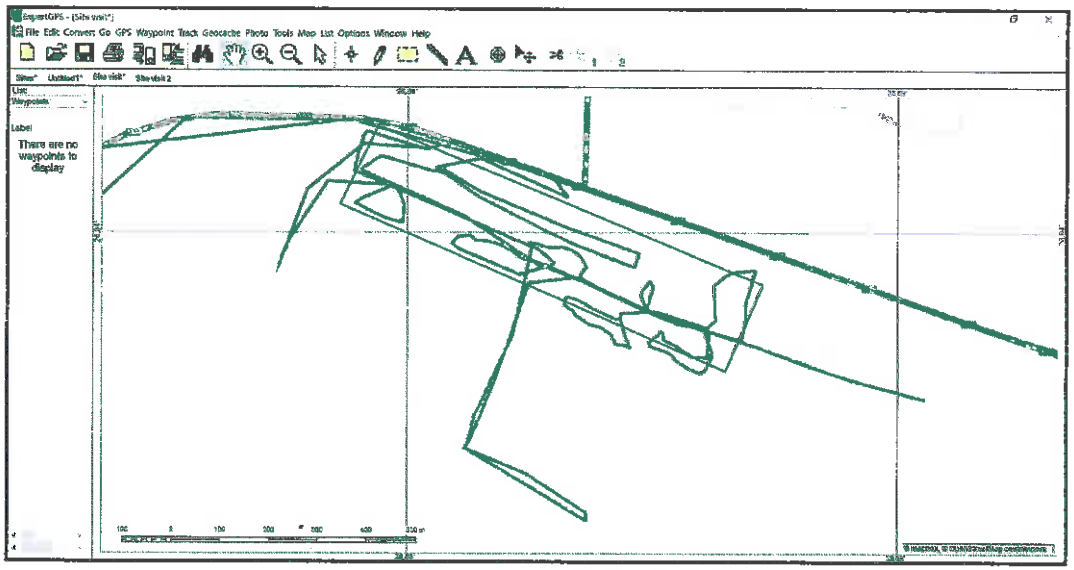

Figure 2. Map indicating the track log of the field survey.
(Site = blue polygon; track log = dark green line)

5. PROJECT DESCRIPTION

5.1 Site location

Arbor Railway Siding is located on Portion 1 of Farm Van Dyksput 214-IR within the Nkangala District Muncipality, Mpumalanga Province. It is located approximately 23km northeast of Delmas and 16km west of Ogies (Fig. 3). For more information, see the Technical Summary on p. V above.

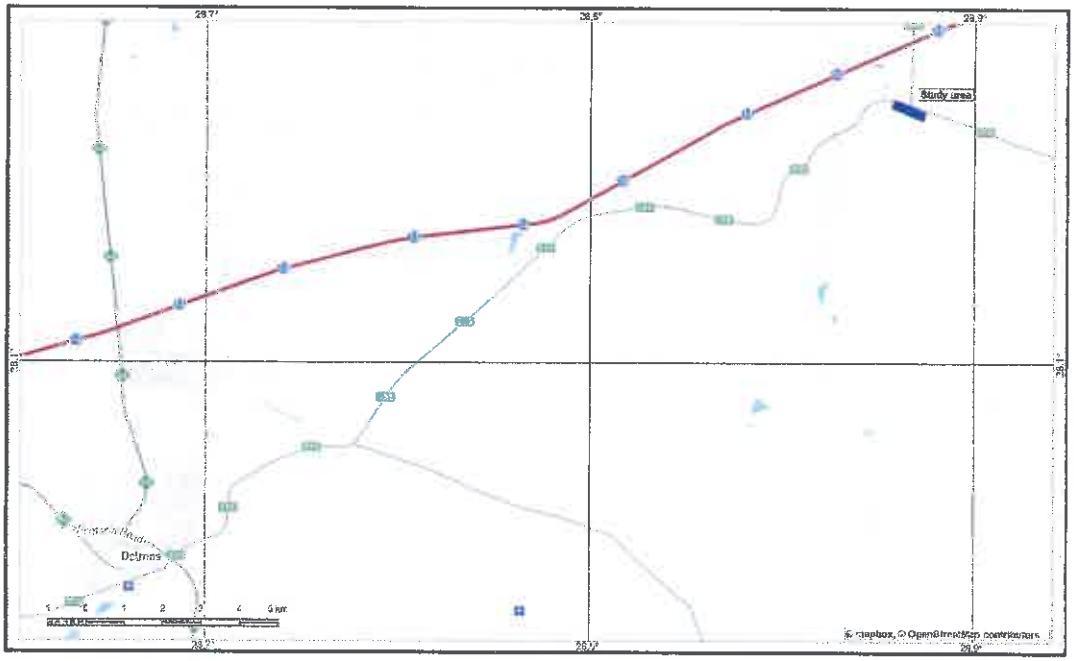

Figure 3. Location of the study area in regional context.
(Study area = blue polygon)

5.2 Development proposal

Arbor railway siding is operated by Gijima Supply Chain Management Services (Pty) Ltd (Gijima) which currently has a signed lease agreement from Transnet for the operation of the siding which is used for loading coal onto rail wagons for domestic as well as export supply. The market for this service has been identified as Eskom, as well as neighbouring mines.

Arbor Railway Siding has been servicing Eskom with 3 978 201 tons of coal over the 3 year period (June 2013 - September 2016). Following the expiry of their contract, Eskom renewed the contract and increased the tonnage to 9, 5 000 000 tons over a 4 year period spreading from the 1st October 2016 to 30th September 2020 and this translates to 198 000 tons per month. The Northern side (the functional side at Arbor Railway siding) operation has reached its maximum operational capacity in terms of stockpiling, receiving trucks and loading the trains.

Thus, Gijima propose that the Railway Siding be expanded so as to meet the demand and maximise its operational capacity. The expansion forms part of a broader vision to reduce the number of trucks on the road network established by Transnet and Eskom, the Transnet Freight Rail Strategy (Myezo Background Information Document).

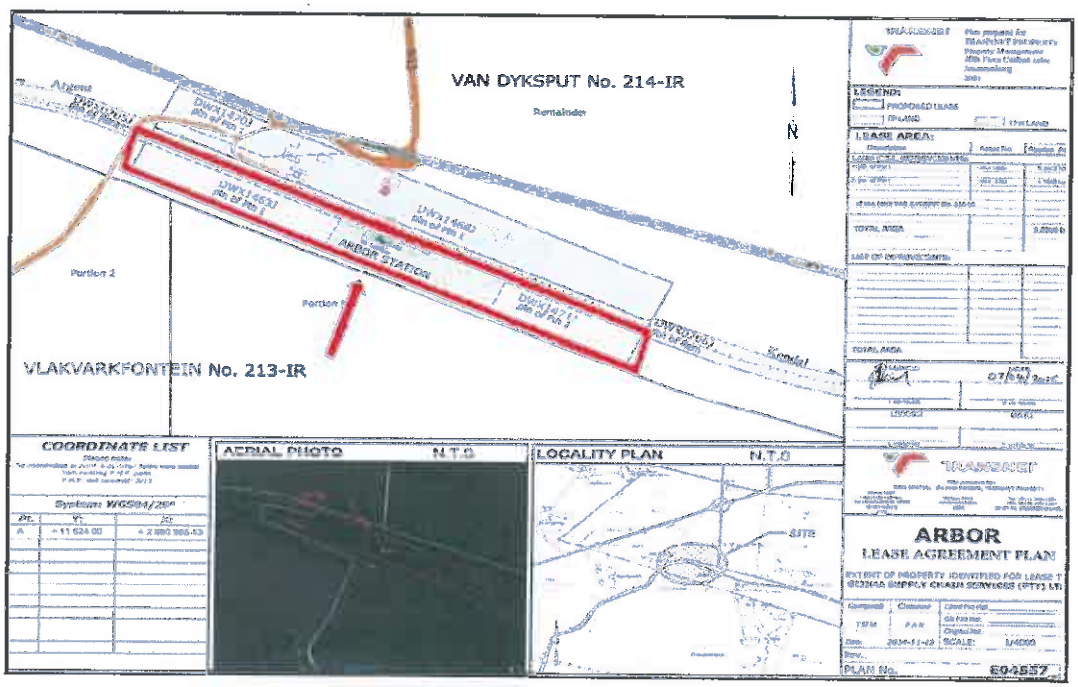

Figure 4. Layout of the proposed development
(Map supplied by Myezo)

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 Natural Environment

The study area lies in a transformed environment with a well-established industrial (infrastructure) setting (Fig. 5). The geology of the study area is made up of mudrock, sandstone, conglomerate, volcanic rocks belonging to the Transvaal Supergroup. This changes just to the south to fine- to coarse-grained sandstone, shale, coal seams belonging to the Karoo Supergroup. The original vegetation is classified as Soweto Highveld Grassland, falling in the Mesic Highveld Grassland Bioregion. However, most of this has been transformed due to urbanisation and mining activities. The topography of the region is classified as moderately undulating plains and pans. The Wilge River passes approximately 1km to the west of the study area, flowing from south to north.

Southern side looking east

Southern side looking west

Figure 5. Views over the study area

The Palaeontological Sensitivity Map (SAHRIS) indicate that the study area (indicated by the white arrow in Fig. 6) has a moderate sensitivity (green) of fossil remains to be found and therefore a palaeontological desktop study of the area is required:

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

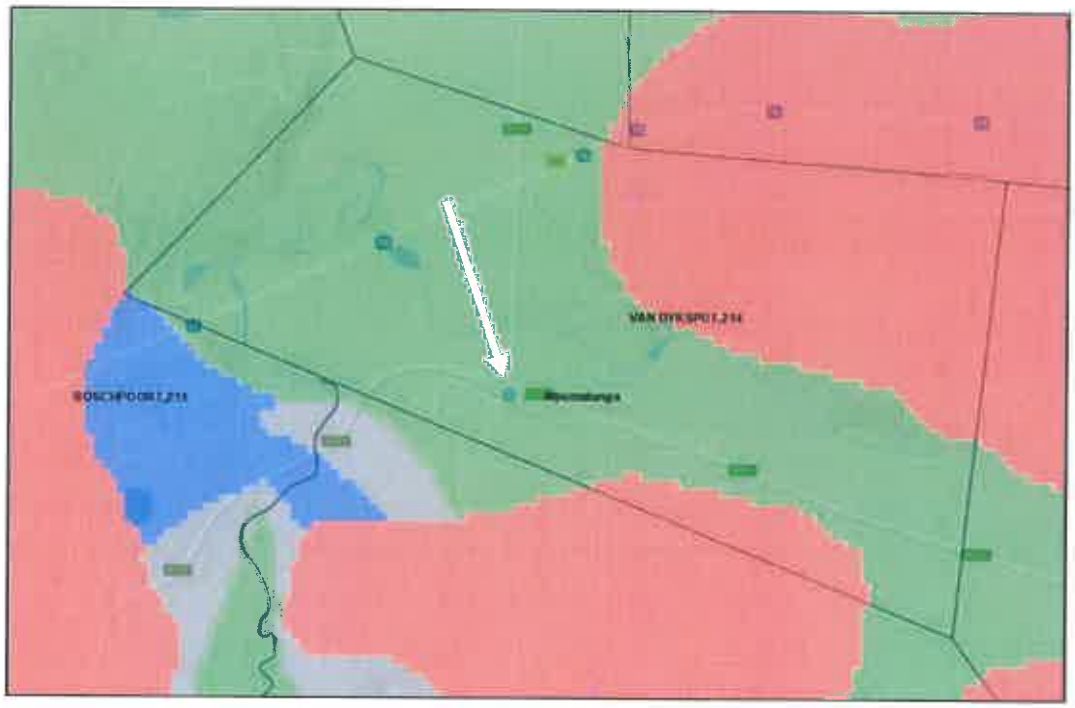

Figure 6. The Palaeontological sensitivity of the study area (arrowed)

6.2 Cultural Landscape

The aim of this section is to present an overview of the history of the larger region in order to eventually determine the significance of heritage sites identified in the study area, within the context of their historic, aesthetic, scientific and social value, rarity and representivity.

The cultural landscape qualities of the region are made up of a pre-colonial element consisting of very limited Stone Age and Iron Age occupation, as well as a much later colonial (farmer) component, which also gave rise to an industrial (mining) component.

6.2.1 *Stone Age*

Very little habitation of the highveld area took place during Stone Age times. Tools dating to the Early Stone Age period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River, or in sheltered areas such as the Magaliesberg. During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology. Open sites were still preferred near watercourses.

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These vary from sealed (i.e. cave) sites, located to the south of the study area (Wadley & Turner 1987), to open sites near the Vaal River. Also, for the first time we get evidence of people's activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA. The LSA people

have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual believes.

6.2.2 *Iron Age*

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom south of Hartebeespoort Dam dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water.

The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating condition that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the treeless plains of the Free State and the Mpumalanga highveld.

This wet period came to a sudden end sometime between 1800 and 1820 by a major drought lasting 3 to 5 years. The drought must have caused an agricultural collapse on a large, subcontinent scale.

This was also a period of great military tension. Military pressure from Zululand spilled onto the highveld by at least 1821. Various marauding groups of displaced Sotho-Tswana moved across the plateau in the 1820s. Mzilikazi raided the plateau extensively between 1825 and 1837. The Boers trekked into this area in the 1830s. And throughout this time settled communities of Tswana people also attacked each other.

As a result of this troubled period, Sotho-Tswana people concentrated into large towns for defensive purposes. Because of the lack of trees, they built their settlements in stone. These stone-walled villages were almost always located near cultivatable soil and a source of water. Such sites are known to occur near Kriel (e.g. Pelser et al 2006) and to the south (Taylor 1979).

6.2.3 *Historic period*

White settlers moved into the area during the first half of the 19th century. They were largely self-sufficient, basing their survival on cattle/sheep farming and hunting. Pretoria was started in 1850, but Johannesburg only dates to the 1880s, after the discovery of gold.

When coal had to be transported from the coal fields of the Witbank to the Witwatersrand area, a need for a direct railway link with the industries in the Rand area arose. In 1906, a railway line was opened between Apex and Witbank, crossing Witklip to where coal was located on the farm Brakfontein of Mr NC Erasmus. In 1907 the surveyor Ewan Curry, instructed by Frank Campbell Dumat, surveyed the layout for the town on the farm Witklip. The name Delmas refers to a small farm (in southern French dialect: *mas*) of Dumat's grandfather in France.

The Delmas district was proclaimed in 1954 and used to be mainly agricultural. As early as 1909 the Delmas Estate and Colliery Co began mining coal in the district. In addition to good roads, the Johannesburg-Witbank railway line and freeway traverses the district and the Springs-Ermelo line runs along the southern boundary. Cultivated holdings were established at Eloff and Sundra. Apart from coal, silica is also mined in the district.

6.3 Site specific review

Although landscapes with cultural significance are not explicitly described in the NHRA, they are protected under the broad definition of the National Estate (Section 3): Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate.

The examination of historical maps and aerial photographs help us to reconstruct how the cultural landscape has changed over time as it shows how humans have used the land.

The railway line from Apex Junction eastwards towards Witbank via Dryden was completed in 1906 (Praagh 1906). All the known, currently existing stations along this route, is clearly indicated on the 1925 version of the South African Railway Map as is included in the Blue Book for that year (Fig. 7). However, it is not clear which of the stations were completed and when – for example, in June 1910 a portion of portion 1 of the farm Weltevreden 227IR was acquired by the South African Railways for a station (Dryden) on this line. However, it would be a mistake to assume that the type of station buildings and houses, for example, previously (Arbor) and currently still at Delmas were completed at the same time. Clearly the materials used, e.g. yellow face bricks, as well as the layout and fittings (doors, window frames, etc.), indicate a construction date from probably only the late 1930s, but more probably the 1940s.

Figure 7. Section of the 1925 map of South African Railways, indicating Arbor station (South African Railways 1925)

According to Wasserfall (1989:225-226) the first houses for railway workers were wood-and-iron houses. These were portable and could be located where the need was the biggest. In the former Transvaal region, much use was made of the old NZASM (Nederlandsche Zuid-Afrikaansche Spoorweg Maatschappij) houses, but of course was limited to these old lines.

Construction of accommodation for (white) railway workers was very slow to take off, largely as a result of the depression 1906-1907. A total of only 136 new tenements was erected in 1910 – 71 on the Pretoria Division and 65 on the Johannesburg Division. A further 96 tenements were erected in the Orange Free State. All of these were wood-and-iron tenements, sometime accommodating up to five families (Wasserfall 1989:234).

It was only towards the end of 1918 that a bungalow type brick dwelling was adopted. Thereafter, the size of the structures increased as well as number of structures that were built. By 1951, the number of houses owned by the Railways totalled 16 190 country-wide.

From the aerial photographs in Fig. 8 and Fig. 9, respectively dating to 1945 and 1953, it can clearly be seen that the station was already well developed, consisting of a number of houses as well as branch lines.

On both the aerial images and the 1965 version of the 1:50 000 topographic map (Fig. 10), what is referred to as a service railway line can be seen to branch of in a north-eastern direction. A more formal line, making a S-curve towards the south, goes to the old Arbor Coal Mine. However, it is not indicated on the 1965 version of the 1:50 000 topographic map, as probably by that time it has already been demolished.

On the 1965 version of the topographic, what is commonly referred to as farm labourer houses, are indicated to the southwest of the station, outside of the study area.

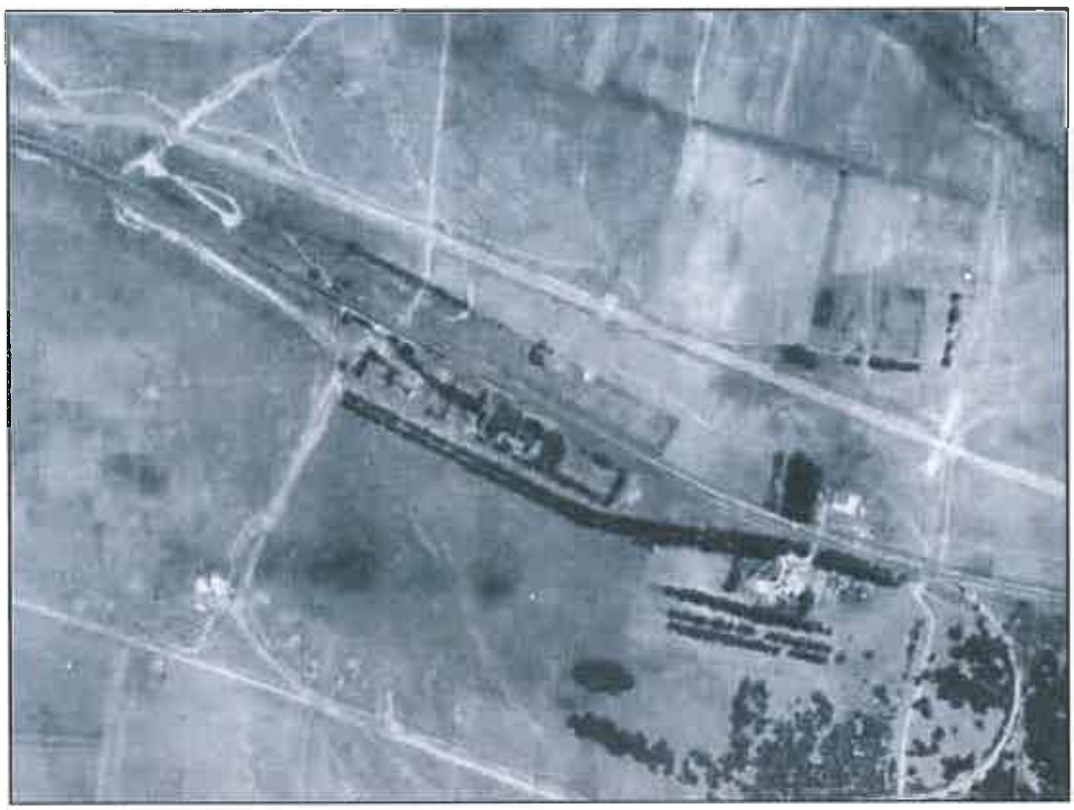

Figure 8. Aerial view of the study area dating to 1945
(Photo: 55_44_0599)

Figure 9. Aerial view of the study area dating to 1953
(Photo: 303_002_00483

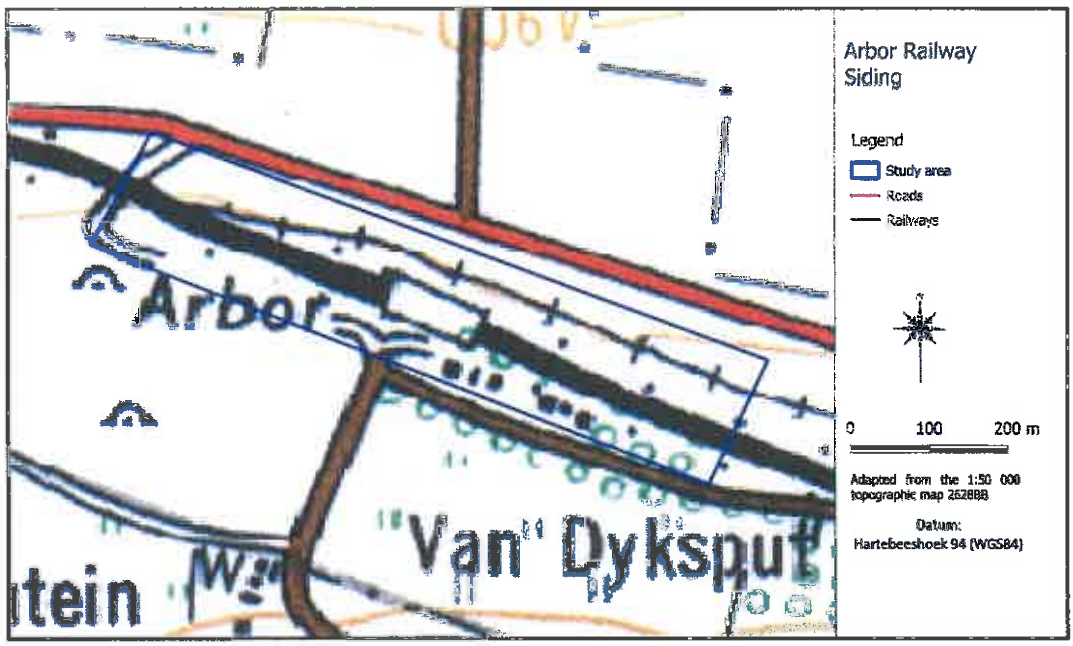

Figure 10. Study area on the 1965 version of the 1:50 000 topographic map

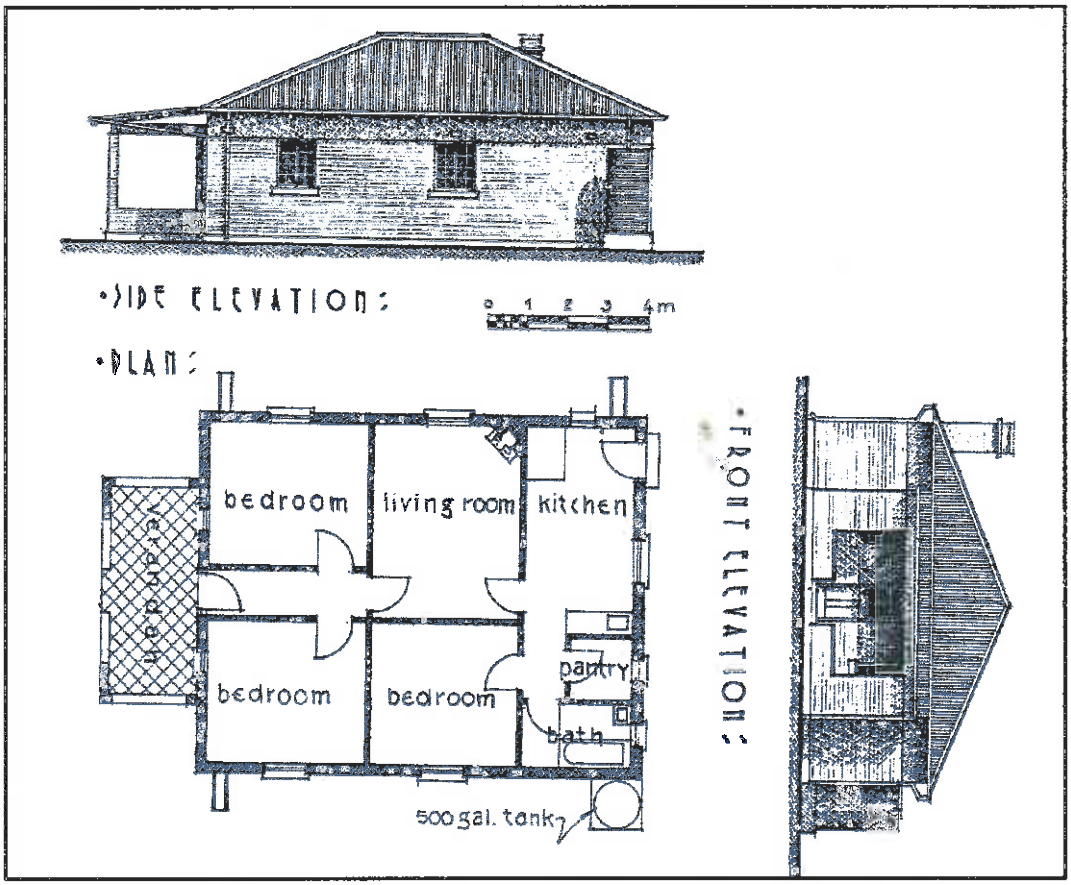

Figure 11. Type P95A housing for foremen, guards, gangers, pumpers, firemen and shunters (1930s) (From Wasserfall 1989)

Fig. 11 and Fig. 12 serve as examples of the houses that might have been built at Arbor Station and what could have existed at other stations on the same line, e.g. Argent and Dryden. Fig. 12 is one example of a variety of houses that are still standing at Delmas station. Unfortunately, in Delmas the houses have fallen on bad times and it is not easy to get access to them in order to conduct proper background research.

Figure 12. Typical station house at Delmas

From the Google aerial image in Fig. 13 it can be seen that at least one house was still standing at Arbor Station in 2004, whereas the rest seems to have been in ruins. By 2018 (Fig. 14) this last house was also demolished, and the site was cleared by all the building rubble having pushed towards the southern boundary of the station site (Fig. 15).

Figure 13. Last of the station houses (2004)
(Image: Google Earth

Figure 14. Indicating that the station houses has been demolished (2018)
(Image: Google Earth)

Figure 15. Where the houses once stood, with the building rubble pushed to one side (arrowed)

7. SURVEY RESULTS

During the physical survey, the following sites, features and objects of cultural significance were identified in the study area (Fig. 16) – see **Section 5** of **Addendum** for a specific description of the sites:

7.1 Stone Age

- No sites, features or objects of cultural significance dating to the Stone Age were identified in the study area

7.2 Iron Age

- No sites, features or objects of cultural significance dating to the Iron Age were identified in the study area.

7.3 Historic period

- 7.3.1: Old station building. According to its style and the material used in its construction, this building probably dates to the 1940s. It is similar in style, layout and material as other stations on the same line, e.g. Dryden and Argent. The structure is fenced off and well protected by an alarm system.

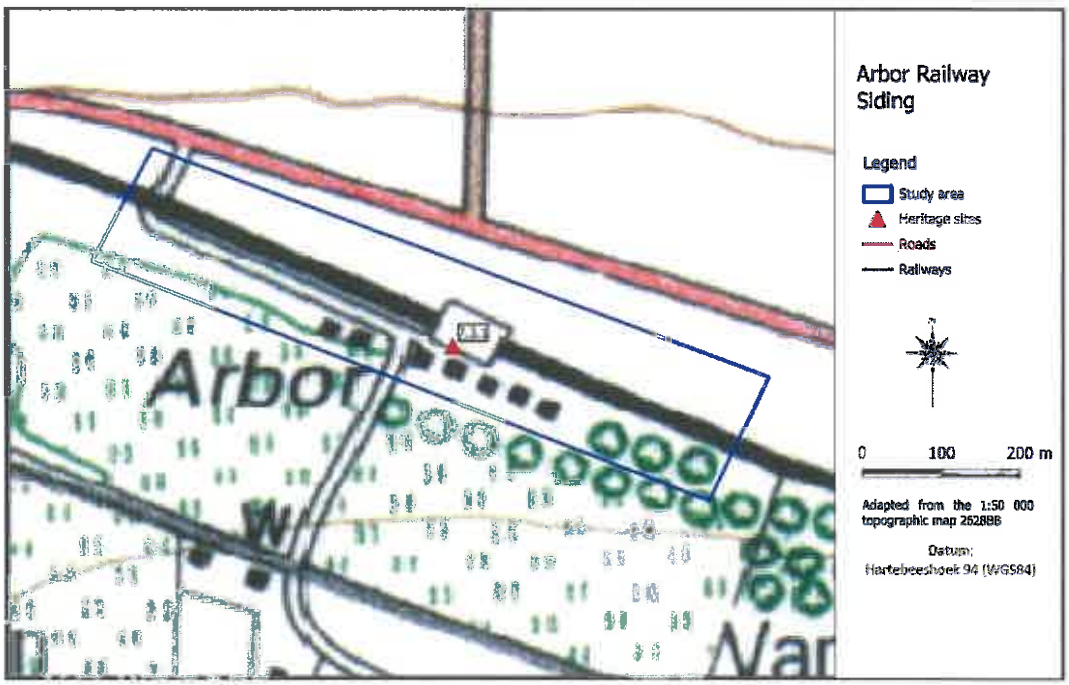

Figure 16. Location of heritage sites in the study area

8. RESULTS: STATEMENT OF SIGNIFICANCE AND IMPACT RATINGS

8.1 Impact assessment

Heritage impacts are categorised as:

- Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries;
- Indirect impacts, e.g. restriction of access or visual intrusion concerning the broader environment;
- Cumulative impacts that are combinations of the above.

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development and is summarised in Table 1 below:

Table 1: Impact assessment

IDENTIFIED HERITAGE RESOURCE: Railway Station Building					
Nature: Expansion of activities might have a permanent and irreversible impact on this structure.					
			Without mitigation	With mitigation	
Extent			Region	Site	
Duration			Permanent	Permanent	
Intensity			Low	Low	
Probability			Definite	Probable	
Significance			Medium (60)	Low (27)	
Status (positive or negative)			Negative	Neutral	
Reversibility			Non-reversible	Non-reversible	
Irreplaceable loss of resources?			Yes	No	
Can impacts be mitigated			Yes		
Mitigation: Full documentation					
Cumulative impact: Loss of information regarding specific technological development in the region.					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Railway station building					
7.3.1	Built structures	Section 34	High significance Grade 4-A	60 27	(1) Avoidance/Preserve; (2) Archaeological investigation

9. MANAGEMENT AND MITIGATION MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

Sources of risk were considered with regards to development activities defined in Section 2(viii) of the NHRA that may be triggered and are summarised in Table 3A and 3B below. These issues formed the basis of the impact assessment described. The potential risks are discussed according to the various phases of the project below.

9.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during construction activities.

The following shall apply:

- Known sites should be clearly marked in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction activities.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

9.2 Control

In order to achieve this, the following should be in place:

- A person or entity, e.g. the Environmental Control Officer, should be tasked to take responsibility for the heritage sites and should be held accountable for any damage.
- Known sites should be located and isolated, e.g. by fencing them off. All construction workers should be informed that these are no-go areas, unless accompanied by the individual or persons representing the Environmental Control Officer as identified above.
- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

Table 2A: Construction Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	The identified risk is damage or changes to resources that are generally protected in terms of Sections 27, 28, 31, 32, 34, 35, 36 and 37 of the NHRA that may occur in the proposed project area.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**
1. Removal of Vegetation 2. Construction of required infrastructure, e.g. access roads, water pipelines	See discussion in Section 9.1 above	Environmental Control Officer	During construction only
Monitoring	See discussion in Section 9.2 above		

Table 2B: Operation Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	It is unlikely that the negative impacts identified for pre-mitigation will occur if the recommendations are followed.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**
1. Removal of Vegetation 2. Construction of required infrastructure, e.g. access roads, water pipelines	See discussion in Section 9.1 above	Environmental Control Officer	During construction only
Monitoring	See discussion in Section 9.2 above		

9.3 Mitigation measures

Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

For the current study, the following mitigation measures are proposed (see **Section 4** of the **Addendum** for a discussion of all mitigation measures):

- Site 7.3.1: Built structure (railway station)
  (1) Avoidance/Preserve: This is viewed to be the primary form of mitigation and applies where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact; or, alternatively
  (2) Archaeological investigation: This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated. Mitigation is to excavate the site by archaeological techniques, document the site (map and photograph) and analyse the recovered material to acceptable standards.

10. CONCLUSIONS AND RECOMMENDATIONS

Gijima Supply Chain Management Services (Pty) Ltd propose the expansion of their scope of activities so as to meet the demand and maximise its operational capacity at Arbor Railway Siding, Delmas region, Nkangala District Municipality, Mpumalanga Province.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The HIA consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region are made up of a pre-colonial element consisting of very limited Stone Age and Iron Age occupation, as well as a much later colonial (farmer) component, which also gave rise to an industrial (mining) component.

Identified sites

During the physical survey, the following sites, features or objects of cultural significance were identified:

- 7.3.1: Old station building. According to its style and the material used in its construction, this building probably dates to the 1940s. It is similar in style, layout and material as other stations on the same line, e.g. Dryden and Argent. The structure is fenced off and well protected by an alarm system.

Impact assessment

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Station building					
7.3.1	Built structures	Section 34	High significance Grade 4-A	60	(1) Avoidance/Preserve; (2) Archaeological investigation

Legal requirements

The legal requirements related to heritage specifically are specified in Section 3 of this report. For this proposed project, the assessment has determined that no sites, features or objects of heritage significance occur in the study area. If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view, it is recommended that the proposed development be allowed to continue on acceptance of the conditions proposed below.

Conditions for inclusion in the environmental authorisation:

- The Palaeontological Sensitivity Map (SAHRIS) indicate that the study area has a moderate sensitivity of fossil remains to be found and therefore a palaeontological desktop study of the area is required.
- Should archaeological sites or graves be exposed in other areas during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

11. REFERENCES

11.1 Data bases

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National Archives of South Africa
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SAHRIS Database

11.2 Literature

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11.3 Maps and aerial photographs

1: 50 000 Topocadastral maps
Google Earth
Aerial photographs: Chief Surveyor-General

12. ADDENDUM

1. Indemnity and terms of use of this report

The findings, results, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and the author reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. The author of this report will not be held liable for such oversights or for costs incurred as a result of such oversights.

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2. Assessing the significance of heritage resources and potential impacts

A system for site grading was established by the NHRA and further developed by the South African Heritage Resources Agency (SAHRA 2007) and has been approved by ASAPA for use in southern Africa and was utilised during this assessment.

2.1 *Significance of the identified heritage resources*

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. SITE EVALUATION			
1.1 Historic value			
Is it important in the community, or pattern of history			
Does it have strong or special association with the life or work of a person, group or organisation of importance in history			
Does it have significance relating to the history of slavery			
1.2 Aesthetic value			
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group			
1.3 Scientific value			
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage			
Is it important in demonstrating a high degree of creative or technical achievement at a particular period			
1.4 Social value			
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons			
1.5 Rarity			
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage			
1.6 Representivity			
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects			
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class			
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.			
2. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			
3. Field Register Rating			
1.	National/Grade 1: High significance - No alteration whatsoever without permit from SAHRA		
2.	Provincial/Grade 2: High significance - No alteration whatsoever without permit from provincial heritage authority.		
3.	Local/Grade 3A: High significance - Mitigation as part of development process not advised.		

4.	Local/Grade 3B: High significance - Could be mitigated and (part) retained as heritage register site	
5.	Generally protected A: High/medium significance - Should be mitigated before destruction	
6.	Generally protected B: Medium significance - Should be recorded before destruction	
7.	Generally protected C: Low significance - Requires no further recording before destruction	

2.2 *Significance of the anticipated impact on heritage resources*

All impacts identified during the HIA stage of the study will be classified in terms of their significance. Issues would be assessed in terms of the following criteria:

Nature of the impact
A description of what causes the effect, what will be affected and how it will be affected.

Extent
The physical **extent**, wherein it is indicated whether:
- 1 - The impact will be limited to the site;
- 2 - The impact will be limited to the local area;
- 3 - The impact will be limited to the region;
- 4 - The impact will be national; or
- 5 - The impact will be international.

Duration
Here it should be indicated whether the lifespan of the impact will be:
- 1 - Of a very short duration (0–1 years);
- 2 - Of a short duration (2-5 years);
- 3 - Medium-term (5–15 years);
- 4 - Long term (where the impact will persist possibly beyond the operational life of the activity); or
- 5 - Permanent (where the impact will persist indefinitely).

Magnitude (Intensity)
The magnitude of impact, quantified on a scale from 0-10, where a score is assigned:
- 0 - Small and will have no effect;
- 2 - Minor and will not result in an impact;
- 4 - Low and will cause a slight impact;
- 6 - Moderate and will result in processes continuing but in a modified way;
- 8 - High, (processes are altered to the extent that they temporarily cease); or
- 10 - Very high and results in complete destruction of patterns and permanent cessation of processes.

Probability
This describes the likelihood of the impact actually occurring and is estimated on a scale where:
- 1 - Very improbable (probably will not happen);
- 2 - Improbable (some possibility, but low likelihood);
- 3 - Probable (distinct possibility);
- 4 - Highly probable (most likely); or
- 5 - Definite (impact will occur regardless of any prevention measures).

Significance
The significance is determined through a synthesis of the characteristics described above (refer to the formula below) and can be assessed as low, medium or high:

S = (E+D+M) x P; where
S = Significance weighting

E = Extent
D = Duration
M = Magnitude
P = Probability

Significance of impact		
Points	Significant Weighting	Discussion
< 30 points		Where this impact would not have a direct influence on the decision to develop in the area.
31-60 points	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60 points		Where the impact must have an influence on the decision process to develop in the area.

Confidence

This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.

- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.
- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Status

- The status, which is described as either positive, negative or neutral.

Reversibility

- The degree to which the impact can be reversed.

Mitigation

- The degree to which the impact can be mitigated.

Nature:		
	Without mitigation	With mitigation
Construction Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Operation Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Reversibility		
Irreplaceable loss of resources?		
Can impacts be mitigated		

3. Mitigation measures

- *Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.*

Impacts can be managed through one or a combination of the following mitigation measures:

- Avoidance
- Investigation (archaeological)
- Rehabilitation
- Interpretation
- Memorialisation
- Enhancement (positive impacts)

For the current study, the following mitigation measures are proposed, to be implemented only if any of the identified sites or features are to be impacted on by the proposed development activities:

- (1) Avoidance/Preserve: This is viewed to be the primary form of mitigation and applies where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. This measure often includes the change / alteration of development planning and therefore impact zones in order not to impact on resources. The site should be retained *in situ* and a buffer zone should be created around it, either temporary (by means of danger tape) or permanently (wire fence or built wall). Depending on the type of site, the buffer zone can vary from
    - 10 metres for a single grave, or a built structure, to
    - 50 metres where the boundaries are less obvious, e.g. a Late Iron Age site.

- (2) Archaeological investigation/Relocation of graves: This option can be implemented with additional design and construction inputs. This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated. Mitigation is to excavate the site by archaeological techniques, document the site (map and photograph) and analyse the recovered material to acceptable standards. This can only be done by a suitably qualified archaeologist.
    - This option should be implemented when it is impossible to avoid impacting on an identified site or feature.
    - This also applies for graves older than 60 years that are to be relocated. For graves younger than 60 years a permit from SAHRA is not required. However, all other legal requirements must be adhered to.
        - Impacts can be beneficial – e.g. mitigation contribute to knowledge

- (3) Rehabilitation: When features, e.g. buildings or other structures are to be re-used. Rehabilitation is considered in heritage management terms as an intervention typically involving the adding of a new heritage layer to enable a new sustainable use.
    - The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation.
    - Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric.
        - Conservation measures would be to record the buildings/structures as they are (at a particular point in time). The records and recordings would then become the 'artefacts' to be preserved and managed as heritage features or (movable) objects.
        - This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (4) Mitigation is also possible with additional design and construction inputs. Although linked to the previous measure (rehabilitation) a secondary though 'indirect' conservation measure would be to use the existing architectural 'vocabulary' of the structure as guideline for any new designs.
    - The following principle should be considered: **heritage informs design**.
        - This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (5) No further action required: This is applicable only where sites or features have been rated to be of such low significance that it does not warrant further documentation, as it is viewed to be fully documented after inclusion in this report.
    - Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation in order to ensure that no undetected heritage/remains are destroyed.

4. Relocation of graves

If the graves are younger than 60 years, an undertaker can be contracted to deal with the exhumation and reburial. This will include public participation, organising cemeteries, coffins, etc. They need permits and have their own requirements that must be adhered to.

If the graves are older than 60 years old or of undetermined age, an archaeologist must be in attendance to assist with the exhumation and documentation of the graves. This is a requirement by law.

Once it has been decided to relocate particular graves, the following steps should be taken:

- Notices of the intention to relocate the graves need to be put up at the burial site for a period of 60 days. This should contain information where communities and family members can contact the developer/archaeologist/public-relations officer/undertaker. All information pertaining to the identification of the graves needs to be documented for the application of a SAHRA permit. The notices need to be in at least 3 languages, English, and two other languages. This is a requirement by law.
- Notices of the intention needs to be placed in at least two local newspapers and have the same information as the above point. This is a requirement by law.
- Local radio stations can also be used to try contact family members. This is not required by law, but is helpful in trying to contact family members.
- During this time (60 days) a suitable cemetery need to be identified close to the development area or otherwise one specified by the family of the deceased.
- An open day for family members should be arranged after the period of 60 days so that they can gather to discuss the way forward, and to sort out any problems. The developer needs to take the families requirements into account. This is a requirement by law.
- Once the 60 days has passed and all the information from the family members have been received, a permit can be requested from SAHRA. This is a requirement by law.
- Once the permit has been received, the graves may be exhumed and relocated.
- All headstones must be relocated with the graves as well as any items found in the grave.

Information needed for the SAHRA permit application

- The permit application needs to be done by an archaeologist.
- A map of the area where the graves have been located.
- A survey report of the area prepared by an archaeologist.
- All the information on the families that have identified graves.
- If graves have not been identified and there are no headstones to indicate the grave, these are then unknown graves and should be handled as if they are older than 60 years. This information also needs to be given to SAHRA.
- A letter from the landowner giving permission to the developer to exhume and relocate the graves.
- A letter from the new cemetery confirming that the graves will be reburied there.
- Details of the farm name and number, magisterial district and GPS coordinates of the gravesite.

5. Inventory of identified cultural heritage sites

NHRA Category	Structures older than 60 years - Section 34

7.3.1. Type: Built structures. **Farm:** Van Dyksput 214 IR. **Coordinates:** S 26,04055; E 28,88314

Description

Old station building. According to its style and the material used in its construction, this building probably dates to the 1940s. It is similar in style, layout and material as other station on the same line, e.g. Dryden and Argent.

Unfortunately, the building is fenced off and has an alarm that goes off when anybody gets to near it. No access could be obtained.

Front view

Rear view

Significance of site/feature	Generally protected: High significance - Grade 4-A

Reasoned opinion: This site represents the remains of a technology and style of life that became redundant due to the cessation in demand of its original purpose. Such sites representing industrial heritage are usually few and far between and therefore the destruction of a single such site would have a proportionate high impact on the occurrences of similar features in the larger landscape.

Impact assessment

This site is located inside the development area and therefore there is a high possibility that it might be impacted on by the expansion of the scope of activities at the railway siding.

Mitigation

(1) Avoidance/Preserve: Because of its location within the larger project development area, it would be possible to avoid this site as it actually occupies a small footprint;
(2) Archaeological investigation: If the former is not possible, the site should be documented in full before destruction.

Significance of impact: before/after mitigation

Extent	Duration	Intensity	Probability	Significance	Weight
3	5	4	5	60	Medium
1	5	3	3	27	Low

Requirements

Conservation by local authority. Sites should be mitigated before impact. Permit required from provincial heritage authority, as well as other institutions – see Section 4 of the Addendum.

References

6. Curriculum vitae

Johan Abraham van Schalkwyk

Personal particulars

Date of birth:	14 April 1952
Identity number:	520414 5099 08 4
Marital status:	Married; one daughter
Nationality:	South African

Current address: home
62 Coetzer Ave, Monument Park, Pretoria, 0181
Mobile: 076 790 6777; E-mail: jvschalkwyk@mweb.co.za

Qualifications

1995 DLitt et Phil (Anthropology), University of South Africa
1985 MA (Anthropology), University of Pretoria
1981 BA (Hons), Anthropology, University of Pretoria
1979 Post Graduate Diploma in Museology, University of Pretoria
1978 BA (Hons), Archaeology, University of Pretoria
1976 BA, University of Pretoria

Non-academic qualifications

12th HSRC-School in Research Methodology - July 1990
Dept. of Education and Training Management Course - June 1992
Social Assessment Professional Development Course - 1994
Integrated Environmental Management Course, UCT - 1994

Professional experience

Private Practice
2017 - current: Professional Heritage Consultant

National Museum of Cultural History
1992 - 2017: Senior researcher: Head of Department of Research. Manage an average of seven researchers in this department and supervise them in their research projects. Did various projects relating to Anthropology and Archaeology in Limpopo Province, Mpumalanga, North West Province and Gauteng. Headed the Museum's Section for Heritage Impact Assessments.
1978 - 1991: Curator of the Anthropological Department of the Museum. Carried out extensive fieldwork in both anthropology and archaeology

Department of Archaeology, University of Pretoria
1976 - 1977: Assistant researcher responsible for excavations at various sites in Limpopo Province and Mpumalanga.

Awards and grants

1. Hanisch Book Prize for the best final year Archaeology student, University of Pretoria - 1976.
2. Special merit award, National Cultural History Museum - 1986.
3. Special merit award, National Cultural History Museum - 1991.
4. Grant by the Department of Arts, Culture, Science and Technology, to visit the various African countries to study museums, sites and cultural programmes - 1993.
5. Grant by the USA National Parks Service, to visit the United States of America to study museums, sites, tourism development, cultural programmes and impact assessment programmes - 1998.
6. Grant by the USA embassy, Pretoria, under the Bi-national Commission Exchange Support Fund, to visit cultural institutions in the USA and to attend a conference in Charleston - 2000.
7. Grant by the National Research Foundation to develop a model for community-based tourism - 2001.

8. Grant by the National Research Foundation to develop a model for community-based tourism - 2013. In association with RARI, Wits University.

Publications
Published more than 70 papers, mostly in scientifically accredited journals, but also as chapters in books.

Conference Contributions
Regularly presented papers at conferences, locally as well as internationally, on various research topics, ranging in scope from archaeology, anthropological, historical, cultural historical and tourism development.

Heritage Impact Assessments
Since 1992, I have done more than 2000 Phase 1 and Phase 2 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

Annexure 16.2-6: Biodiversity Assessment

2019

BIODIVERSITY ASSESSMENT REPORT

OMPILED BY:-

VUYOKAZI APRIL (*PR.SCI.NAT*)

ZEN ENVIRONMENTAL CONSULTANTS

LACKWATTLE AVENUE

CENTURION

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REPORT INFORMATION

Report Title:	Biodiversity Management Plan for Arbor Railway Siding operated by Gijima Supply Chain (Pty) Ltd		
Report Reference:	BIO-REP-01_2016		
Report Status:	FINAL		
Author(s):	Vuyokazi MaCeduma April (**Pr.Sci.Nat.**)		
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Report Quality Control	Name	Signature	Date
Reviewed By:	Chipo J. Muhomba		22/10/2019
Approved By:			

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DECLARATION OF INDEPENDENCE

I, **Vuyokazi April,** in my capacity as a specialist consultant, hereby declare that I:-

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act 107 of 1998;
- Have and will not have vested interest in the proposed activity nor will I engage myself in any conflicting interest associated with this project
- As a registered member of the South African Council for Natural Scientific Professions, I will undertake my profession in accordance with the Code of Conduct of the Council as well as other associates to which I am a member;
- I undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of the National Environmental Management Act 107 of 1998 and EIA Regulations of 2014 as part of authorisation and compliance with environmental legislation, conservation and management of natural biodiversity;
- Based on the information provided to me by the client and in addition to information obtained during the course of this study, I have presented the results and conclusion with regard to this project to the best of my professional ability;
- I reserve the right to modify aspects pertaining to this study should additional information become available through ongoing research and further work on this field;
- I undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study.

22/10/2019

EXECUTIVE SUMMARY

Introduction

Zen Environmental Consultant, as an independent environmental and specialist consultants has been appointed by Myezo Environmental Management Services (Pty) Ltd on behalf of Gijima Supply Chain (Pty) Ltd to undertake and compile a Biodiversity Management Plan as part of the Environmental Management Plans compliance process for their operation at Arbor Railway Siding on Portion 1 of the Farm Vandykspunt 214 IR in Mpumalanga Province.

Objectives of the study

This assessment was undertaken as a requirement in terms of National Environmental Management Act 107 of 1998 which manages and conserves natural resources; thus monitors and assess their sustainable use and compliance and the Environmental Impact Assessment Regulations of 2014 which indicates the listed activities that pose environmental threats anticipated during proposed development in order to attain sustainable environmental management and economic development prior to authorization.

The aim of the assessment was to determine the present ecological status of the proposed site by assessing the current biodiversity and ecosystem functionality at the earmarked expansion site. This was achieved through assessing the current vegetation types and their conservation status, identification of flora and fauna species on the proposed site and to recommend steps to be taken should a Red or Orange list and protected species be found. Furthermore, to highlight the potential impact the proposed construction would have on the current ecosystem of the study area especially should sensitive flora and fauna occur in the site; and provide management recommendations to mitigate negative impacts and enhance positive impacts of the proposed activity.

The management plan is aimed to indicate biodiversity important species and ecosystems within the operating area. The occurrence and diversity of flora and fauna species associated with the site, the ecological functionality and conditions that influence the area's ecosystems interactions will be detailed. And, the client with the help of this plan will be advised on what measures and mitigation to undertake while enabling a successful operation and biodiversity management within the site. This report presents the findings obtained following desktop research and field work undertaken within the study area.

Approach to conduct the survey

Areas within the proposed site were surveyed and co-ordinates taken in order to establish the present biodiversity status. The ecological importance was determined by the area's vegetation unit status, elements of habitat capability to support flora and fauna species capacity, areas susceptibility to transformation & degradation and occurrence of flora and fauna of conservation importance.

However, it was assumed that wide coverage of the area was constricted due to time and the seasonal factors will affect the wide range of species identification due to their favorable climatic occurrence requirements, as a result spatial analysis using Geographic Information System (GIS) software was used in creation of maps for the site to understand the distribution of the species within the site.

High Level Findings and Recommendations

The following findings were made regarding the biodiversity integrity of the site and its significance:-

- The area adjacent to the operating site (Arbor Siding) is mainly used for residential, agriculture and mining activities that left it in a destitute form and can be considered **Transformed**.

- With regards to flora and fauna, the study site is located in a **Highveld Moist Grassland** within the Highveld part of Mpumalanga province which commonly known for its wetlands and grass plains with variety of flora species.
- The **Grassland biome** is the heavily impacted and disturbed biome in the country and its associated wetlands and rivers continually get affected as a result. However, within the Arbor Siding area availability of **flora is restricted to alien invasive plants**, thus the vegetation is **transformed**.
- **No critical flora species of conservation importance within the site was recorded.** Furthermore, with exception with random encounters with fauna, **no faunal species of importance was observed or recorded within the site as the site is highly disturbed to carry any wild faunal species** unless that species is domesticated.
- The overall biodiversity significance of the site is **disturbed and thus susceptible to alien plant invasion** establishment.
- The site sensitivity classification was considered to be Class 1.

With exception of one transformed wetland and dam constructed to support the activity, **there were no natural or functioning wetlands were observed and recorded within Arbor siding boundary**.

Outside the boundaries of the study site there are thriving ecosystems such as wetlands and rivers located on the north of the site. These ecosystem supports variety of species such as Grass Owl and **Arbor Siding activities only affect these ecosystems due to the uncontrolled stormwater drainage as a result it is recommended that the proponent put in place proper stormwater measures that could prevent it from draining into the nearest freshwater ecosystems**.

ACRONYMS

C-Plan	Conservation Plan
CR	Critically Endangered
DEA	Department of Environmental Affairs
NFEPA	National Freshwater Ecosystem Priority Areas
WMA	Water Management Areas
EIA	Environmental Impact Assessment
EN	Endangered
EW	Extinct in the Wild
EX	Extinct
EA	Environmental Authorization
MPTCP	Mpumalanga Terrestrial Conservation Plan
IUCN	International Union for Conservation of Nature
LC	Least Concern
R	Rare
BGIS	Biodiversity Geographic Information System
NEMBA	National Environmental Management Biodiversity Act
ESA	Ecological Support Areas
CBA	Critical Biodiversity Areas
NEMA	National Environmental Management Act
NT	Near Threatened
NWA	National Water Act
SANBI	South African National Biodiversity Institute
DEA	Department of Environmental Affairs
RDL	Red Data List
BLSA	Bird Life South Africa
POSA	Plants of Southern Africa
ToR	Terms of Reference

NBSAP	National Biodiversity Strategy and Action Plans
IEM	Integrated Environmental Management
VU	Vulnerable
QDS	Quarter Degree Square
NBA	National Biodiversity Assessment
ADU	Animal Demographic Unit

1. INTRODUCTION

Biodiversity forms the most crucial environmental aspect and as such its status is used to evaluate decisions pertaining to activities with significant environmental impacts. The inclusion of biodiversity in decision making has been aimed to bridge a gap between economic development and land destruction, thus mitigating the environmental effects these developments may pose while still maintaining a functioning biodiversity (Driver et al., 2005). Therefore, as part of the Environmental Impact Assessment guidelines it is important to assess the potential impact of the proposed and existing activities as they can impact directly or indirectly on the receiving environment.

This assessment study was undertaken as part of compliance with the National Environmental Management Act, 1998 (Act 107 of 1998), as amended and the Environmental Impact Assessment Regulations of 2014.

The objective of this study was to cover the season flora and fauna species variation habiting and likely to occur within Vandykspunt 214 IR Portion 1 where Gijima Supply Services are operating a coal siding at Arbor Railway Sidings. The flora and fauna species that potentially occur and seen during the survey were recorded. Red data or Orange data species (both fauna and flora) that are known to occur on site were investigated. The current ecological status and conservation priority of vegetation on the site was also assessed.

To comply with the requirements of the Provincial Authorities, Departmental divisions and regional requirements, the Terms of Reference (ToR) for this study are:-

- To assess the current status of the habitat components and its conservation status;
- To identify the floral species on site and to recommend steps to be taken should a Red list / Orange list or protected species be found;
- To identify the fauna species on the site and to recommend steps to be taken should a Red list/ Orange List species be found;
- To highlight the potential impacts the development may have on the ecosystem components of the study area; and
- Provide management recommendation to mitigate negative impacts and enhance positive impacts of the proposed activity

This assessment was undertaken as a requirement in terms of National Environmental Management Act 107 of 1998 which manages and conserves natural resources; thus monitors and assess their sustainable use and compliance and the Environmental Impact Assessment Regulations of 2014 which indicates the listed activities that pose environmental threats anticipated during proposed development in order to attain sustainable environmental management and economic development prior to authorization.

1.1. PROJECT LOCATION

The coal handling and storage operation is currently taking place in Arbor Siding situated on Portion 1 of Vandykspunt 214 IR in Witbank, Nkangala District Municipality, Mpumalanga Province. The siding is located west of N12 and can be accessed through R555 to Ogies.

Figure 1: Aerial Image of Gijima Supply operated Arbor Coal Storage and Handling Siding in Mpumalanga Province (©Google Earth).

1.2. SCOPE OF BIODIVERSITY ASSESSMENT

- Determine the biome and vegetation units occurring within the proposed site;
- To assess the current vegetation and its conservation status;
- To identify the floral species on the proposed site and to recommend steps to be taken should a Red or Orange list and protected species be found;
- To identify the fauna species on the proposed site and recommend steps to be taken should a Red or Orange listed and protected species be found;
- Comment on the ecological or conservation status of the flora and fauna observed at the site;
- Recommend preservation of the indigenous and protected plants species observed and
- To provide management recommendations to mitigate negative impacts and enhance positive impacts of the activity.

2. METHODOLOGY

2.1. LEGISLATIVE CONTEXT

Below are the most important environmental legislations which are inspired by the Bill of Right of the Constitution of the Republic of South Africa, these legislations are accountable for biodiversity conservation and management in the country. They regulate and guide the impact the development activities have on the biodiversity and the need to rectify, mitigate or remedy these for sustainable environment and thriving ecosystem.

- The Constitution of the Republic of South Africa Act (Act No. 108 of 1996) – Section 24;
- National Environmental Management Act (Act No. 107 of 1998) (NEMA), as amended;
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA);
- National Environmental Management Biodiversity Act List of Threaten Terrestrial Ecosystems (GN 34809 Reg 1002 of 2011);
- National Environmental Management Protected Areas Act (Act No. 57 of 2003) (NEMPAA), as amended;
- Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA);
- National Water Act (Act No. 36 of 1998) (NWA);
- National Environmental Management Waste Act (Act No. 59 of 2008 as amended in 2014) (NEMWA);
- Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA);
- Mpumalanga Province Biodiversity Act 6 of 1998 (MPBA);
- Mpumalanga Terrestrial Protected Areas Act 5 of 2005 (MTPAA);
- Biodiversity management plans (BMP);
- National biodiversity strategy and action plans (NBSAP);
- National biodiversity assessment (NBA); and
- Integrated Development Plan (IDP).

2.2. LAND USE IN THE AREA

Apart from the coal siding operating at the study location, the area is characterised by the following land use activities:-

1. Agriculture (Farming and Cultivation);

2. Power Station;

3. Active mines; and

4. Human dwellings or Residential settlement.

2.3. METHODOLOGY

The study consists of three components, viz:-
a) A desktop review and analysis

b) Site Screening and ground truthing

c) A field assessment

2.3.1. Desktop Study

The available provincial biodiversity data sets, Red and Orange listed fauna and flora data, species conservation status data and relevant legislation and policies information were researched and included for constructive environmental impact assessment conclusion. Previously conducted studies for proposed activities of similar nature were reviewed and used as references. The specialist also liaised and communicated with relevant sectors whose mandate is to conserve and be custodians of biodiversity. Maps and any spatial data on biodiversity (where available) were used to determine the species occurrence, distribution and status.

2.3.2. Site screening and ground trothing

The site visit was conducted on 18 November 2015 on Portions 1 of the Farm Vandykspunt 214 IR in Witbank, Mpumalanga Province. The visit was used to verify if the results yielded by the desktop research and other reference material significance. Macro and micro changes in the environment that has not yet documented were investigated during screening. This component entailed a visual assessment of the area, monitoring of species activities and other activities taking place within or adjacent to the project area.

2.3.3. Field Assessment

This component was aimed at assessing terrestrial biodiversity by visual observations and recording of species occurrence. Flora and fauna observed during this component were recorded and the results were compared with the desktop reviews and used to conclude on the ecological sensitivity of the area. This particular assessment was done in conjunction with the site screening and groundthrothing on the 18 November 2015.

The site was visited and assessed to determine the various plant communities, fauna and ecosystems occurring on the site. All observed species were recorded. Faunal species were observed visually and the survey was done mostly on foot. Avi-fauna observed was then verified using the checklist obtained from the desktop studies and further identified using Sasol Birds of Southern Africa (Sinclair et. al., 2002), South African Bird Atlas Phase 2 and Bird Life South Africa for avian species occurring in the area. Animals and small mammals were identified within the study site using siting's, spoor, tracts, signs and droppings as well as burrows and nesting sites on the grounds where possible.

National Freshwater Ecosystem Priority Areas (NFEPA) identified and recognized ecosystems occurrence, their functionalities were assessed and reported.

All the observed biodiversity was identified, recorded and used to compile this report.

2.4. ASSUMPTION AND LIMITATIONS

Vegetation

This study was not intended to provide an inventory of all species present within the study area but instead aimed to provide an overall assessment of the ecological values with particular emphasis on the endemic vegetation status, endangered ecological communities and condition.

Fauna

Faunal assessment was limited to desktop even though the sightings were intended during ground trothing, the incidents were limited and avifauna-survey was omitted due to time period allocated and extent of ecological aspects that were to be covered.

Spatial Mapping

Spatial mapping of the areas of importance was done on a coarse scale.

3. RESULTS AND DISCUSSION

3.1 SITE CHARACTERISTICS

Arbor Siding is highly disturbed and transformed due to the coal handling and storage operation. The operations footprints in the site and adjacent areas to the site are highly identifiable. The following visuals were taken at the site.

Figure 2: Entrance to Arbor Siding.

Figure 3: View from the North side of the site, this is an area the proponent use for coal truck parking.

Figure 4: View from the west side of the site, this is the area towards the residential area.

Figure 5: View from the south side of the site, this area is mostly used for stockpiling by the proponent.

Figure 6: Coal loading operation into a freight carriage underway.

Figure 7: Coal storage stockpiles that are loaded into the train carriages using a front scoop caterpillar.

Figure 8: Gijima Supply Offices, parking area and weigh bridge area.

Figure 9: Coal dust along R555 road.

3.2. FINDINGS OF THE STUDY

With regards to flora and fauna, the study site is located in a Highveld part of Mpumalanga province which commonly known for its wetlands and grass plains with variety of flora species. The Grassland biome is the heavily impacted and disturbed biome in the country and its associated wetlands and rivers continually get affected as a result.

Findings show that the area adjacent to the operating site is mainly used for residential, agriculture and mining activities that left it in a destitute form. However, within the Arbor Siding area availability of flora is restricted to alien invasive plants, thus **the vegetation is transformed in the edges of the site.**

No critical flora species of conservation importance within the site was recorded. Furthermore, with exception with random encounters with fauna, **no faunal species of importance was observed or recorded within the site as the site is highly disturbed** to carry any faunal species. With exception of one transformed wetland (Figure 11) and dam (Figure 10) constructed to support the activity, there were no natural or functioning wetlands observed and recorded within Arbor siding boundary.

Figure 10: Slurry Control dam within Arbor siding (Image ©MYEZO).

Figure 11: Transformed wetland observed within Arbor siding boundary. This wetland is completely destroyed and its delineation was determined using the soil morphology and can only happen to persist during heavy rainfalls episodes.

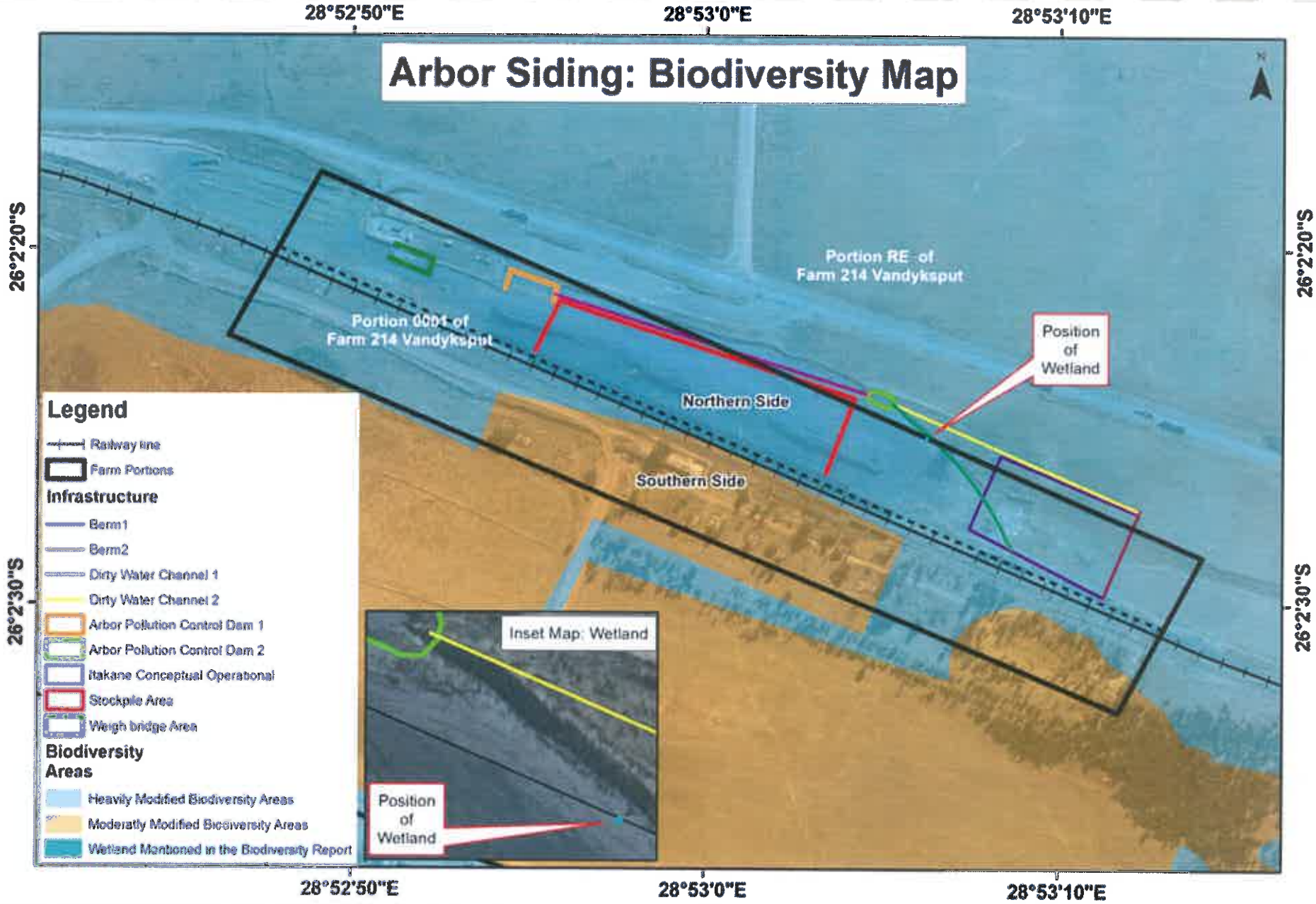

Figure 12: Arbor Siding Biodiversity Sensitivity Map, the darker colour represents heavily modified or transformed areas within the study site.

3.1. FAUNA SPECIES

No faunal species of conservation importance and management was observed or encountered during the survey.

3.2. ECOLOGICAL SENSITIVITY CLASSIFICATION

The environmental sensitivity analysis of the operational area or locality site is based on the land cover (natural, transformed or degraded) and the occurrence of significant ecological features on the site. The sensitivity analysis is not comprehensive; however, it is designed to rapidly identify highly sensitive ecosystems features which may constitute a fatal flaw in the operation. The ecological sensitivity ranking is presented in **Table 1** is a classification of the ecological sensitivity based on CBA areas, endangered plant records (locality buffered by 250 m) which are considered indicators of very high sensitivity and assigned to **Class 5** if in *Natural state*, and **Class 1** if in a *Transformed state*. The river areas, pans/Wetlands are protected by legislation and are considered highly sensitive and these areas were, therefore, classified as **Class 4** if in a *Natural State*, and **Class 0** if in a *Transformed State*. The natural areas within 1 km of a formal Protected Area were assigned to Class 4 as highly sensitive areas. The ESA areas, NPAES priority areas, and vulnerable vegetation types were considered features of interest indicating a *medium sensitivity* (**Class 3**). A combination of 3 or more of these factors (i.e. ESA areas, NPAES priority areas, and vulnerable vegetation types) indicates *high sensitivity* (**Class 4**). The low sensitivity areas are those in which natural vegetation is not complimented by any know addition ecological feature. Finally, the transformed areas are those with no natural habitats remaining and *cannot be considered sensitive* (**Class 0**) unless they are transformed CBA areas (such as wet lands, critical vegetation types) (**Class 1**).

The proposed site is considered to be a **Class 1**, it is disturbed and transformed.

Table 1: Ecological Sensitivity Classification.

Sensitivity	Class Description
0 – Not sensitive	Transformed areas, no natural habitat remaining
1 – Not sensitive but potentially ecologically important	Transformed areas, no natural habitat remaining, restorable and potentially important ecologically (e.g. CBA areas)
2- Low sensitivity	Natural areas of low sensitivity, no additional ecological features present
3- Medium sensitivity	Natural areas of moderate sensitivity, 1 -2 additional ecological features of interest present
4-High sensitivity	Natural areas of high sensitivity, 3 or more important ecological features present or classified as Wetlands/Pans or River or River Buffer Area
5-Very high sensitivity	Natural Areas of very high sensitivity - threatened or protected ecosystems or species present, identified priority areas (CBAs) from fine scale biodiversity plans, high likely hood of endangered species.

4. IMPACT ASSESSMENT AND MITIGATION

The following impact rating used is a basic exponential rating system to assess actual and potential negative and positive environmental impacts. Environmental activities are identified based on :-

- The phases of the project; and
- Description of the actual and potential impacts.

In addition, for every project activity, various environmental impacts are listed. Every negative impact is allocated a value as per the following criteria:-

- Likelihood;
- Extent;
- Duration;
- Consequence; and
- Magnitude.

Every negative impact is allocated a +value, and positive impacts are not rated since the rating is based on risks.

The following table list the impact assessment and mitigation measures recommended for the proposed cemetery expansion.

Table 2: Impact Assessment and Mitigation Measures.

Project Phase	Description	Likelihood (0-5)	Extent	Duration	Consequences	Magnitude (0-5)	With Mitigation	Without Mitigation
PREPARATION	Vegetation removal	2	Site	3-6 months	Low	2	Very Low	Low as the proposed expansion area is a transformed Greenfield within a siding.
OPERATING	Excavation and Maintenance	4	Site	Frequently	Medium	3	Very Low	Low, it is recommended that grass be used as part of maintenance measure for stormwater runoffs and to cover the exposed soil within the unused areas.
DECOMMISSION	Removal or use for other purposes	0	Site	n/a	n/a	n/a	Not Assessed	Unlikely.

5. CONCLUSION & RECOMMENDATIONS

The operational site is highly transformed and with exception of Eucalyptus species randomly occurring on the boundaries of the site and serve as screening method; the site is unable to carry and sustain any flora species as a habitat due to coal dust footprint. However, outside the boundaries of the study site on the east side there are thriving ecosystems such as wetlands and rivers located on the north of the site. These ecosystem supports variety of species such as Grass Owl. Arbor Siding activities only affect these ecosystems due to the uncontrolled stormwater as a result it is recommended that the proponent put in place proper stormwater measures that could prevent it from draining into the nearest freshwater ecosystems.

The following visuals were taken from the drainage coming on Arbor siding side towards the NFEPA ecosystem in the close vicinity to the operational site. This is outside Arbor Siding boundary; however, stormwater with coal dust residue was observed:-

Figure 13: Stormwater colbet from R555 used to drain stormwater from the operational site.

Figure 14: The drainage continues from the colbet into the sensitive area near the Arbor Siding operation area.

Figure 15: Coal dust residue observed in stormwater drained on the area towards NFEPA recognised ecosystem in the area.

Figure 16: Dried coal dust residue stormwater.

Figure 17: The study area falls within 500m buffer of the sensitive NFEPA ecosystem location in the east from the operation.

Figure 18: NFEPA recognised river and wetland in the area.

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7. GLOSSARY

Assessment: process of documenting, usually in measurable terms, knowledge, skills, attitudes and beliefs

Biodiversity: is the degree of variation of life forms within a given species, it is a measure of the ecosystem health

Breeding: is the reproduction OR producing of offspring by animals or plants

Checklist: Template useful to do list tips and task management

Colliery: A coal mine together with its physical plant and outbuildings

Conservation: movement aimed to protect animals, fungi, plants and their habitats.

Cryptophytes: collective word of geophytes, helophytes and hydrophytes

Displacement: the act or process of removing something from its usual or proper place or the state resulting to dislocation

Ecology: the relations that living organisms have with respect to each other and their natural environment

Ecosystem: is a biological system consisting of all the living organisms in a particular area and the non-living organisms which the organisms interact

Endangered: species whose existence is being threaten by environmental effects

Floodplain: is a flat or nearly flat land adjacent a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge

Geophytes: plants that grow in dry area or part of the land

Gramniods: Collective word for grass species

Habitat: an area or site where plants or animals persist or used

Helophytes: Plants that occupy marshy or pod edges

Herbaceous: plants with no persistent woody stem above the ground

Hydrophytes: plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content

Indicator species: species that indicate a specific condition

Invader: a species that is not indigenous to a particular area

Migration: Movement of species from one area to another

Noxious: a weed or plant proclaimed in the Weeds Act 42 of 1937

Pioneer: a plant capable of invading bare or undisturbed sites and persisting there until replaced by other species

Portion: a piece of land in an area distributed into small areas that are shared, commonly known as farm

Protection levels: Are areas of biodiversity importance that are formally and informally protected under NEMPA 57 of 2003

Rehabilitation: process of restoring a land to its original or near original after it has been used or disturbed

Riparian: area is the interface between land and a river or stream

Seepage: The slow escape of a liquid or gas through porous material or small holes.

Vulnerability: are species whose status is vulnerable or sensitive to the environmental conditions in an area where it persist

Waterlogged: saturation of the soil by groundwater sufficient to prevent or hinder agriculture

Wetlands: Wetlands are considered as those ecosystems defined by the National Water Act (NWA) as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." However, there are two definitions used to define what a wetland is; according to NWA a wetland is a hydrological zone that would be present without human modification. Whereas RAMSAR Convention defines a wetland as areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.

Annexure 16.2-7: Stockpile Coal Handling Capacity

PO Box 68863
Highveld Park
Gauteng
0169
Tel. +27 12 661 5612
Cell. +27 83 655 0413

Date: 27th March 2018

Our ref: 126_FdL_Arbor Rail Siding Coal Storage Capacity_Rev2

Your ref: GAE 2015 / 05

Myezo Environmental Management Services (Pty) Ltd
645 Jacqueline Drive
Garsfontein
0081

Postnet Suite B165
Private Bag X18
Lynnwood Ridge
0040

Attention: Me. Babalwa Fatyi

ARBOR RAIL SIDING BULK – BULK HANDLING CAPACITY STUDIES IN SUPPORT OF THE ENVIRONMENTAL MANAGEMENT REQUIREMENT

Thank you for the opportunity to be of service to you on the abovementioned project.

After clarification of the scope and deliverables at the inception meeting of 04-03-2018, the site was inspected on 05-03-2018. The coal stock yard was almost filled to capacity and many interlink trucks were waiting in line to off-load. The train wagons were already loaded and waiting for the engine to be taken away.

Measurements were taken of the stockpiles on the existing northern storage area. The actual angle of repose of a typical stockpile was measured and found to be approximately 33 degrees (1:1,5 vert : hor). The stockpiles were plotted on a scaled Google image as shown in the attached site layout drawing. Assuming a storage height of 4m, (which is the height the loaders on site can reach), the volume of each of the five stockpiles was calculated and totaled 23 903m^3. An additional available storage area was identified at the north-eastern side of the site that can store another 2 602m^3, bringing the total volume of storage of the existing site to 26 505m^3. At a loose coal density of 800 kg/m^3, this equates to a total weight of 21 204 ton.

The southern side of the rail siding was also inspected to establish where the proposed new storage area, weigh bridge and truck holding area could be located. The suggested storage layout was plotted on the layout drawing and submitted to GIJIMA officials for comment. Allowance has been made for truck turning circles with 28m diameter. The total volume of storage was calculated at 20 847m^3. At a loose coal density of 800 kg/m^3, this equates to a total weight of 16 678 ton.

Therefore, the combined total storage capacity of both the northern and southern stockpile areas, as shown on the layout drawing, is 47 352m^3 which equals a total weight of 37 882 ton.

The Table 1 below show the details of each of the storage piles.

Table 1: Calculation of Storage Volume and Tonnage

Storage Pile Designation	Bottom Length (m)	Bottom Width (m)	Floor Area (m^2)	Storage Height (m)	Storage Volume (m^3)	Density of Coal (ton/m^3)	Weight of Coal (ton)
Existing Northern Storage Area							
Pile EF1	99	17.5	1732.5	4	4326	0.8	3461
Pile EF2	112	17.5	1960	4	4924	0.8	3939
Pile EF3	118	17.5	2065	4	5200	0.8	4160
Pile EB1	152	17.5	2660	4	6764	0.8	5411
Pile EB2	61	17.5	1067.5	4	2690	0.8	2152
Pile EB3	59	17.5	1032.5	4	2602	0.8	2081
Total Existing			10518		26505		21204
Proposed New Southern Storage Area							
Pile NF1	160	22	3520	4	9904	0.8	7923
Pile NF2	90	14	1260	4	2736	0.8	2189
Pile NF3	90	14	1260	4	2736	0.8	2189
Pile NB1	90	14	1260	4	2736	0.8	2189
Pile NB2	90	14	1260	4	2736	0.8	2189
Total New			**8560**		**20847**		**16678**
Total Existing + New			**19078**		**47352**		**37882**

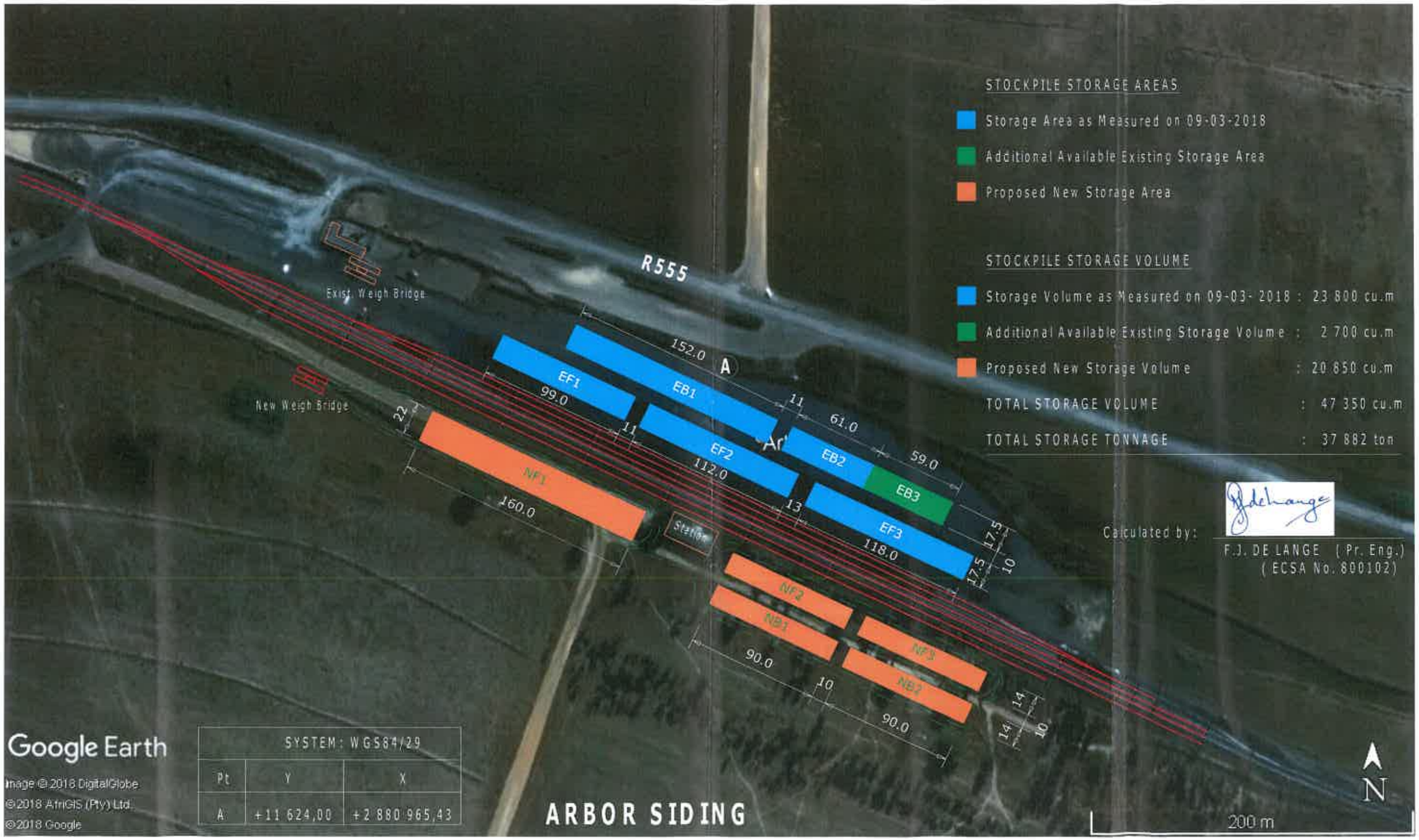
If the space taken up by the center road between piles NF2, NF3 and NB1 and NB2 is also utilized for storage, as shown on the second layout drawing, then the combined total storage capacity of both the northern and southern stockpile areas, increases from 47 352m^3 to 58 009m^3 and the total tonnage increases from 37 882 ton to 46 407 ton. See Table 2 below.

Table 2: Calculation of Storage Volume and Tonnage for Alternative Arrangement

Storage Pile Designation	Bottom Length (m)	Bottom Width (m)	Floor Area (m^2)	Storage Height (m)	Storage Volume (m^3)	Density of Coal (ton/m^3)	Weight of Coal (ton)
Existing Northern Storage Area							
Pile EF1	99	17.5	1732.5	4	4326	0.8	3461
Pile EF2	112	17.5	1960	4	4924	0.8	3939
Pile EF3	118	17.5	2065	4	5200	0.8	4160
Pile EB1	152	17.5	2660	4	6764	0.8	5411
Pile EB2	61	17.5	1067.5	4	2690	0.8	2152
Pile EB3	59	17.5	1032.5	4	2602	0.8	2081
Total Existing			10518		26505		21204
Proposed New Southern Storage Area							
Pile NF1	160	22	3520	4	9904	0.8	7923
Pile NF2	90	38	3420	4	10800	0.8	8640
Pile NF3	90	38	3420	4	10800	0.8	8640
Total New			**10360**		**31504**		**25203**
Total Existing + New			**20878**		**58009**		**46407**

Regards

Franz de Lange Pr Eng


STOCKPILE STORAGE AREAS
Storage Area as Measured on 09-03-2018
Additional Available Existing Storage Area
Proposed New Storage Area
STOCKPILE STORAGE VOLUME
Storage Volume as Measured on 09-03- 2018 : 23 800 cu.m
Additional Available Existing Storage Volume : 2 700 cu.m
Proposed New Storage Volume : 20 850 cu.m
TOTAL STORAGE VOLUME : 47 350 cu.m
TOTAL STORAGE TONNAGE : 37 882 ton
Calculated by:
F.J. DE LANGE (Pr. Eng.)
(ECSA No. 800102)
R555
Exist. Weigh Bridge
New Weigh Bridge
EF1
EB1
EF2
EB2
EB3
EF3
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NB1
NF3
NB2
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59.0
112.0
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© 2018 AfriGIS (Pty) Ltd.
© 2018 Google
SYSTEM : WGS84/29
Pt
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+11 624,00
+2 880 965,43
ARBOR SIDING
N
200 m

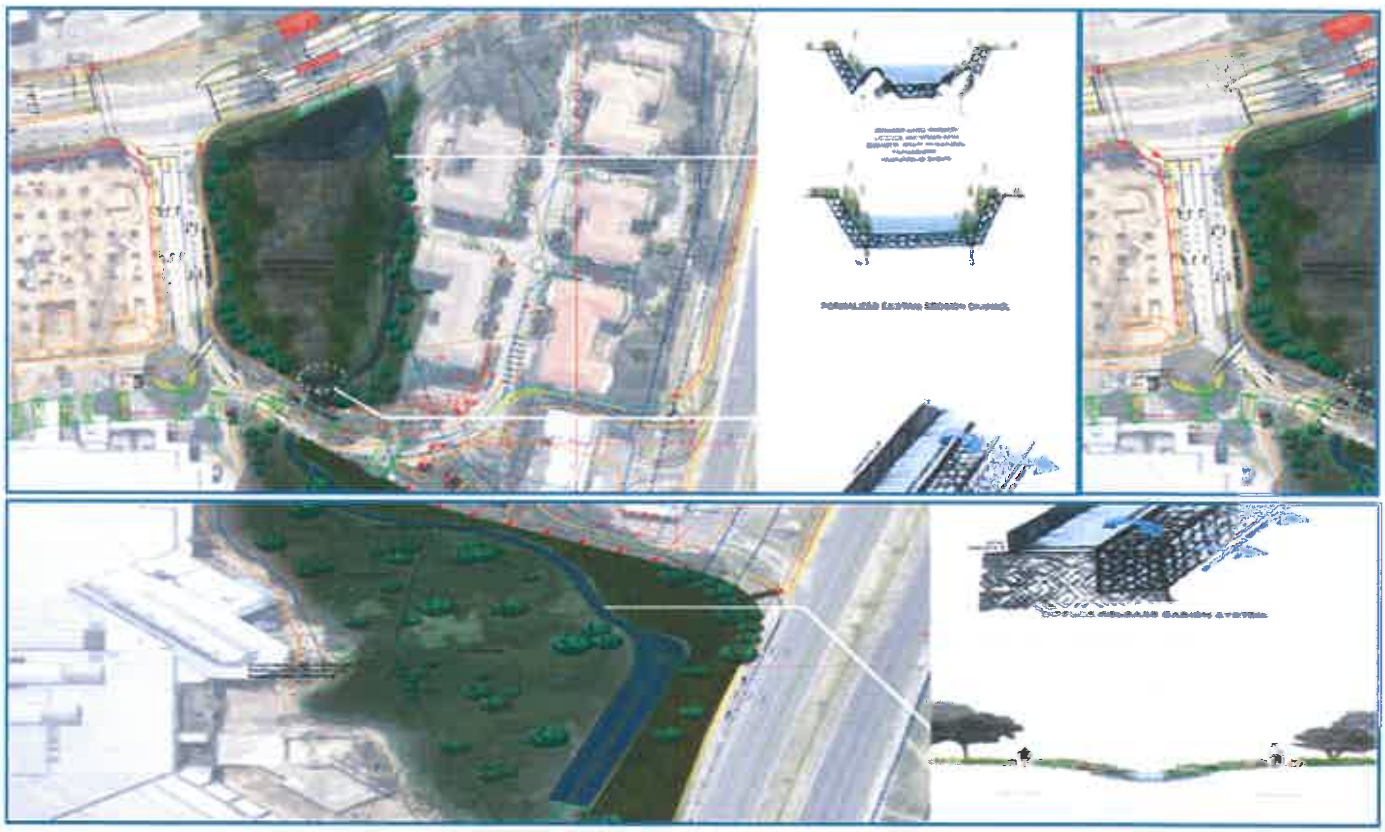
Annexure 16.2-8: Wetland Delineation Assessment

ARBOR RAILWAY COAL SIDING:
Wetland Assessment

Prepared for:
LETSOLO
Water and Environmental services

Prepared by:

Willem Lubbe
trading as
WaterMakers



November 2019

Declaration of Independence by Specialist

I, **WILLEM LUBBE**, in my capacity as a specialist consultant, hereby declare that I -

- act as an independent consultant;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered; and
- as a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member.

5/11/2019

Willem Lubbe Pr.Sci.Nat
Wetland Specialist
SACNASP Reg. No. 100064/08

Date

EXECUTIVE SUMMARY

Gijima Supply Chain Management Services (Pty) Ltd manages an existing coal loading facility at the Arbor railway siding east of Ogies and are planning on expanding the current facilities stockpiles. Subsequently, WaterMakers was appointed by Letsolo Water and Environmental services as independent specialists to conduct the relevant wetland-related studies in order to facilitate the required environmental authorisation and water use licence processes if applicable. The present study represents the wetland assessment of the study and should be read in association with other specialist assessments conducted for the proposed activity.

In order to enable an adequate description of potential wetland habitat and so as to ensure that the wetland study conducted is applicable for both an Environmental Authorisation as well as a Water Use Licence Application if applicable, the following approach was to be undertaken:

- Desktop assessment;
- Site assessment for Identification and delineation of wetland habitat;
- Classification of identified wetland habitat;
- Identification of wetland goods and services by means of the Wet-EcoServices approach;
- Determination of the Present Ecological State of identified wetlands by means of the Wet-Health approach;
- Determination of the Ecological Importance and Sensitivity of identified wetlands; and
- Impact assessment, mitigations and recommendations

Two hydro-geomorphic wetland types were identified and delineated within the study area and within 500m from the study area during the present study and classified into two distinct hydro-geomorphic (HGM) units, HGM 1, a hillslope seepage wetland connected to HGM 2, and HGM 2, a valley bottom wetland that was likely unchannelled historically

The HGM units were found to potentially perform functions through the provision of various ecosystem services such as streamflow regulation, flood attenuation, nitrogen removal, toxicant removal, phosphate and sediment trapping. However, ecosystem services provided by the wetlands within the study area has been impacted through current and historic anthropogenic activities. Combined area weighted Wet-Health results indicated that the wetlands associated within 500m from the study area have been moderately to largely altered as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetlands units, as well as vegetation changes within the wetlands and surrounding catchments due to historic and current anthropogenic impacts.

Hydrological and Functional Importance for HGM 1 was considered to be moderate as a result of the important bio-geochemical processes that hillslope seepages renders and supporting role to the potential FEPA wetland downstream. Although the hydrology seems to be largely to seriously impacted at this stage, the post mining environment could re-instate hydrological drivers once the void in the upper catchment are filled. The seepage wetland could therefore potentially receive increased flows in the future, including possible decant with poor associated water qualities. The

Ecological Importance and Sensitivity of HGM 1 were perceived to be low as a result of anthropogenic impacts especially the dominance of invasive and terrestrial vegetative species in several sections of the wetland.

HGM 2, the valley bottom wetland was assigned a very high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the occurrence of species of conservation concern, status of the associated wetland vegetation type, several FEPA wetlands and wetland clusters downstream from the study areas as well as the importance of providing clean water and biodiversity support to the Wilge River.

The impact assessment identified surface water pollution including sedimentation and pollution, altered hydrological regime and decreased water quality downstream as the major impacts during the construction and operational phase. Several general and specific mitigation measures were proposed in order to reduce negative impacts and incorporate some potentially positive impacts from the proposed development. It is recommended that he proposed lay-out plan be adapted in order to shift stockpiles slightly to the west to enable a more effective clean and dirty water separation trough staying on the western side of the highest local topographical line (Proposed new additional stockpile area). Dirty water will thus be able to drain away from the seepage wetland and connectivity within the seepage wetland increased. Other site specific measures include:

- Installing a clean water cut-off trench side on the south eastern side of the siding (southern periphery of the study area). Both the existing clean water cut-off trench and the new proposed clean water cut-off trench must also be accompanied by the installation of diffuse release structure;
- The dirt road from the mine to the south must receive a speedhump to allow stormwater to be diverted from entering the dirty water area and pass into a silt trap before passing through the diffuse release structure (from the clean water cut-off trench on the western side);
- A monitoring program must be implemented to ensure that effective clean and dirty water separation is achieved. The monitoring program must also monitor sub-surface flow regimes to inform the proposed Rehabilitation Phase B recommendations. The monitoring program should include the establishment and monitoring of a piezometer network.

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ACRONYMS

CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water and Sanitation
DWS	Department of Water and Sanitation
EC	Ecological Category
FEPA	Freshwater Ecosystem Priority Area
GPS	Global Positioning System
HGM	Hydrogeomorphic
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Areas project
NWRS	National Water Resource Strategy
PES	Present Ecological State
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
VEGRAI	Vegetation Reponses Assessment Index
WMA	Water Management Areas
WRC	Water Research Commission
WWF	Worldwide Fund for Nature

1. INTRODUCTION

1.1 Project Description

Gijima Supply Chain Management Services (Pty) Ltd manages an existing coal loading facility at the Arbor railway siding east of Ogies and are planning on expanding the current facilities stockpiles. Subsequently, WaterMakers was appointed by Letsolo Water and Environmental services as independent specialists to conduct the relevant wetland-related studies in order to facilitate the required environmental authorisation and water use licence processes if applicable. The present study represents the wetland assessment of the study and should be read in association with other specialist assessments conducted for the proposed activity.

1.2 Scope of Work

In order to enable an adequate description of potential wetland habitat and so as to ensure that the wetland study conducted is applicable for both an Environmental Authorisation as well as a Water Use Licence Application, the following approach was to be undertaken:

- Desktop assessment
- The wetland delineation should be conducted following the guidelines contained in the DWAF Guideline document entitled "A Practical Field Procedure for Identification and delineation of wetlands and riparian areas" (DWAF, 2008);
- Corroborate field and desktop data and classify confirmed wetlands into hydrogeomorphic units;
- Determine the functionality of wetlands, using a Level 2 Wet-EcoServices (Kotze *et al.*, 2005) assessment for wetlands within the study area;
- Determine the Present Ecological Status (PES) of identified wetlands within the study area through applying a Level 2 Wet-Health assessment (Macfarlane *et al.*, 2008);
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands by utilising methodology described by Rountree (2013);
- Determine and ground truth the NFEPA status of any wetlands on site, if any;
- Assess the potential impacts and recommend mitigation measures for the proposed development;

A site visit to the area to be affected by the proposed activity was undertaken on the 15th of October and on the 7th of November 2019. A detailed description of the methodology used to address the above Terms of Reference is provided in Appendix A.

1.3 Assumptions and Limitations

During the course of the present study, the following limitations were experienced:

- In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. The current study relied on information gained during a single field survey conducted during a single season, desktop information for the area, as well as professional judgment and experience;
- Wetland and riparian areas within transformed landscapes, such as urban and/or agricultural settings, or mining areas with existing infrastructure, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a result of dense stands of alien vegetation, dumping, sedimentation, infrastructure

encroachment and infilling). As such, wetland and riparian delineations as provided are based on indicators where available and the author's interpretation of the current extent and nature of the wetlands and riparian areas associated with the proposed activity;

- Some precision agricultural techniques such as topographical manipulation and soil redistribution ploughing were evident within the study area which in some instances could obscure pedological signs of wetness and hydric soil forms;
- Wetland and riparian assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation (DWS). These methods are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration. Current and historic anthropogenic disturbance within and surrounding the study area has resulted in soil profile disturbances as well as successional changes in species composition in relation to its original /expected benchmark condition;
- Delineations of wetland areas were largely dependent on the extrapolation of field indicator data obtained during field surveys, 5m contour data for the study area, and from interpretation of geo-referenced orthophotos and satellite imagery as well as historic aerial imagery data sets received from the National Department of Rural Development and Land Reform. As such, inherent ortho-rectification errors associated with data capture and transfer to electronic format are likely to decrease the accuracy of wetland boundaries in many instances; and
- Wetlands outside of the study area boundary was extrapolated using aerial imagery, although some sampling was done outside of the study boundaries in order to confirm findings and better interpret hydropedological characterisation of the study area.

2. GENERAL CHARACTERISTICS

2.1 Location

The study area is located on the Arbor Railway siding, which is approximately 19km northeast of Delmas, 19km west of Ogies, 50km south of Bronkhorstspruit (along the R42 and N12) along the N12 (Figure 1). The study area is situated within Victor Khanye (Delmas) Local Municipality in the Nkangala Magisterial District, Mpumalanga (Figure 1).

2.2 Biophysical Attributes

2.2.1 Climate

The climate for the study area was derived from recorded data (en.climate-data.org and worldweatheronline.com). The area around Delmas receives seasonal summer rainfall and has generally very dry winters. Rainfall ranges between 620 – 750 mm, with the long term average around 650 mm. Most rain fall between November and March, peaking between December and February. Summer day temperatures fluctuate daily on average between 14°C and 25°C in January, but higher temperatures are experienced. The daily winter temperatures in July fluctuate on average between 1°C and 16°C. Incidence of frost is frequent which helps grasslands to persist.

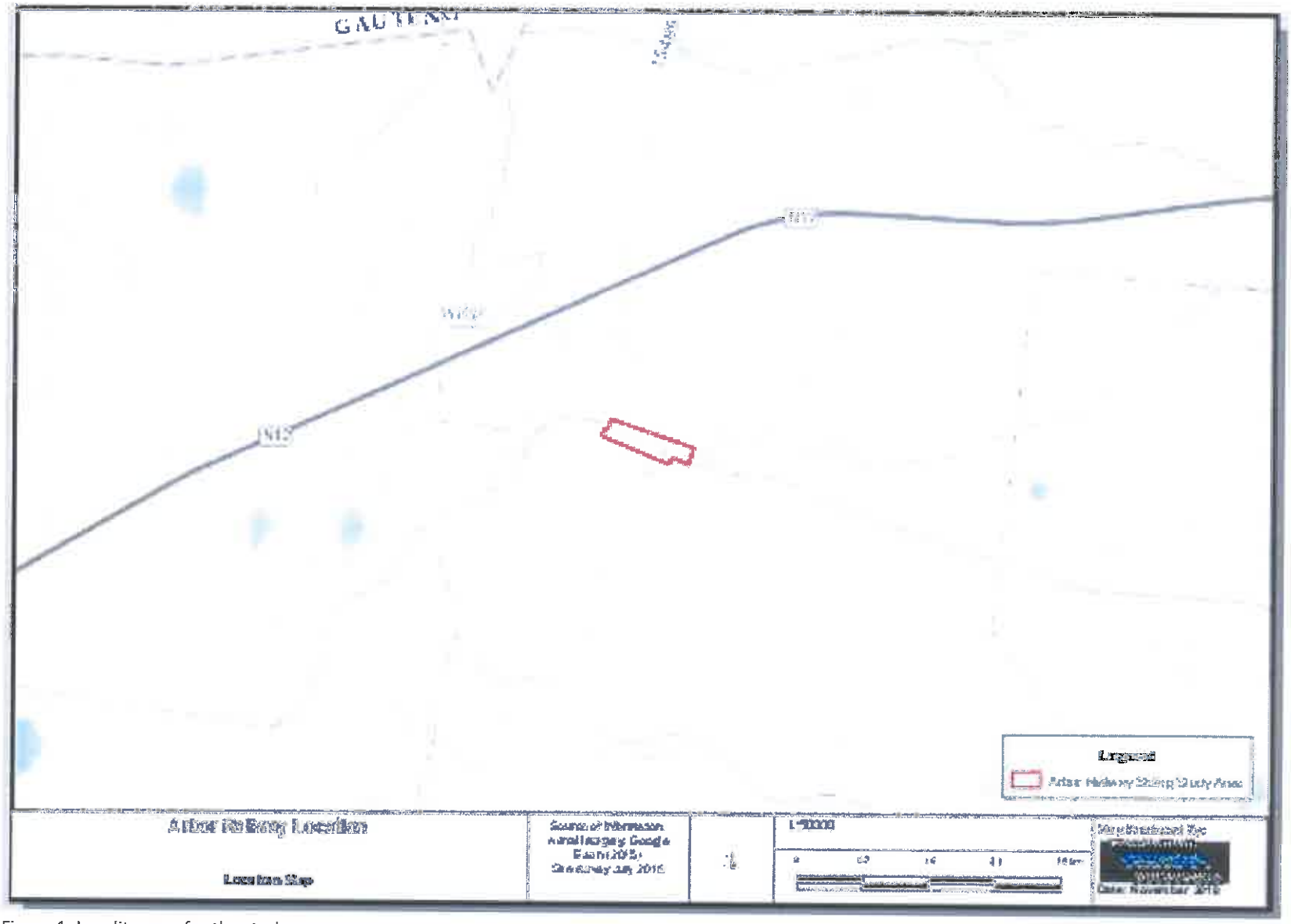


Figure 1: Locality map for the study area

2.2.2 Historic vegetation overview

Mpumalanga is known for its extensive grasslands and numerous wetlands, in which natural dominance of high shrubs and/or trees is largely prevented by frequent frost occurrences (and other factors) during winter, which tufted perennial grasses are better adapted to survive. Mpumalanga is host to approximately 21% of South Africa's flora. The majority (64 %) of these plant species are soft herbs and bulbous plants (geophytes) situated in the grassland biome. The majority of these species remain dormant during winter or very dry seasons, and re-sprout during early summer if rains are sufficient.

The grassland biome is made up of a mosaic of many different vegetation types, which vary according to the prevailing abiotic conditions. According to the delineation of these vegetation types, as described and mapped for South Africa (in Mucina and Rutherford, 2006 and updated 2012 on BGIS), the study area was historically covered with Eastern Highveld Grassland (Gm 12) as well as Rand Highveld Grassland (Gm 11), whilst the wetlands surrounding the study area typically harbour Eastern Temperate Freshwater Wetland (AZf 3) Vegetation (Mucina and Rutherford, 2006).

The Rand Highveld Grassland (Gm 11) lies within a highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. The conservation status for the area is endangered and almost half of the land has been transformed primarily by cultivation, plantations, urbanisation and building of dams (Mucina and Rutherford 2006). Eastern Highveld Grassland (Gm 12) historically covered the slightly to moderately undulating plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief (Mucina and Rutherford, 2006). The vegetation of this grassland type consists of short dense grassland dominated by the usual Highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda*, and *Tristachya*). Small, scattered rocky outcrops have a variable cover of wiry, sour grasses and some woody species (*Acacia caffra, Celtis africana, Diospyros lycioides* subsp. *lycioides, Parinari capensis, Protea caffra, P. welwitschii* and *Rhus magalismontanum*) (Mucina and Rutherford, 2006).

Dominant and/or prominent taxa in primary, undisturbed grasslands (Mucina and Rutherford, 2006) would have included following species:

Graminoids: *Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata subsp. eckloniana.*

Herbs: *Berkheya setifera , Haplocarpha scaposa , Justicia anagalloides , Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*

Geophytes: *Gladiolus crassifolius, Haemanthus humilis* subsp. *hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Succulents: *Aloe ecklonis.*
Low Shrubs: *Anthospermum rigidum* subsp. *pumilum, Stoebe plumosa.*

Eastern Temperate Freshwater Wetlands are found on flat or gently undulating landscapes or shallow depressions filled with (temporary) water bodies such as pans, periodically flooded vleis, and edges of calmly flowing rivers that support zoned systems of aquatic and hygrophilous vegetation where grasslands are temporarily flooded. Dominant Taxa that can be expected in the different zones in wetlands include:

Marshes:
Graminoids: *Cyperus congestus, Agrostis lachnantha, Carex acutiformis, Eleocharis palustris, Eragrostis plana, E. planiculmis, Fuirena pubescens, Helictotrichon turgidulum, Hemarthria altissima, Imperata cylindrica, Leersia hexandra, Paspalum dilatatum, P. urvillei, Pennisetum thunbergii, Schoenoplectus decipiens, Scleria dieterlenii, Setaria sphacelata, Andropogon appendiculatus, A. eucomus.*
Herbs: *Centella asiatica, Ranunculus multifidus, Berkheya radula, B. speciosa, Berula erecta subsp. thunbergii, Centella coriacea, Chironia palustris, Equisetum ramosissimum, Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile, H. dregeanum, H. mundtii, Hydrocotyle sibthorpioides, H. verticillata, Lindernia conferta, Lobelia angolensis, L. flaccida, Mentha aquatica, Monopsis decipiens, Pulicaria scabra, Pycnostachys reticulata, Rorippa fluviatilis var. fluviatilis, Rumex lanceolatus, Senecio inornatus, S. microglossus, Sium repandum, Thelypteris confluens, Wahlenbergia banksiana.*
Geophytes: *Cordylogyne globosa, Crinum bulbispermum, Gladiolus papilio, Kniphofia ensifolia, K. fluviatilis, K. linearifolia, Neobolusia tysonii, Satyrium hallackii* subsp. *hallackii.*

Reed and sedge beds:
Graminoids: *Phragmites australis, Schoenoplectus corymbosus, Typha capensis, Cyperus immensus. Carex rhodesiaca.*

Water bodies:
Aquatic Herbs: *Aponogeton junceus, Ceratophyllum demersum, Lagarosiphon major, L. muscoides, Marsilea capensis, Myriophyllum spicatum, Nymphaea lotus, N. nouchali var. caerulea, Nymphoides thunbergiana, Potamogeton thunbergii.*
Carnivorous Herb: *Utricularia inflexa.*
Herb: *Marsilea farinosa* subsp. *farinosa*. (Mucina & Rutherford, 2006).

2.2.3 Geology

Geology underlying the study area is made up of elements from the Vryheid Formation of the Ecca group (part of the Karoo Supergroup), which is characterised by the presence of sandstone and shale, with coal beds in places, especially towards the south. Towards the north and west of the study area there are elements of agglomerate lava as well as porhyritic rhyolite with interbedded mudstone and sandstone

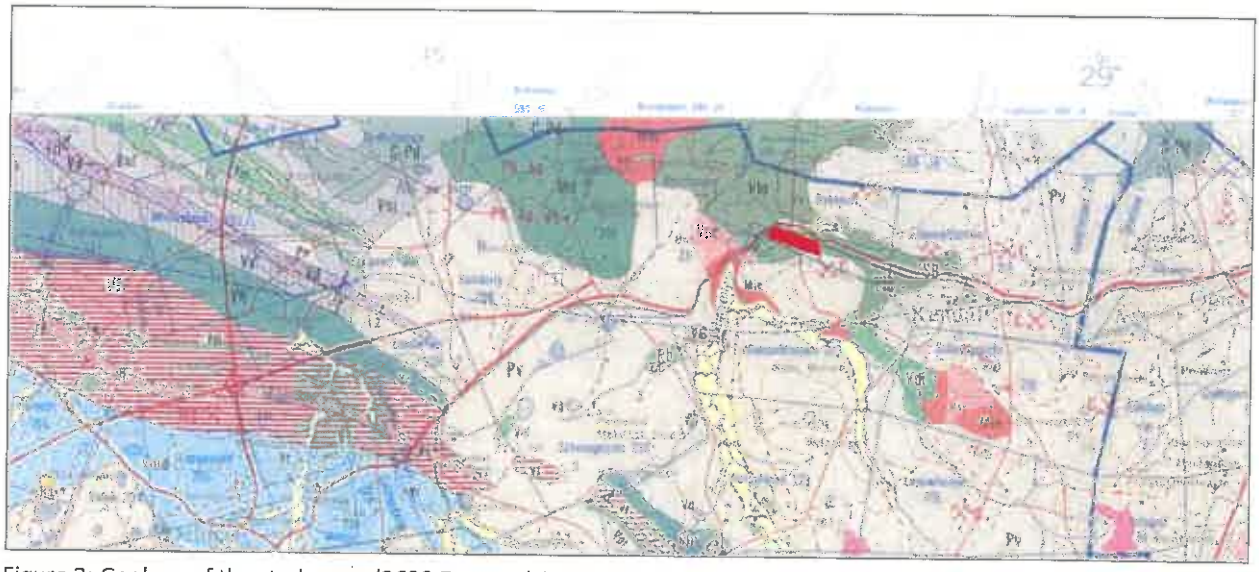


Figure 2: Geology of the study area (2628 Eastrand 1:250 000; Department of Mines – Geological Survey) with the approximate study area indicate by red polygon of the map inset

2.2.4 *Associated Aquatic Ecosystems, Drainage and Eco-region*

The NWRS-1 (National Water Resource Strategy, Version 1) originally established 19 Water Management Areas (WMA) within South Africa and proposed the establishment of the 19 Catchment Management Agencies to correspond to these areas. In rethinking the management model and based on viability assessments with respect to water resources management, available funding, capacity, skills and expertise in regulation and oversight, as well as to improve integrated water systems management, the original 19 designated WMAs have been consolidated into nine WMAs. The study area lies within the Olifants River Catchment (Water Management Area 4) with the Wilge River situated approximately 1km west of the study area. The Wilge River flows northwards before joining the Bronkhorstspruit River and eventually the Olifants River. Furthermore, the project area falls within the B20F quaternary catchment.

The area is dominated by gentle undulating topography with elevation generally reducing to the east and south, with small valleys draining in mainly an easterly direction towards the northward flowing Wilge River. The general elevation of the study area varies roughly between 1525 mamsl, on the eastern boundary of the study area, to a minimum of 1515 mamsl on the western boundary.

According to GemScience (2011a), ecoregions are regions that share similar ecological characteristics and are *"based on the understanding that ecosystems and their biota display regional patterns that mirror causal factors such as climate, soils, geology, physical land surface and vegetation"* (Ferrar and Lötter 2007). The study area falls within the Highveld Ecoregion which is an area of flat grasslands with undulating rocky areas and rich coal deposits covered by deep, red to yellow sandy soils (Balance, cited in GemScience, 2011a). Wetlands that overlie these deposits are therefore threatened by potential mining activities in the area.

The Ecoregion Level 2 for the project area is Ecoregion 7.04 (Balance, cited in GemScience, 2011a). The instream and riparian habitats show a fair to unacceptable state according to the River Health Programme (RHP), with the general condition being fair in the project Ecoregion 7.04 (Balance, cited in GemScience, 2011a). The biological communities also reflect fair to unacceptable health for the area, with mining (mainly coal mining) and other industrial activities in the area resulting in severe disturbances and are therefore the main contributors to the poor instream and riparian habitat conditions (Balance, cited in GemScience, 2011a). Rivers in Ecoregion 7.04 generally have a low pH and high concentrations of dissolved salts and in some places the riverbeds have even been eroded down to the bedrock, leaving little suitable habitat for fish and aquatic invertebrates (Balance, cited in GemScience, 2011a).

2.2.5 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF),

South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim comprises a national and sub-national component. The national component aims to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component aims to use three case study areas to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes at a sub-national level (Driver et al., 2011). The project further aims to maximize synergies and alignment with other national level initiatives such as the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation.

Based on current outputs of the NFEPA project (Nel et al., 2011; Figure 3), no FEPA wetlands or wetland clusters were located within the study area. However, several FEPA wetlands and wetland clusters are situated directly downstream of the study area (Figure 3). One FEPA wetland, FEPA wetland unit nr 31191 is situated directly north, just a few hundred meters downstream of the study area

2.2.6 Wetland Vegetation Group

According to Nel et al. (2011), the study area falls within the Mesic Highveld Grassland Group 4 wetland vegetation group. According to Macfarlane et al. (2014), the Mesic Highveld Grassland Group 4 wetland vegetation group is regarded as being Critically Endangered (Macfarlane et al., 2014)

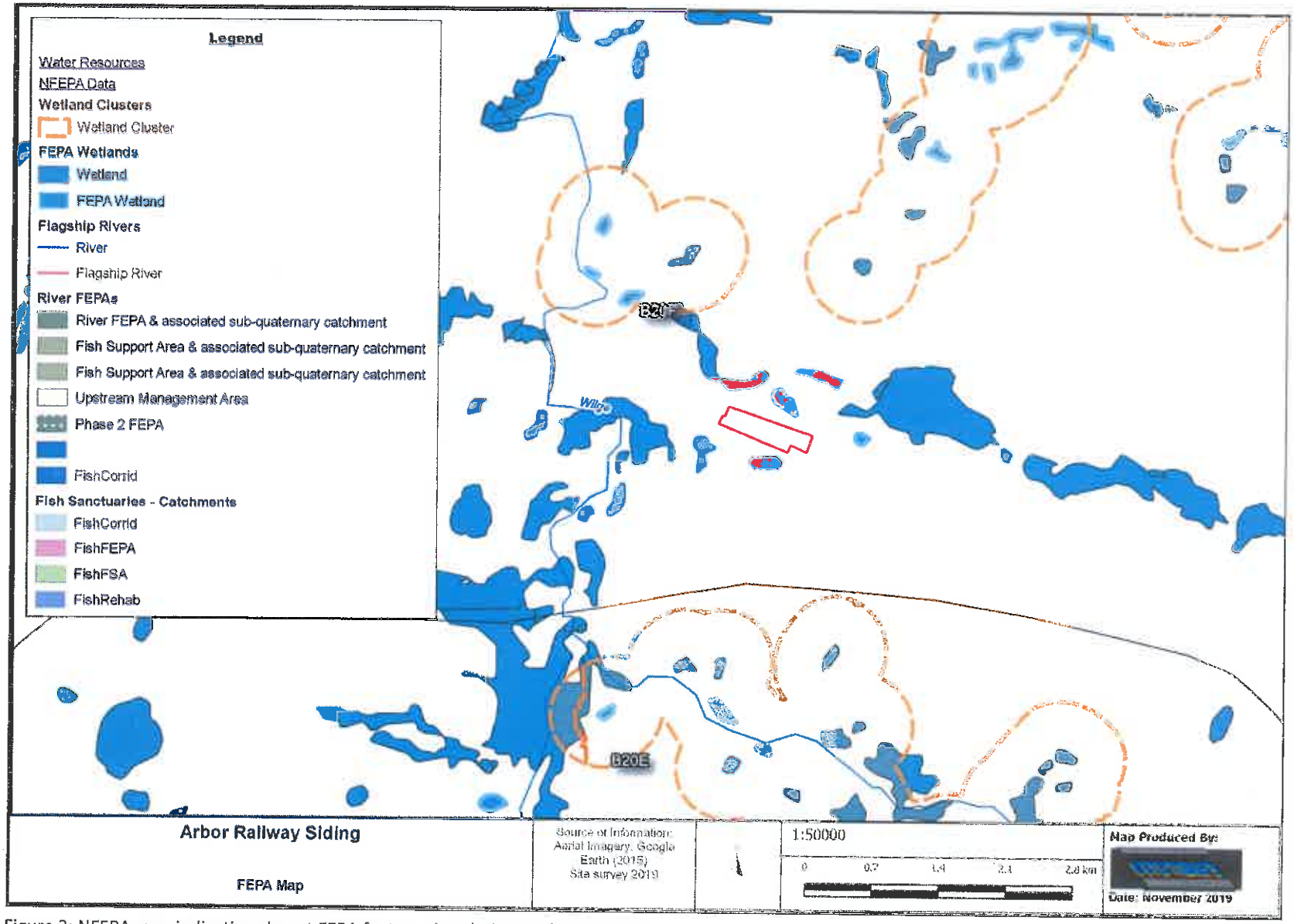


Figure 3: NFEPA map indicating closest FEPA features in relation to the study area

3. ASSOCIATED WETLANDS

3.1 Wetland soils

According to the Department of Water Affairs and Forestry (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, Tsitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (Department of Water Affairs and Forestry, 2005).

Traversed catenas within the vicinity of the study area revealed soilscapes with a plinthic topo-sequence, deep red recharge soilscapes, yellow interflow as well as a remnant / disturbed soilscape. Plinthic soils are characterized by their susceptibility to prolonged seasonal wetness due to a fluctuating water table, which creates reducing redox conditions that are expressed as mottles and sometimes Iron and Manganese concretions. Plinthic soils in which the Orthic A horizon grades directly into a plinthic horizon (e.g. Westleigh soil form) are generally wetter than soils in which the Orthic A horizon grades indirectly through an E horizon (e.g. Longlands soil form) or a yellow-brown apedal B horizon (e.g. Pinedene soil form). Furthermore, presence of an E horizon on plinthic soils such as in the Longlands form generally indicates greater susceptibility to wetness than those soils with a yellow-brown apedal B horizon such as the Pinedene soil form. Albic / E- horisons are indicative of interflow taking place in the landscape and in the study area is situated between the deep red recharge soils to the south (hilltop position) and the responsive soils situated within the valley bottom. Further, hard plinthic horisons were abundant in various sections of the study area and included the Dresden and Wasbank soil forms. The seepage wetland contained considerable thick albic / E horisons which are indicative of strong potential lateral interflow within the landscape, albeit only historic potentially (Figure 4).

Figure 4: Thick albic / E horison of the Wasbank soil form associated with the hillslope seepage wetland within the study area

Poorly drained soils were observed in the wetter section of the hillslope seepage and valley bottom wetland (north of the study area) and comprised of Kroonstad and Katspruit soil forms (responsive soils). The Kroonstad soil family has a characteristic bleached E and gleyed G horizons, both of which are indicative of prolonged water saturation. The Katspruit soil form also has the G horizon with marked gleyed features indicative of a permanent wetland zone.

Terrestrial soil forms included Mispah, Clovelly and Hutton soil forms as well as several Anthrosols. The study area itself was dominated by Anthrosols and some interflow soils towards the eastern periphery. The new Soil Classification working Group (2018) classification system has incorporated several changes to the previous soil classification Soil Classification Working Group (1991). The new open classification system allows for the classification of whole-soil profiles which potentially enhances studies of water flows in river basins where soil morphology is recognised as an important hydrological indicator of water flow paths and storage mechanisms in hillslopes. The new Soil Classification working Group (2018) soil classification system's open classification structure also allows "natural soils" and "anthropogenic materials" to be separated at the highest category with their respective criteria and structures. This was relevant in the study area itself where historic infrastructure activities are responsible for the complete removal of horisons. Physically disturbed anthrosols identified within the study area included Grabouw 1000 and Grabouw 2000 cf, whereas transported technosols included Witbank 1100, Witbank 1200, Witbank 1300 and Cullinan 1000 cf.

Figure 5: Siding with various anthrosols such as Grabouw 1000 and Witbank 1100

Figure 6: Section of siding towards the east siding with anthrosols Witbank 1100, Witbank 1200 and Witbank 1300

According to the DWAF (2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence due to the fact that soil wetness indicators remain in wetland soils in most instances, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil), or non-hydric (non-wetland soil) (Collins, 2005). Redoximorphic features were present within soil profiles of the disturbed valley bottom wetland as well as within the hillslope seepage wetland including black, orange and red mottles and rhizospheres (Figure 5).

Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Redoximorphic features typically occur in three types (Collins, 2005):

- **A reduced matrix** - i.e. an *in situ* low chroma (soil colour), resulting from the absence of $Fe^{3}+$ ions which are characterised by "grey" colours of the soil matrix.
- **Redox depletions** - the "grey" (low chroma) bodies within the soil where Fe - Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- **Redox concentrations** - Accumulation of iron and manganese oxides (also called mottles). These can occur as:
    - Concretions - harder, regular shaped bodies;
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours; and,
    - Pore linings – zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognised as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres

Figure 7: Orange rhizospheres and mottles (arrows) observable in the transition between the orthic and albic horison of an augered soil sample from the temporary zone of the hillslope seepage wetland

3.2 Wetland Vegetation

According to the Department of Water Affairs and Forestry (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act (Act 36 of 1998). Using vegetation as a primary wetland indicator however, requires undisturbed conditions (Department of Water Affairs and Forestry, 2005). A cautionary approach must therefore be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind.

There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside the wetland (Department of Water Affairs and Forestry, 2005). It is important to identify the vegetative indicators which determine the three wetness zones (temporary, seasonal and permanent) which characterize wetlands. Each zone is characterized by different plant species which are uniquely suited to the soil wetness within that zone.

The wetness gradient on site and within the surrounding environment were heavily disturbed as a result of current and historic anthropogenic activities particularly through excavations, linear railway and road infrastructure and activities as well as a mining operation within the catchment of the seepage wetland. Permanent wetland areas within the valley bottom wetland just north of the study area contained *Phragmites australis, Typha capensis, Cyperus spp., Schoenoplectus* sp., *Fuirena* sp. and *Persicaria* sp. with a mixture of obligatory, facultative and terrestrial species (mostly graminoids and weeds) dominating the seasonal and temporary wetland areas, including species such as *Fuirena* sp., *Cyperus* spp., *Pycreus* sp., *Alloteropsis semialata, Lobelia* sp., *Sporobolus* sp., *Paspalum dilatatum, Agrostis lachnantha, Verbena bonariensis, Eragrostis plana, Cynodon dactylon* as well as the species of conservation concern *Kinphofia ensifolia* (Figure 8).

Figure 8: Valley bottom wetland just north of the study area of which a portion is indicated as a FEPA wetland

Figure 9: Valley bottom wetland north of the study area with the protected species *Kniphofia ensifolia* in the foreground

The seepage wetland associated with the study area has been severely impacted from a vegetation perspective and has undergone negative successional vegetation changes as evident by the dominance of pioneer, invasive exotic vegetation , rudimentary and terrestrial vegetation within the hillslope seepage wetland including: *Amarthus hybridus. Berkheya radula, Bidens pilosa, Eragristis chloromelas, Eragrostis plana, Haplocarpa lyrata, Hyparrhenia hirta, Seriphium plumosum* and *Tagetus minuta.* Several alien vegetation species were also present in disturbed areas and included species such as *Pennisetum clandestinum, Bidens pilosa, Cirsium vulgare, Pseudognaphalium luteo-alba, Ricardia braziliense, Acacia dealbata* and *Populus* sp..

Figure 10: Disturbed seepage wetland just south of study area that has undergone successive successional vegetation changes as evident by the dominance of terrestrial vegetation species compared to soil indicators

3.3 Delineated Wetland Areas

According to the National Water Act (Act no 36 of 1998), a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*" Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water. An area which has a high water table at or just below the surface of the soil is as much a wetland as a pan that only contains water for a few weeks during the year.

Hydrophytes and hydric soils are subsequently used as the two main wetland indicators. The presence of these two indicators is symptomatic of an area that has sufficient saturation to classify the area as a wetland. Terrain unit, which is another indicator of wetland areas, refers to the land unit in which the wetland is found.

In practice all indicators should be used in any wetland assessment/delineation exercise, the presence of redoximorphic features being most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to Department of Water Affairs and Forestry (2005), the more wetland indicators that are present the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present. Classification for the purpose of the current project therefore focused on classifying watercourses according to the most dominant hydrological and geomorphological drivers, especially in terms of relating potential impacts of the potential development on especially the watercourses associated with the study area.

Two hydro-geomorphic wetland types were identified and delineated within the study area and within 500m from the study area during the present study and classified into two distinct hydro-geomorphic (HGM) units, HGM 1, a hillslope seepage wetland connected to HGM 2, and HGM 2, a valley bottom wetland that was likely unchannelled historically (Figure 8).

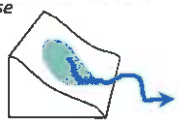
HGM units encompass three key elements (Kotze et al., 2008):

(1) Geomorphic setting. This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
(2) Water source. There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
(3) Hydrodynamics, which refers to how water moves through the wetland.

Table 1 describes the characteristics that form the basis for the classification of the HGM units within the study area.

The disturbance caused by anthropogenic impacts and resulting vegetation changes made the use of vegetation indicators complex in various circumstances, especially on the temporary boundaries of wetlands. Therefore, identifying wetland features on site was primarily done by identifying terrain unit, soil forms and soil wetness features such as the presence of mottling, a gleyed matrix and/or Fe and Mg concretions. However, vegetation indicators did confirm to delineated boundaries and wetness zonation in many instances. Further, the exact extent of hydrological features could not always be determined due to various disturbances and the high degree of transformation within various sections of the associated catchments and within the wetland e.g. bulk earthworks associated with historical platform development.

Table 1: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa within the vicinity of the study area (adapted from Kotze et al., 2008)

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seepage feeding a watercourse 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a watercourse.	*	***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source:
- * Contribution usually small
- *** Contribution usually large
- */*** Contribution may be small or important depending on the local circumstances

 Wetland

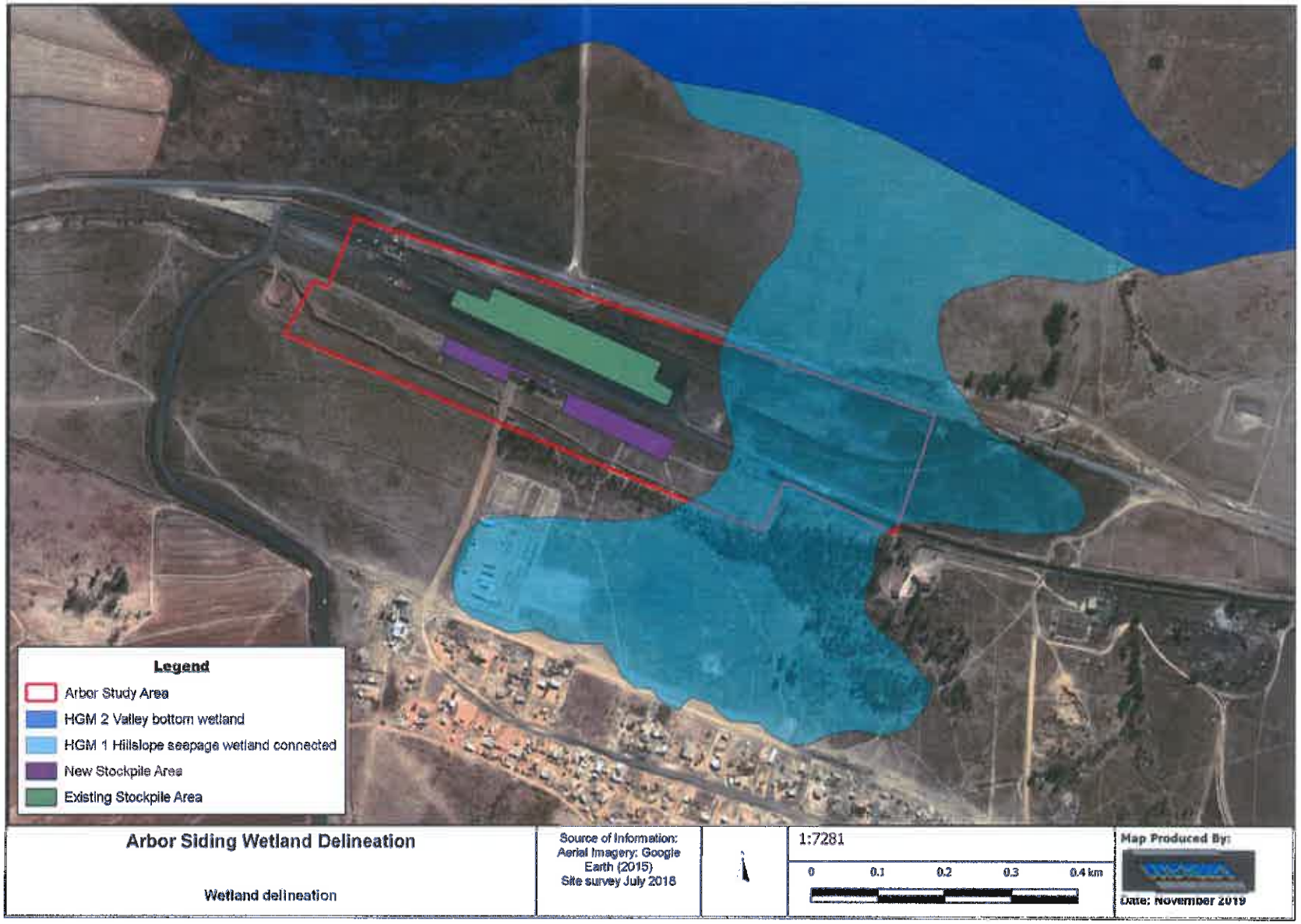


Figure 11: Delineated wetlands within the study area and within 500m from the study area

3.4 Functional and Present Ecological State Assessment

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits therefore contribute directly or indirectly to increase biodiversity within the transformed study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes (Table 2).

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands in the study area, means that these wetlands are able to contribute better to some ecosystem services than to others (Kotze et al., 2008). The determined Present Ecological State and wetland ecosystem services provided by HGM 1 and HGM 2 are discussed in more detail below.

Table 2: Potential wetland services and functions in study area

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment trapping	Particle assimilation
Harvesting of natural resources	Reeds, Hunting, etc.
Livestock usage	Water for livestock
	Grazing for livestock
Crop farming	Irrigation

3.4.1 Hydro-Geomorphic Unit 1 (HGM 1): Hillslope seepage wetland connected to a watercourse

The highest scoring eco-services attributes for the hillslope seepage wetland associated with the study area were streamflow regulation, sediment trapping, phosphate trapping, nitrate removal and provision of natural resources (Figure 9). The accumulation of organic matter and fine sediments in the wetland soils results in the wetland slowing down the sub-surface movement of water down the slope. This "plugging effect" increases the storage capacity of the slope above the wetland, and prolongs the contribution of water to the stream system during low flow periods (Kotze, 2005). Seepage wetlands are commonly considered to supply a number of water quality enhancement benefits, for example, removing excess nutrients and inorganic pollutants produced by agriculture, industry and domestic waste (Rogers *et al.*, 1985; Gren, 1995; Ewel, 1997; Postel, 1997). Hillslope seepage wetlands generally would be expected to have a relatively high nitrogen removal potential. Nitrogen, and specifically nitrate removal, could be expected as the groundwater emerges through low redox potential zones within the wetland soils, with the wetland plants contributing to the necessary supply of organic carbon. Particularly effective removal of nitrates has been recorded from diffuse sub-surface flow, as characterizes hillslope seepages (Muscutt *et*

al., 1993). Various agricultural activities and housing with pit latrines occur within the catchment of the seepage wetland and would likely act as sources of nitrates and phosphates.

The seepage wetlands are expected to contribute to biodiversity through potentially serving as a movement corridor for faunal species as well as through the provision of habitat, albeit to a much diminished capacity . Further, from a natural resource utilisation perspective, seepage wetlands within the study area were evidently utilised for grazing and has been previously utilised for the planting pasture and crops. Some small sand mining activities have also been noticed within the seepage wetland.

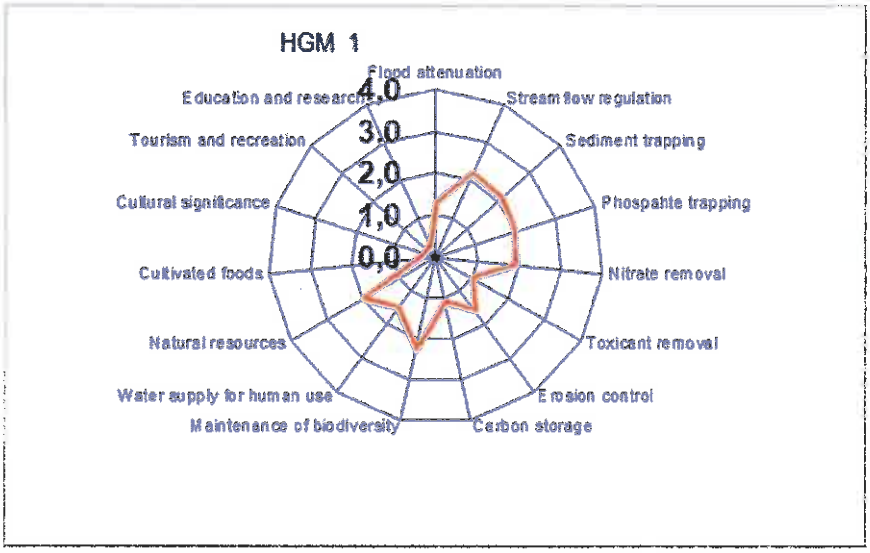


Figure 12: Radar diagram depicting ecosystem services for HGM 1

Each wetland's ability to contribute to ecosystem services within the study area is further dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. Through the use of a scoring system, the perceived departure of elements of each particular system from the "natural-state" was determined. The following elements were considered in the assessment:

- Hydrologic: Flow modification (has the flow, rates, volume of run-off or the periodicity changed);
- Geomorphic (Canalisation, impounding, topographic alteration and modification of key drivers);
- Biota (Changes in species composition and richness, Invasive plant encroachment, over utilization of biota and land-use modification)

Degradation of wetlands through impacts in catchments or in wetlands themselves is resulting in the reduction and loss of their functional effectiveness and ability to deliver ecosystem services or benefits to humans and the environment (Kotze *et al.*, 2008). The set relationships allow the provision of ecosystem services to be inferred from the determination of wetland health (PES) and presented as healthy wetland hectare equivalents.

Wet-Health results obtained for HGM 1 indicate that the hillslope seepage wetland is largely to seriously modified (PES category D/E), Table 3.

Table 3: Wet-Health scores for HGM 1

Hydrology	Geomorphology	Vegetation	Ecological Category
5.5	4.0	8.5	D (5.9)

PES scores obtained for the hydrology module indicated that water inputs derived from the wetland's catchment have been modified and that water retention and distribution patterns within the hillslope seepage wetland within the study area have been largely modified. Alien invasive species dominate in a few sections of the wetland and within the wetland's catchment, likely resulting in reduced inflow to the HGM unit. Changes in flow patterns within the catchment of the wetland also include road infrastructure, buildings, hardened surfaces, excavations as well as reduced basal cover in various segments. Distribution and retention patterns of water within the wetland itself has been negatively impacted by dense alien invasive stands, vegetation removal, road and railway infrastructure as well as drainage channels and stormwater features. A large opencast coal mine is located within the upper catchment of the wetland which is likely partially responsible for negative impacts on the hydrology of the seepage wetland

Vegetation composition changes of the hillslope seepage wetland was also a considerable driver of the Present Ecological State category. Due to the nature of historic and current land uses within the catchment, species composition within the wetlands have changed relative to the perceived natural condition or benchmark. This was most evident in areas with historic and or current infrastructure, alien vegetation infestation which dominated a portion of the hillslope seepage wetland, areas dominated by terrestrial and pioneer species, as well as areas utilised for cultivation. Surface roughness within the wetlands have also been reduced as a result of successional changes which caused reduced basal cover in many areas, likely through historic heavy grazing regimes and infrastructure development.

3.4.2 Hydro-Geomorphic Unit 2 (HGM 2): Valley Bottom Wetland

HGM 1 represents a valley bottom wetland, that is situated just north of the study area. From a functional perspective, HGM 1 received its highest ecosystem services scores for flood attenuation, nitrate removal, toxicant removal, maintenance of biodiversity and natural resources (Figure 10). According to Kotze (2005), compared to floodplains, valley bottom wetlands tend to contribute less towards flood attenuation and sediment trapping, but would supply these benefits to a certain extent, especially where HGM 1 intermittently displays a relatively wider cross-sectional profile, more gradual slopes and dense vegetation which provides high surface roughness. Certain parts also display floodplain features which will help spread floodwaters and serve as a temporary attenuation feature, especially upstream from the study area.

Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the supporting lateral footslope seepages associated with HGM 1. Toxicant removal can likely take place through photodegradation in shallow open water bodies along the intermittent main stream channel and farm dams. From a direct human benefit perspective, the valley bottom is extensively utilised for grazing of livestock, especially during the winter months as well as potentially for some selective reed harvesting. It is also expected that HGM 2 serves as a biodiversity corridor linking species with several wetland and riverine habitat as well as primary upland terrestrial areas

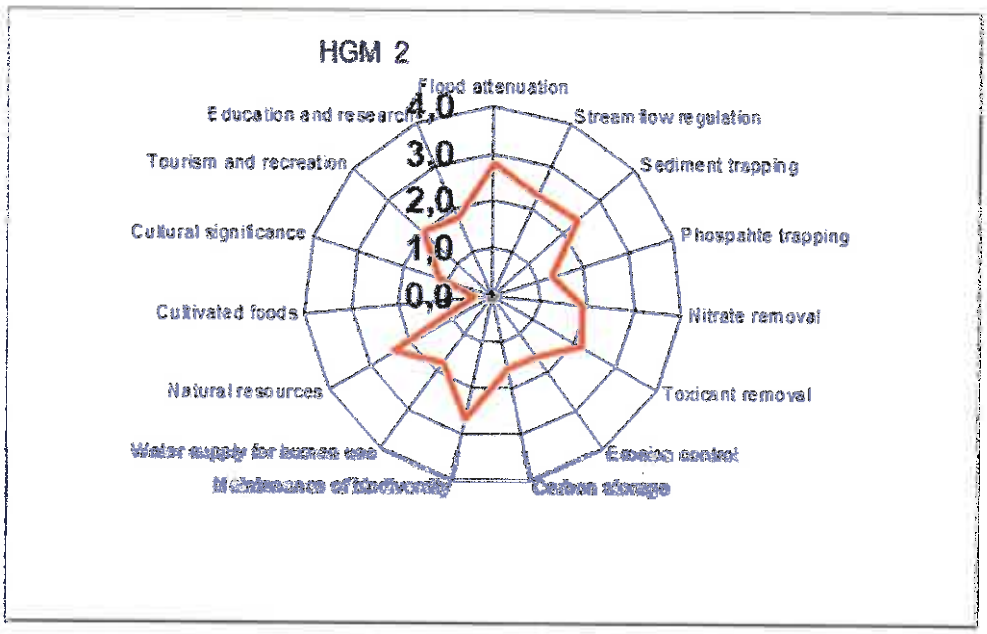


Figure 13: Radar diagram depicting ecosystem services for HGM 2

Scores obtained for the hydrology module indicated that water inputs (derived from its catchment) and water retention and distribution patterns within the hydrogeomorphic unit itself have been moderately altered. The HGM unit was determined to be moderately modified (PES Category C; Table 4). HGM 2 drains a considerable catchment which is dominated by agricultural areas embedded with natural to semi-natural areas as well as some mining activities within especially the upper catchment associated with the Ogies mining area. The largest impact on the hydrology of the system are irrigation dams and a slight increase in peak flow discharges as a result of road infrastructure, soils compaction and reduced basal cover associated with poor land management in some areas. Road and other linear infrastructure often results in nick points due to concentrated floe through limited culverts which can increase channelization in some sections.

Historic and current impacts on the wetland in combination with landuse changes in the surrounding catchments resulted in species composition changes in several sections of the wetland, including establishment of invasive alien vegetation as well as rudimentary and pioneer species establishing in some of the disturbed areas. If one were to focus on a much smaller extent of the valley bottom and reduce the inclusion of catchment issues further away, the local section of valley bottom wetland just north of the study area seems to be in very good condition and provide habitat for species of conservation concern which would lend itself towards a PES category B (largely intact) wetland an thus serve as a confirmation of a FEPA wetland.

Table 4: Wet-Health scores for HGM 2

Hydrology	Geomorphology	Vegetation	Ecological Category
3.5	2.0	3.6	C (3.1)

3.5 Ecological Importance and Sensitivity

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. The vegetation in and around rivers and drainage lines play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment. All flood lines, riparian zones and wetlands along with corresponding buffer zones must be designated as sensitive.

The Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses).

Water resources which have high values for one or more of these criteria may thus be prioritised and managed with greater care due to their ecological importance (for instance, due to biodiversity support for endangered species), hydrological functional importance (where water resources provide critical functions upon which people may be dependent, such as water quality improvement) or their role in providing direct human benefits (Rountree et al., 2013). Ecological Importance and Sensitivity results for HGM 1 identified to be associated with the study area are listed in Table 6.

Table 6: Ecological Importance and Sensitivity scores for wetland complexes

Wetland Complex	Parameter	Rating (0 -4)	Confidence (1 – 5)
HGM 1 (Hillslope seepage wetland)	Ecological Importance & Sensitivity	Low (1.8)	1.5
	Hydrological / Functional Importance	Moderate (2.1)	2.0
	Direct Human Benefits	Low (1.9)	2.5
HGM 2 (Valley bottom wetland)	Ecological Importance & Sensitivity	Very High (3.1)	1.5
	Hydrological / Functional Importance	High (3.1)	2.0
	Direct Human Benefits	Moderate (1.5)	2.5

Hydrological and Functional Importance for HGM 1 was considered to be moderate as a result of the important bio-geochemical processes that hillslope seepages renders and supporting role to the potential FEPA wetland downstream. Although the hydrology seems to be largely to seriously impacted at this stage, the post mining environment could re-instate hydrological drivers once the void in the upper catchment are filled. The seepage wetland could therefore potentially receive increased flows in the future, including possible decant with poor associated water qualities. The Ecological Importance and Sensitivity of HGM 1 was perceived to be low as a result of anthropogenic impacts especially the dominance of invasive and terrestrial vegetative species in several sections of the wetland.

HGM 2, the valley bottom wetland was assigned a very high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the occurrence of species of conservation concern, status of the associated wetland vegetation type, several FEPA wetlands and wetland clusters

downstream from the study areas as well as the importance of providing clean water and biodiversity support to the Wilge River.

4. IMPACT ASSESSMENT

Potential impacts of the proposed activity on the associated wetland ecosystem were assessed in terms of a formalised method, whereby a typical risk assessment process was undertaken in order to determine the significance of the potential impacts without the application of mitigation/management measures (i.e. without mitigation measures, or WOMM). Once the significance of the impacts without the application of mitigation/management measures was known, the impacts were then re-evaluated, taking cognisance of proposed mitigation/management measures provided in order to reduce the impact (i.e. with mitigation measures, or WMM), thus enabling an understanding of the overall impact after the implementation of mitigation/management measures.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction phase and the operational phase. The criteria against which these activities were assessed are discussed below.

Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

Extent of the Impact

A description of whether the impact will be local, limited to the study area and its immediate surroundings, regional, or on a national scale.

Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

The following risk assessment was used to determine the significance of impacts:

Significance = (Magnitude + Duration + Scale) x Probability

The maximum potential value for significance of an impact is 100 points. Environmental impacts can thus be rated as high, medium or low significance on the following basis:

- High environmental significance 60 – 100 points
- Medium environmental significance 30 – 59 points
- Low environmental significance 0 – 29 points

Table 7 illustrates the scale used to determine the overall ranking.

Table 7: Scale used to determine significance ranking

Magnitude (M)		Duration (D)	
Description	**Numerical value**	**Description**	**Numerical value**
Very high	10	Permanent	5
High	8	Long-term (ceases at end of operation)	4
Moderate	6	Medium-term	3
Low	4	Short-term	2
Minor	2	Immediate	1
Scale (S)		**Probability (P)**	
Description	**Numerical value**	**Description**	**Numerical value**
International	5	Definite (or unknown)	5
National	4	High	4
Regional	3	Medium	3
Local	2	Low	2
Site	1	Improbable	1
None	0	None	0

5.1 Impact Assessment

Proposed development within the study area include the opencast pit, various stockpiles, clean and dirty water infrastructure, offices and workshops (Figure 12).

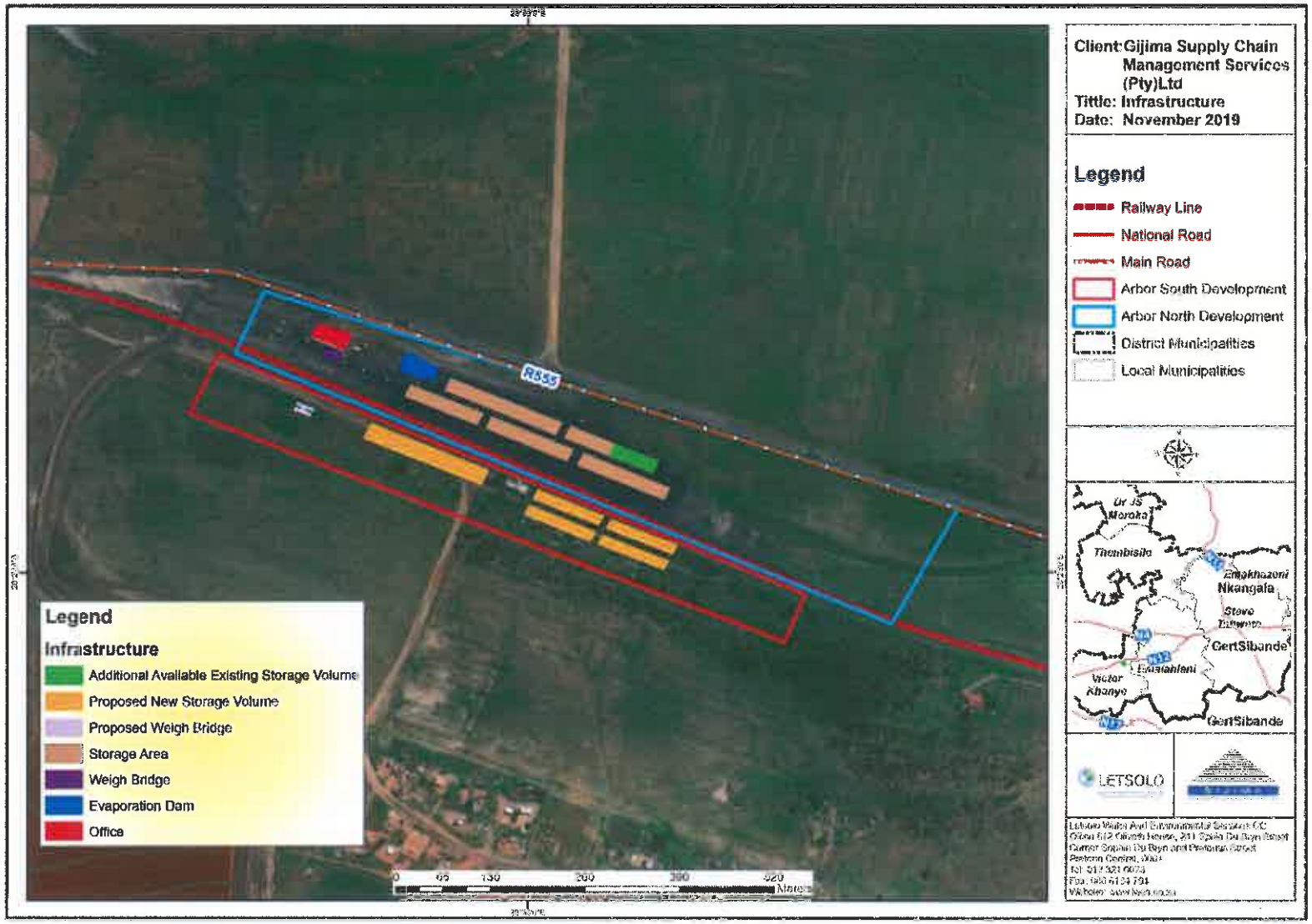


Figure 12: Proposed lay-out of the existing and proposed railway siding and stockpiling infrastructure within the study area

Possible impacts and their sources associated with the proposed activities are provided in Table 8 (Construction Phase) and Table 9 (Operational and Decommissioning Phase). Some of the impacts are relevant during more than one phase and has therefore only been described once under the initial phase.

Table 8: Possible impacts arising during the construction phase

Possible impact	Source of impact
Destruction of wetlands	Destruction of hydric soils, hydrophytic vegetation and changes to catchment hydrology including changes to sub-surface flow regimes
Sedimentation of wetland and increased erosion	Runoff from construction activities associated with clearing of natural vegetation and earthworks related activities
Pollution of water resources	Mobilisation of sediments, excavations removal and disturbances to vegetation, mobilisation of sulphur, hydrocarbon, metals, pyrite and or other harmful aquatic compounds.
Altered hydrologic regime	Destruction of hydric soils, hydrophytic vegetation and changes to catchments hydropedological regimes including changes to sub-surface flow regimes
Decrease of downstream water quality	Discharge of polluted water Lack of clean and dirty water separation.

Table 9: Possible additional impacts arising during the operational phase and decommissioning phase

Possible Risks	Source of the Risk
Decreased downstream water quality	Pollution from remnant spillages and ineffective clean and dirty water separation

4.1.1 *Construction and Operational Phase*

Degradation of wetlands

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without mitigation measures	Regional (3)	Permanent (5)	High (8)	High (4)	High (64)	Low
With mitigation measures	Local (2)	Short term (2)	Low (4)	Medium (3)	Low (24)	Low

Description of Impact

The footprint of new infrastructure will not directly infringe on or destroy wetland habitat. No direct impacts such as the destruction of hydric soils or hydrophytic vegetation is therefore expected according to the layout plan along with standard environmental controls, some of which mentioned below. The largest indirect threat to wetlands and the downstream environment is the potential influx of coal and coal discard materials and pollutants being carried downstream through stormwater and potential subsurface flows as per the current situation.

Mitigation Measures

- All contaminated water and acidic water emanating from the stockpiles and dirty water areas will be channelled into the dirty water system and will eventually end up in the pollution control dam. From here the water will be appropriately treated before it is released or utilised as dust suppression within the dirty water area.
- Management has the responsibility to inform members of staff of the need to be vigilant against any practice that will have a harmful effect on wetlands;
- Any proclaimed weed or alien species that germinate during the operational period shall be cleared by hand before flowering;
- The re-release of clean water from clean and dirty water separation infrastructure must be diffused and not reach wetland habitat as concentrated flows. The stormwater plan must include adequate attenuation facilities to ensure that peak flows do not cause negative impacts on wetlands. More specifically as a guideline, stormwater release structures must be designed to be released diffusely, mimicking seepage wetlands;
- The construction of surface stormwater drainage systems during the operational phase must be done in a manner that would protect the quality and quantity of the downstream system;
- All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimized, and be surrounded by bunds. It should also only be stored for the minimum amount of time necessary;
- Littering and contamination of water sources during mining activities must be mitigated by effective camp management;
- All construction materials including fuels and oil should be stored in a demarcated area that is contained within a bunded impermeable surface to avoid spread of any; and

Sedimentation of wetlands and increased erosion

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without mitigation measures	Regional (3)	Medium-term (3)	High (8)	Moderate (3)	Medium (42)	Moderate
With mitigation measures	Local (2)	Short-term (2)	Low (4)	Moderate (3)	Low (24)	Moderate

Description of Impact

The clearing of natural vegetation and the stripping of topsoil will result in increased runoff of sediment from the site into watercourses associated with the study area. This is particularly so during times of high rainfall and high winds. Water flowing down trenches and access roads, as well as movement of vehicles and personnel, could cause additional erosion processes and sediment to accumulate within the wetland areas. The potential siltation of the wetland system would alter geomorphologic functioning, the movement of water through the system (hydrological functioning) as well as having an impact on water quality within the resource. In addition, hardened surfaces and bare areas are likely to increase surface run off velocities and peak flows received by wetlands unless mitigated.

Mitigation Measures

- A phased planned approach must be taken when construction is initiated. Areas must only be stripped directly prior to construction and only expose soils to erosion for the minimum period necessary. Where possible, re-vegetation of areas must be implemented as soon as possible;
- An effective stormwater and clean and dirty water separation must be designed and approved by a wetland specialist as part of the WULA. Erosion control and stormwater infrastructure must form the basis of the initial construction activities, prior to production related construction activities;
- Wetland habitat must be clearly demarcated and access strictly prohibited (fenced off);
- Topsoil and subsoil must be stockpiled separately in low heaps;
- Stockpile any topsoil or any overburden material outside of the outer boundary of wetlands;
- Erosion must not be allowed to develop on a large scale before effecting repairs;
- Make use of existing roads and tracks where feasible rather than creating new routes through vegetated areas;
- Vegetation and soil must be retained in position for as long as possible, and removed immediately ahead of construction / earthworks in that area (DWAF, 2005);
- Runoff from roads must be managed to avoid erosion and pollution problems;
- All areas susceptible to erosion must be protected and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas;
- Natural trees, shrubbery and grass species must be retained wherever possible;
- Areas exposed to erosion due to construction should be vegetated with species naturally occurring in the area; and
- Surface water or storm water must not be allowed to concentrate, or flow down cut or fill slopes without erosion protection measures being put in place.

Pollution of water resources

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without mitigation measures	Regional (3)	Permanent (5)	High (8)	High (4)	High (64)	Medium
With mitigation measures	Local (2)	Short-term (2)	Low (4)	Low (3)	Low (24)	Medium

Description of Impact

Hydrocarbon-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into the surface water bodies. The mobilisation of sediments, excavations, removal and disturbances to vegetation, mobilisation of sulphur, hydrocarbon and pyrite compounds could have various negative impacts on wetlands and their associated functionality. Should appropriate toilet facilities not be provided for construction workers at the construction crew camps, the potential exists for surface water resources and surroundings to be contaminated by raw sewage. The utilisation of the water courses for disposal of water used for washing will decrease the abundance and diversity of aquatic macro-invertebrates inhabiting the section of the wetland areas associated with the proposed development and possibly further downstream.

It is recommended that he proposed lay-out plan be adapted in order to shift stockpiles slightly to the west to enable a more effective clean and dirty water separation trough staying on the western side of the highest local topographical line (Proposed new additional stockpile area). Dirty water will thus be able to drain away from the seepage wetland and connectivity within the seepage wetland increased (Figure 14). Other site specific measures include:

- Installing a clean water cut-off trench side on the south eastern side of the siding (southern periphery of the study area. Both the existing clean water cut-off trench and the new proposed clean water cut-off trench must also be accompanied by the installation of diffuse release structure (Figure 14)
- The dirt road from the mine to the south must receive a speedhump to allow stormwater to be diverted from entering the dirty water area and pass into a silt trap before passing through the diffuse release structure (from the clean water cut-off trench on the western side)
- A monitoring program must be implemented to ensure that effective clean and dirty water sparation is achieved. The monitoring program must also monitor sub-surface flow regimes to inform the proposed Rehabilitation Phase B recommendations. The monitoring program should include the establishment and monitoring of a piezometer network

Although the risk is reduced as a result of the proposed lay-out plan and distance of wetlands from the stockpiling area, the following general mitigation measures should still be implemented:

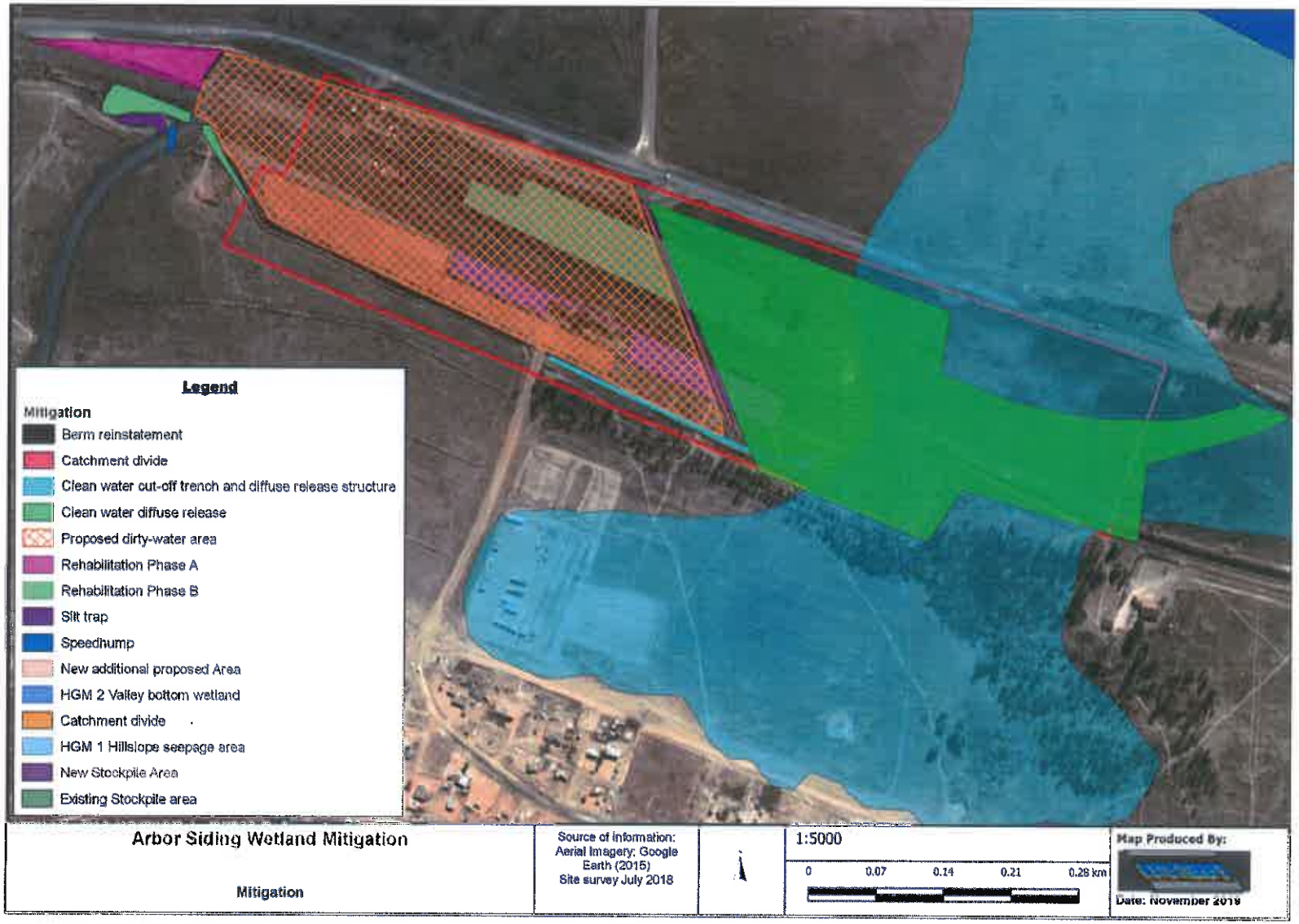


Figure 14: Proposed mitigation measures including proposed clean and dirty water separation measures

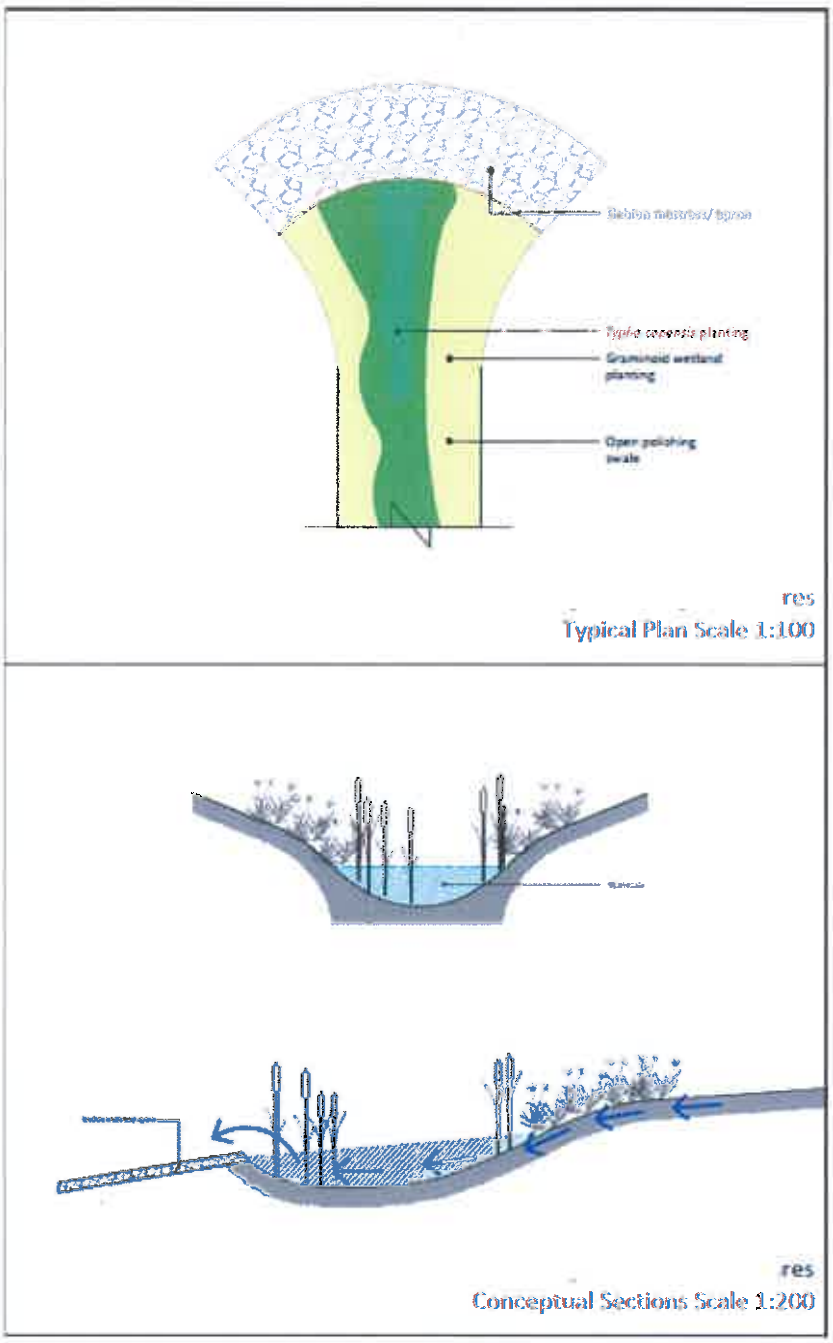


Figure 15: Diffuse release structure to be installed on the downstream side of each of the clean water cut-of trenches

General Mitigation Measures

- Construction vehicles are to be maintained in good working order so as to reduce the probability of leakage of fuels and lubricants;
- Emergency plans and infrastructure to deal with spillages (especially hydro-carbon spillages) must be in place, this should include mobile response units to deal with spillages in the field;

- A walled concrete platform, dedicated store with adequate flooring or bermed area should be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Storage of potentially hazardous materials should be above any 100-year flood line, or as agreed with the Environmental Control Officer. These materials include fuel, oil, cement, bitumen etc.;
- Surface water draining off contaminated areas containing oil and petrol would need to be channelled towards a sump which will separate these chemicals and oils;
- All construction materials liable to spillage are to be stored in appropriate structures with impermeable flooring;
- Portable septic toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;
- Under no circumstances may ablutions occur outside of the provided facilities;
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;

- Store all litter carefully so it cannot be washed or blown into any of the water courses within the study area;
- Provide bins for construction workers and staff at appropriate locations, particularly where food is consumed;
- The construction site should be cleaned daily and litter removed; and
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering.

Altered hydrological regime

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without mitigation measures	Regional (3)	Permanent (5)	High (8)	Medium (3)	Moderate (48)	Low
With mitigation measures	Local (2)	Long-term (4)	Moderate (4)	Low (2)	Low (20)	Low

Description of impact

The reduction of recharge areas and the destruction of interflow soils could result in changes to the hydrological regime to the seepage wetland (HGM 1). Further, the presence of hard impermeable surfaces such as roads, parking areas and roofs, will result in an increase in stormwater runoff volume and velocity. The increase of surface water runoff and the decrease of infiltration will result in an increase in erosion potential and sedimentation. Attenuation of surface water runoff and its subsequent diffused release are imperative to control erosion on site and not accentuate the problem. The development of a comprehensive surface runoff and stormwater management plan is therefore required, indicating how all surface runoff generated as a result of the development This plan should also indicate how surface runoff

will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological regimes.

Mitigation Measures

- Implement an ecologically-sensitive stormwater management plan that includes not allowing stormwater to be discharged directly into watercourse and drainage lines.

Decrease in downstream water quality.

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without mitigation measures	Regional (3)	Long Term (4)	Moderate (6)	Medium (3)	Medium (39)	Medium
With mitigation measures	Local (2)	Long-term (4)	Moderate (4)	Low (2)	Low (20)	Low

Description of impact

Site-based pollution sources associated with the loading facility (e.g. runoff from stockpiles, etc.) are likely to occur and the possibility therefore exists that runoff water from this area could potentially enter into HGM 1 and result in water quality impairment.

Mitigation Measures

- Provide a mechanisms such as the installation of silt traps that will prevent sedimentation of associated watercourses during all phases of the project.
- All pollution control dams or any other such dirty water dams should be lined with an impermeable layer so as to prevent seepage into the underlying weathered rock present;
- Separate clean and dirty water systems, not allowing dirty water to be released into watercourses;
- A designated area for the servicing of vehicles is to be demarcated outside of all proposed buffer areas. Surface water draining off contaminated areas containing oil and petrol must be channelled towards a sump which will separate these chemicals and oils;
- Oil residue shall be treated with oil absorbent such as Drizit or a similar product and this material removed to an approved waste site;
- Stormwater shall not be allowed to flow through the batching area or washing area. Cement sediment shall be removed from time to time and disposed of in a manner as instructed by the consulting engineer;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;
- No uncontrolled discharges from the project area to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;

4.1.2 *Decommissioning Phase*

Phase A rehabilitation should be implemented as soon as possible (Figure 15). This area can be cleared of rubble and anthropogenic materials, ripped, scarified and appropriately replanted with a terrestrial graminoid species mix in order to effect diffuse clean water run-off.

Phase B rehabilitation should be implemented during the decommissioning phase or when the opportunity arises and or when the wetland monitoring program indicates increased hydrological flows (e.g. once draw down effect from the opencast mine in the upper catchment ceases post mining). The study area has undergone some severe historic impacts, many a result of SANRAL infrastructure developments. The linear nature of these infrastructure impacts should be rectified through re-establising and enhancing connectivity within the seepage wetland, thereby providing increased hydrological support to the sensitive HGM 2 downstream. This is not limited to but includes the one railway siding not in use anymore and increasing sub-surface and surface flow paths across linear infrastructure. A detailed rehabilitation and landscape plan should be designed in conjunction with SANRAL that needs to share responsibility, especially since SANRAL is currently constructing a new road through the seepage wetland).

Figure 16: Old railway siding on the eastern periphery that is not in use anymore acts as an effective, large drainage canal. Note that the whole of the old siding is located within the seepage wetland

5. CONCLUSION AND RECOMMENDATIONS

Two hydro-geomorphic wetland types were identified and delineated within the study area and within 500m from the study area during the present study and classified into two distinct hydro-geomorphic (HGM) units, HGM 1, a hillslope seepage wetland connected to HGM 2, and HGM 2, a valley bottom wetland that was likely unchannelled historically

The HGM units were found to potentially perform functions through the provision of various ecosystem services such as streamflow regulation, flood attenuation, nitrogen removal, toxicant removal, phosphate and sediment trapping. However, ecosystem services provided by the wetlands within the study area has been impacted through current and historic anthropogenic activities. Combined area weighted Wet-Health results indicated that the wetlands associated within 500m from the study area have been moderately to largely altered as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetlands units, as well as vegetation changes within the wetlands and surrounding catchments due to historic and current anthropogenic impacts.

Hydrological and Functional Importance for HGM 1 was considered to be moderate as a result of the important bio-geochemical processes that hillslope seepages renders and supporting role to the potential FEPA wetland downstream. Although the hydrology seems to be largely to seriously impacted at this stage, the post mining environment could re-instate hydrological drivers once the void in the upper catchment are filled. The seepage wetland could therefore potentially receive increased flows in the future, including possible decant with poor associated water qualities. The Ecological Importance and Sensitivity of HGM 1 was perceived to be low as a result of anthropogenic impacts especially the dominance of invasive and terrestrial vegetative species in several sections of the wetland.

HGM 2, the valley bottom wetland was assigned a very high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the occurrence of species of conservation concern, status of the associated wetland vegetation type, several FEPA wetlands and wetland clusters downstream from the study areas as well as the importance of providing clean water and biodiversity support to the Wilge River.

The impact assessment identified surface water pollution including sedimentation and pollution, altered hydrological regime and decreased water quality downstream as the major impacts during the construction and operational phase. Several general and specific mitigation measures were proposed in order to reduce negative impacts and incorporate some potentially positive impacts from the proposed development. It is recommended that he proposed lay-out plan be adapted in order to shift stockpiles slightly to the west to enable a more effective clean and dirty water separation trough staying on the western side of the highest local topographical line (Proposed new additional stockpile area). Dirty water will thus be able to drain away from the seepage wetland and connectivity within the seepage wetland increased . Other site specific measures include:

- Installing a clean water cut-off trench side on the south eastern side of the siding (southern periphery of the study area). Both the existing clean water cut-off trench and the new proposed

clean water cut-off trench must also be accompanied by the installation of diffuse release structure;

- The dirt road from the mine to the south must receive a speedhump to allow stormwater to be diverted from entering the dirty water area and pass into a silt trap before passing through the diffuse release structure (from the clean water cut-off trench on the western side);
- A monitoring program must be implemented to ensure that effective clean and dirty water separation is achieved. The monitoring program must also monitor sub-surface flow regimes to inform the proposed Rehabilitation Phase B recommendations. The monitoring program should include the establishment and monitoring of a piezometer network.

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APPENDIX A – Methodology

Wetland Delineation

The report incorporated a desktop study, as well as field surveys, with site visits conducted during December 2018. Additional data sources that were incorporated into the investigation for further reliability included:

- Google Earth images;
- 1:50 000 cadastral maps;
- ortho-rectified aerial photographs; and
- 5m contour data.

A pre-survey wetland delineation was performed in order to assist the field survey. Identified wetland areas during the field survey were marked digitally using GIS (changes in vegetation composition within wetlands as compared to surrounding non-wetland vegetation show up as a different hue on the orthophotos, thus allowing the identification of wetland areas). These potential wetland areas were confirmed or dismissed and delineation lines and boundaries were imposed accordingly after the field surveys.

The wetland delineation was based on the legislatively required methodology as described by Department of Water Affairs and Forestry (2005). The DWAF delineation guide uses four field indicators to confirm the presence of wetlands, namely:

- terrain unit indicator (i.e. an area in the landscape where water is likely to collect and a wetland to be present);
- soil form indicator (i.e. the soils of South Africa have been grouped into classes / forms according to characteristic diagnostic soil horizons and soil structure);
- soil wetness indicator (i.e. characteristics such as gleying or mottles resulting from prolonged saturation); and
- vegetation indicator (i.e. presence of plants adapted to or tolerant of saturated soils).

The wetland delineation guide makes use of indirect indicators of prolonged saturation by water, namely wetland plants (hydrophytes) and (hydromorphic) soils. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. Hydrophytes were recorded during the site visit and hydromorphic soils in the top 0.5 m of the profile were identified by taking cored soil samples with a bucket soil auger and Dutch clay auger (photographs of the soils were taken). Each auger point was marked with a handheld Global Positioning System (GPS) device (Figure 38).

Wetland Functionality

The methodology "Wet-EcoServices" (Kotze et al., 2008) was adapted and used to assess the different benefit values of the wetland units. A level one assessment, including a desktop study and a field assessment were performed to determine the wetland functional benefits between the different hydro-geomorphological types within the study area. Other documents and guidelines used are referenced accordingly. During the field survey, all possible wetlands and drainage lines identified from maps and aerial photos were visited on foot. Where feasible, cross sections were taken to determine the state and boundaries of the wetlands. Following the field survey, the data was submitted to a GIS program for

compilation of the map sets. Subsequently the field survey and desktop survey data were combined within a project report.

In order to gauge the Present Ecological State of various wetlands within the study area, a Level 2 Wet-Health assessment was applied in order to assign ecological categories to certain wetlands. Wet-Health (Macfarlane et al., 2008) is a tool which guides the rapid assessment of a wetland's environmental condition based on a site visit. This involves scoring a number of attributes connected to the geomorphology, hydrology and vegetation, and devising an overall score which gives a rating of environmental condition.

Wet-Health is useful when making decisions regarding wetland rehabilitation, as it identifies whether the wetland is beyond repair, whether rehabilitation would be beneficial, or whether intervention is unnecessary, as the wetland's functionality is still intact. Through this method, the cause of any wetland degradation is also identified, and this facilitates effective remediation of wetland damage. There is wide scope for the application of Wet-Health as it can also be used in assessing the Present Ecological State of wetlands and thereby assist in determining the Ecological Reserve as laid out under the National Water Act. Wet-Health offers two levels of assessment, one more rapid than the other.

For the assessments, an impact and indicator system were used. The wetland is first categorized into the different hydrogeomorphic (HGM) units and their associated catchments, and these are then assessed individually in terms of their hydrological, geomorphologic and vegetation health by examining the extent, intensity and magnitude of impacts, of activities such as grazing or draining. The extent of the impact is measured by estimating the proportion the wetland that is affected. The intensity of the impact is determined by looking at the amount of alteration that occurs in the wetland due to various activities. The magnitude is then calculated as the combination of the intensity and the extent of the impact and is translated into an impact score. This is rated on a scale of 1 to 10, which can be translated into six health classes (A to F – compatible with the EcoStatus categories used by DWAF, Table 19). Threats to the wetland and its overall vulnerability can also be assessed and expressed as a likely Trajectory of Change.

Determination of Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. As wetlands outside of the study area were only partially visited, there could easily be oversight as detailed studies are required to increase the confidence of the assessment which relied heavily on the experience of the author. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments, and the work conducted by Kotze et al. (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree et al., 2013). An example of the scoring sheet is attached as Table 20. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 21.

Table 12: Interpretation of scores for determining present ecological status (Kleynhans 1999)

Rating of Present Ecological State (Ecological Category)
CATEGORY A
CATEGORY B
CATEGORY C
CATEGORY D
Score: 4 – 5.9; Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE
CATEGORY E
Score: 6 -7.9; Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
CATEGORY F

* If any of the attributes are rated <2, then the lowest rating for the attribute should be taken as indicative of the PES category and not the mean

Table 13: Example of scoring sheet for Ecological Importance and sensitivity

Ecological Importance	Score (0-4)	*Confidence (1-5)*	Motivation
Biodiversity support			
Presence of Red Data species			
Populations of unique species			
Migration/breeding/feeding sites			
Landscape scale			
Protection status of the wetland			
Protection status of the vegetation type			
Regional context of the ecological integrity			
Size and rarity of the wetland type/s present			
Diversity of habitat types			
Sensitivity of the wetland			
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
ECOLOGICAL IMPORTANCE & SENSITIVITY			

Table 14: Category of score for the Ecological Importance and Sensitivity

Rating	Explanation
Very low (0-1)	Rarely sensitive to changes in water quality/hydrological regime.
Low (1-2)	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate (2-3)	Some elements sensitive to changes in water quality/hydrological regime.
High (3-3.5)	Many elements sensitive to changes in water quality/ hydrological regime.
Very high (+3.5)	Very many elements sensitive to changes in water quality/ hydrological regime.

Annexure 16.2-9: Noise Impact Assessment

REPORT
NOISE IMPACT STUDY FOR THE GIJIMA COAL LOADING FACILITY AT ARBOR STATION

November 2019

Report No 19/9/4
Draft 2

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EXECUTIVE SUMMARY

Introduction

Gijima Supply Chain Management Services (Pty) Ltd intends to increase the scope of their current activities at the Arbor Railway Siding, which is located on Portion 1 of Farm Van Dyksput No. 214 - IR within the Victor Khanye Local Municipality (VKLM), under the Emalahleni Magisterial District, Mpumalanga Province.

Arbor Railway Siding is used for loading domestic coal, as well as exporting coal onto rail wagons. The market for this service has been identified as Eskom, as well as neighbouring mines. Arbor is used as a point of entry into the rail network. Although coal mining and transport already forms a part of the ambient noise climate, the noise emissions from the proposed extensions will necessarily have an impact on current ambient noise levels.

This report describes the methodology, results and findings of the required noise impact study.

Purpose of the noise study

The purpose of this noise study was to:

- Conduct a site visit;
- Estimate the pre-development ambient noise levels in the environment of the planned mining operation;
- Develop a model for calculating the noise emissions during the various stages of the mining operation;
- Estimate, present and assess the impact that the noise emissions will have on existing ambient noise levels; and
- Provide a report on the findings of the noise impact study.

Regulatory framework

The present noise regulations [1] were published on 2 July 2010 under the Air Quality Act, 2005 [2]. They are a model that can be adapted by local authorities to suit their specific requirements.

In terms of the setting of standards the regulations make direct and extensive reference to SANS 10103 [3]. This document successfully addresses the way environmental noise measurements are to be taken and assessed in South Africa. It also provides guidelines to typical ambient noise levels that may be expected in different types of districts. Therefore, SANS 10103 [3] was followed for the purpose of this noise impact study.

Methodology of the noise study

Site visit

A site visit was conducted on 7 October 2019 for the purpose of orientation, information gathering and the taking of noise measurement samples.

Modelling of noise emissions

A detailed three-dimensional model of the noise emissions from the Gijima coal loading facility at Arbor and its environment was developed. The propagation of noise was calculated

in accordance with the CONCAWE method, as specified in SANS 10357 [4]. This method takes account of the following:

- Sound power emission levels of equipment and processes;
- Operational conditions at the mine;
- Attenuation due to geometric spreading of the noise energy;
- Absorption of noise energy by the atmosphere and ground;
- Metrological and other atmospheric conditions that influence the propagation of noise, e.g. day- vs night-time conditions; and
- Attenuation due to acoustic screening by the topography and other structures such as pit walls.

Investigated mining phases

The mining phases that were investigated for this noise study are summarised in the table below.

Phase	Description	Activities	Equipment
1	Present operations	Hauling of coal Queuing of trucks Weigh bridge operations Dumping of coal Loading of trains	Road transport truck 40t FEL 966 Water bowser
2	Construction Daytime only, i.e. 06:00 – 18:00	Construction: Earth works Offices Weighbridge Storage area Access road	ADT 40 tonne CAT Dozer 68 tonne CAT Dozer 40 tonne CAT 14 grader Vibrating roller Water Bowser
3	Operation 24 hr operation	Hauling of coal Queuing of trucks Weigh bridge operations Dumping of coal Loading of trains	Road transport truck 40t FEL 966 Water bowser
4	Closure	Removal of structures and materials	General noise

SITE VISIT AND DESCRIPTION OF THE ENVIRONMENT

The images below show were taken during the site visit on 7 October 2019 for the purpose of orientation, information gathering and the taking of noise measurement samples.

The following observations were made:

- As far as the propagation of noise is concerned the topography in environment of Arbor is flat, thus providing no acoustic screening against the propagation of noise;
- The vegetation mainly consists of grasslands and a limited number of medium sized trees while the ground conditions are compacted. In terms of the propagation of noise over longer distances the conditions can be described as acoustically 'hard'. This means that there will only be little attenuation of noise due to the absorption of sound energy;
- The nearest noise sensitive receptor is Arbor village located approximately 400m south of the railway lines;
- The N4 highway is located at a distance of approximately 1400m towards the North-East;

- Road traffic on the highway is audible but does not provide a significant contribution to ambient noise levels;
- Present ambient noise levels are determined by the movement of coal trucks, the activities at the Arbor loading facility and limited road traffic on the R555;
- Trains on the main railway line pass Arbor in both directions at regular intervals; and
- Despite this, the ambient noise climate in the general area is surprisingly calm. This may largely be due to the fact that substantial road works are being carried out on the R555.

For the purpose of calculating the noise impacts of the proposed extension of the facilities a low baseline ambient noise level of 33 dBA was assumed. This assumption will tend to over- rather than under estimate the severity of any noise impacts.

SUMMARY OF THE FINDINGS

A summary of the findings is given in the table below.

Phase	Severity of the noise impact				Community Reaction **	Estimated Overall Severity
	Resulting total noise level		Increase in noise level			
	Day * Criterion 55 dBA	Night * Criterion 45 dBA	Day	Night		
1 Present	Farmsteads and Arbor village well within criterion level	Farmsteads and Arbor village well within criterion level	-	-	-	-
2 Construction	Farmsteads and Arbor village well within criterion level	-	< 3 dB Insignificant	-	'Little with sporadic complaints'	**Low** Day-time only
3 Operations N & S	Farmsteads and Arbor village well within criterion level	Farmsteads and Arbor village well within criterion level	< 3 dB Insignificant	< 3 dB Insignificant	'Little with sporadic complaints'	**Low** Some activities probably audible
4 Closure	Farmsteads and Arbor village well within criterion level	-	< 1 dB Negligible	-	'No response'	**Very Low** Day-time only

Note *: Table 2 of SANS 10103 [3] lists 45 dBA and 35 dBA as typical for 'rural districts' during the day (06:00 to 22:00) and night (22:00 to 06:00), respectively.

Note **: Community reaction in accordance with Table 5 of SANS 10103 [3].

NOISE MITIGATION MEASURES

Necessity for noise mitigation

In terms of assessment parameters described in SANS 10103 [3], i.e. the resulting total and increase in ambient noise levels, respectively, the findings indicate that the severity of the of the noise impacts are generally **low**. As a result, the introduction of specific noise mitigation measures is not necessary.

CONCLUSIONS

The following conclusions are drawn from the results and findings of noise impact study:

- Although the area between the R555 and the N4 has a rural character, the larger environment is characterised by coal mines, railway lines and roads. The noise emissions from these sources are constantly audible;
- The significance rating of the noise impacts during construction, operational conditions is **Low**, but **Very Low** during the closure phase;

- Due to the low pre-development ambient noise levels it is likely that mining operations will be audible, depending on location and meteorological conditions; and
- However, due to the character of the environment this is unlikely to cause any additional annoyance or disturbance.

RECOMMENDATIONS

The following recommendations are made:

- All diesel powered machinery must be in good condition and regularly serviced. Servicing must include the inspection of exhaust and intake mufflers and if necessary, their replacement;
- Any change in the noise emission character of diesel powered equipment must trigger a retirement thereof for the purpose of repair and/or servicing;
- The replacement of the traditional reversing alarms that emit beeping single frequency sound with devices that emit broadband frequency noise instead is highly recommended.

REPORT
NOISE IMPACT STUDY FOR THE GIJIMA COAL LOADING FACILITY AT ARBOR STATION

1. INTRODUCTION

Gijima Supply Chain Management Services (Pty) Ltd intends to increase the scope of their current activities at the Arbor Railway Siding, which is located on Portion 1 of Farm Van Dyksput No. 214 - IR within the Victor Khanye Local Municipality (VKLM), under the Emalahleni Magisterial District, Mpumalanga Province.

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This report describes the methodology, results and findings of the required noise impact study.

2. PURPOSE OF THE NOISE STUDY

The purpose of this noise study was to:

- Conduct a site visit;
- Estimate the pre-development ambient noise levels in the environment of the planned mining operation;
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- Estimate, present and assess the impact that the noise emissions will have on existing ambient noise levels; and
- Provide a report on the findings of the noise impact study.

3. REGULATORY FRAMEWORK

The present noise regulations [1] were published on 2 July 2010 under the Air Quality Act, 2005 [2]. They are a model that can be adapted by local authorities to suit their specific requirements.

In terms of the setting of standards the regulations make direct and extensive reference to SANS 10103 [3]. This document successfully addresses the way environmental noise measurements are to be taken and assessed in South Africa. It also provides guidelines to typical ambient noise levels that may be expected in different types of districts. Therefore, SANS 10103 [3] was followed for the purpose of this noise impact study.

4. METHODOLOGY OF THE NOISE STUDY

4.1 Site visit and measurements

A site visit was conducted on 7 October 2019 for the purpose of orientation, information gathering and the taking of noise measurement samples. The ambient noise level was sampled at the location indicated in Figure 4.1.1.

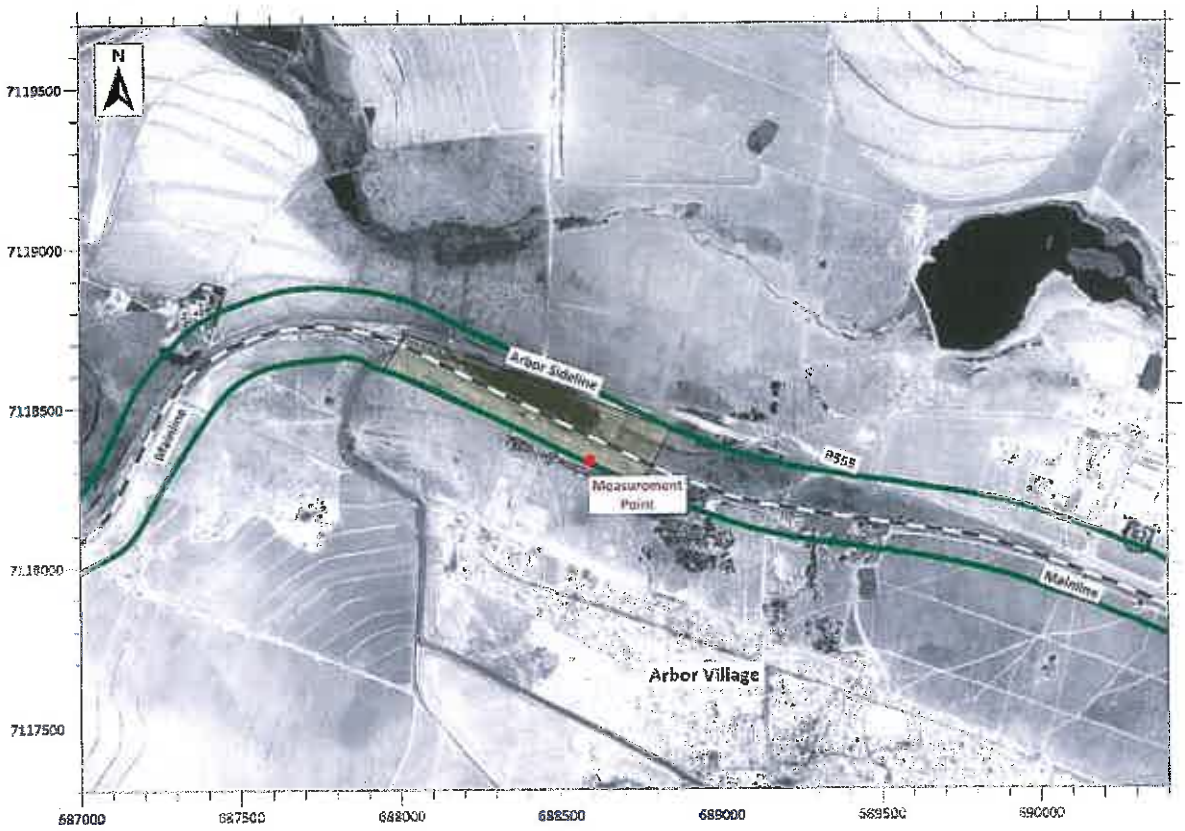

Figure 4.1.1: Image showing the location of the noise measurement point.

4.2 Modelling of noise emissions

A detailed three-dimensional model of the noise emissions from the Gijima coal loading facility at Arbor and its environment was developed. The propagation of noise was calculated in accordance with the CONCAWE method, as specified in SANS 10357 [4]. This method takes account of the following:

- Sound power emission levels of equipment and processes;
- Operational conditions at the mine;
- Attenuation due to geometric spreading of the noise energy;
- Absorption of noise energy by the atmosphere and ground;
- Metrological and other atmospheric conditions that influence the propagation of noise, e.g. day- vs night-time conditions; and
- Attenuation due to acoustic screening by the topography and other structures.

A list of the sound power emission levels of equipment and processes and the assumed meteorological conditions are given in Appendix A to this report.

4.3 Investigated phases

The mining phases that were investigated for this noise study are summarised in Table 4.3.1.

TABLE 4.3.1
Investigated phases

Phase	Description	Activities	Equipment
1	Present operations	Hauling of coal Queuing of trucks Weigh bridge operations Dumping of coal Loading of trains	Road transport truck 40t FEL 966 Water bowser
2	Construction Daytime only, i.e. 06:00 – 18:00	Construction: Earth works Offices Weighbridge Storage area Access road	ADT 40 tonne CAT Dozer 68 tonne CAT Dozer 40 tonne CAT 14 grader Vibrating roller Water Bowser
3	Operation 24 hr operation	Hauling of coal Queuing of trucks Weigh bridge operations Dumping of coal Loading of trains	Road transport truck 40t FEL 966 Water bowser
4	Closure	Removal of structures and materials	General noise

4.4 Presentation and assessment of the results

The modelling results were presented as contours of the resulting total ambient noise levels and the increases in existing ambient noise levels, superimposed on a georeferenced satellite image of the Arbor coal loading facility and its environment.

According to Table 2 of SANS 10103 [3] the typical time-averaged ambient noise levels for an 'urban district' are 55 dBA and 45 dBA for the day- (06:00 to 22:00) and night-time (22:00 to 06:00), respectively. The noise guidelines of the World Health Organisation (WHO) [5] recommends the same noise levels as limits for residential areas. Therefore, in this noise study 55 dBA and 45 dBA were used as criterion noise levels for day- and night-time, respectively.

The contours calculated for future resulting total ambient noise levels were:

- 35 dBA;
- 40 dBA;
- 45 dBA;
- 50 dBA;
- 55 dBA; and
- 60 dBA.

Table 5 of SANS 10103 [3] provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- $\Delta \leq 0$ dB: An increase of 0 dB or less will not cause any response from a community. Any increase of less than 1 dB is negligible. For a person with average hearing acuity an increase of less than 3 dB in the general ambient noise level will not be

noticeable. Therefore, 3 dB is a useful 'significance indicator' that will be used in this study to assess whether a noise impact is significant or not;

- 0 dB < Δ ≤ 10 dB: An increase of between 0 dB and 10 dB will elicit 'little' community response with 'sporadic complaints'. However, between 5 dB and 15 dB the strength of the response will gradually change to 'medium' with 'widespread complaints';
- 5 dB < Δ ≤ 15 dB: An increase of between 5 dB and 15 dB will elicit a 'medium' community response with 'widespread complaints'. It is also worth noting that an increase of 10 dB is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dB the community reaction will be 'strong' with 'threats of community action';
- 15 dB < Δ: For an increase in excess of 15 dB the community response will gradually increase in strength to 'very strong' with 'vigorous community action'; and
- 10 dB < Δ ≤ 20 dB: For an increase of between 10 dB and 20 dB the community response will gradually increase in strength to 'strong' with 'threats of community action';

The overlapping ranges of community responses reflect the fact that there is no clear-cut transition from one community response to another. Instead the transition is more gradual and may differ substantially from one scenario to another, depending on many variables.

The increase in the ambient noise level was expressed as contours of:

- Δ = 0 dB
- Δ = 1 dB
- Δ = 3 dB (significance indicator)
- Δ = 5 dB
- Δ = 10 dB
- Δ = 15 dB

5. RESULTS

5.1 Site visit and description of the environment

A site visit was conducted on 18 May 2018. The following observations were made:

- As far as the propagation of noise is concerned the topography in environment of Arbor is flat, thus providing no acoustic screening against the propagation of noise;
- The vegetation mainly consists of grasslands and a limited number of medium sized trees while the ground conditions are compacted. In terms of the propagation of noise over longer distances the conditions can be described as acoustically 'hard'. This means that there will only be little attenuation of noise due to the absorption of sound energy;
- The nearest noise sensitive receptor is Arbor village located approximately 400m south of the railway lines;
- The N4 highway is located at a distance of approximately 1400m towards the North-East;

- Road traffic on the highway is audible but does not provide a significant contribution to ambient noise levels;
- Present ambient noise levels are determined by the movement of coal trucks, the activities at the Arbor loading facility and limited road traffic on the R555;
- Trains on the main railway line pass Arbor in both directions at regular intervals; and
- Despite this the ambient noise climate in the general area is surprisingly calm. This may largely be due to the fact that substantial road works are being carried out on the R555.

5.2 Results of the ambient noise level measurement sample

The results of the ambient noise level sample measurement are given in Table 5.2.1 and Figure 5.2.1.

TABLE 5.2.1
Summary of the measurement sample results

Start Time	Duration T	Noise level, dBA		Comments
		L_{Aeq} (T)	L_{A90}	
11:44:57	00:10:00	37.3	33.3	Occasional gusts of wind have an effect on the measurement. Limited local traffic audible. Coal trains passing in both directions on the main railway lines. 2x train hooter during the measurement.

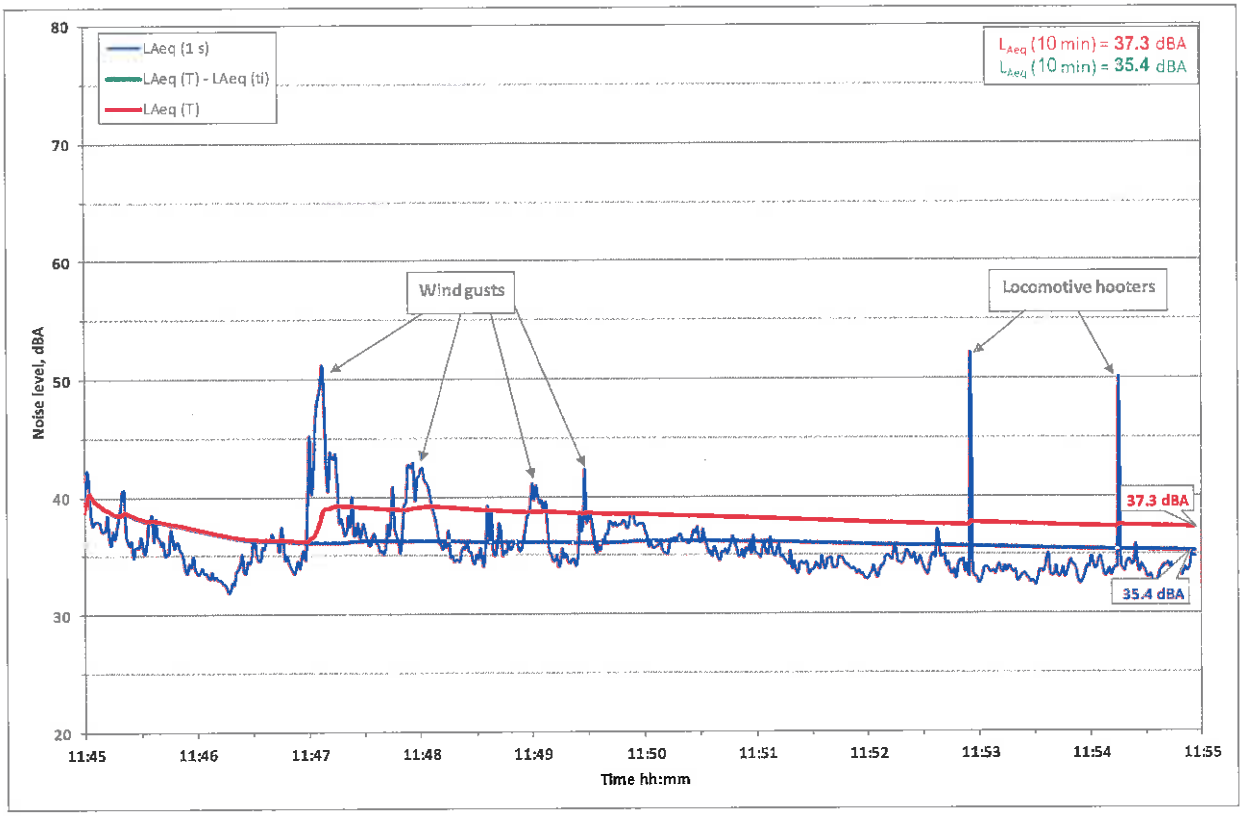

Figure 5.2.1: Time profile of the measurement results.

The green line in the time profile (Figure 5.2.1) shows the effect of removing the noise contributions caused by the gusts of wind and the locomotive hooters. Therefore, the result of 35.4 dBA represents the noise caused by the passing trains at the measurement point. Using the model that was developed (see section 4.2) to calculate the ambient noise levels under the conditions prevalent during the taking of the measurement sample produces the results illustrated in Figure 5.2.2.

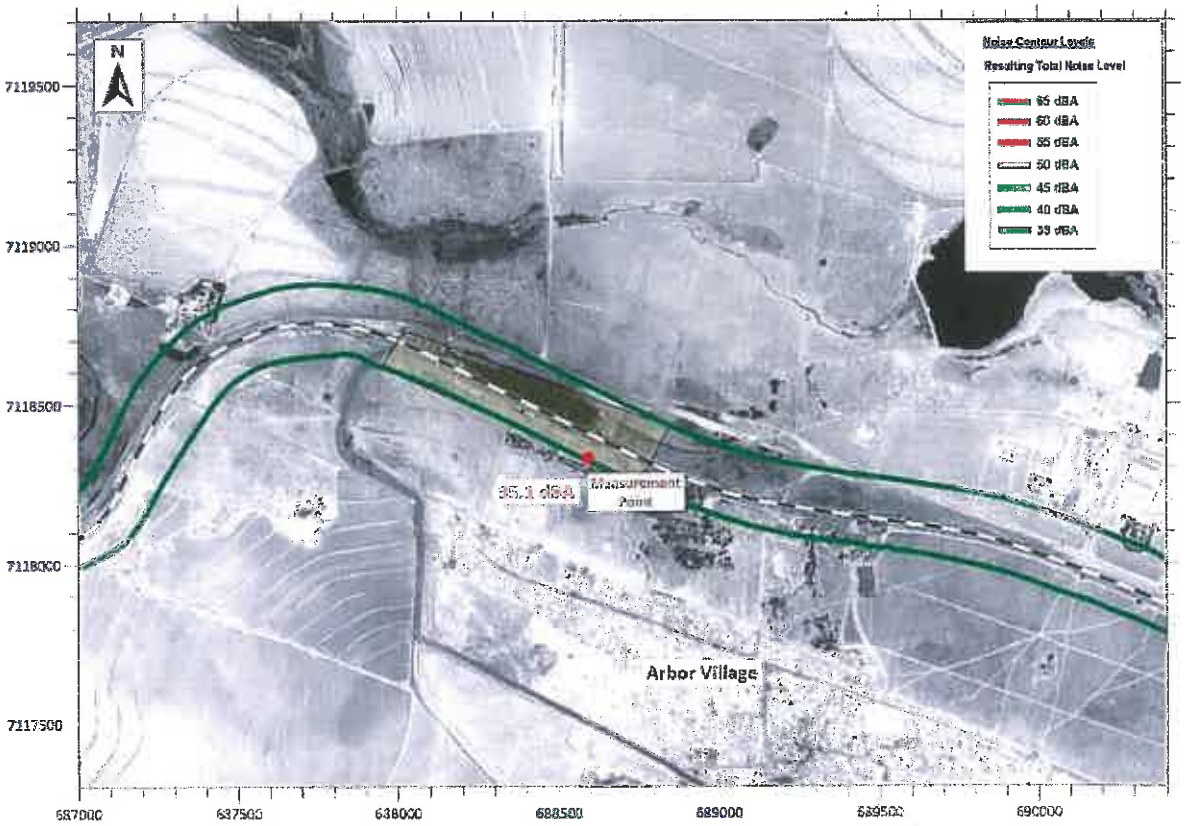

Figure 5.2.2: Modelled ambient noise levels for conditions prevalent during the taking of measurement sample.

The results in figure 5.2.2 show that the modelled noise level at the measurement point is 35.1 dBA, which differs from the processed measurement result by a negligible 0.3 dB.

Therefore, the consultant is confident that the developed model (see section 4.2) produced reliable calculation results.

The measured L_{A90} of 33.3 dBA (see Table 5.2.1) provides a good indication of what the ambient noise level would be in the absence of any noisy single events, e.g. hooters or squealing train wheels. Therefore, for the purpose of calculating the noise impacts of the proposed extension of the facilities a low baseline ambient noise level of 33 dBA was assumed. This assumption will tend to over- rather than under estimate the severity of any noise impacts.

5.3 Phase 1: Present ambient noise levels

The modelled ambient noise levels under the present operating conditions are given in Figures 5.3.1 and 5.3.2.

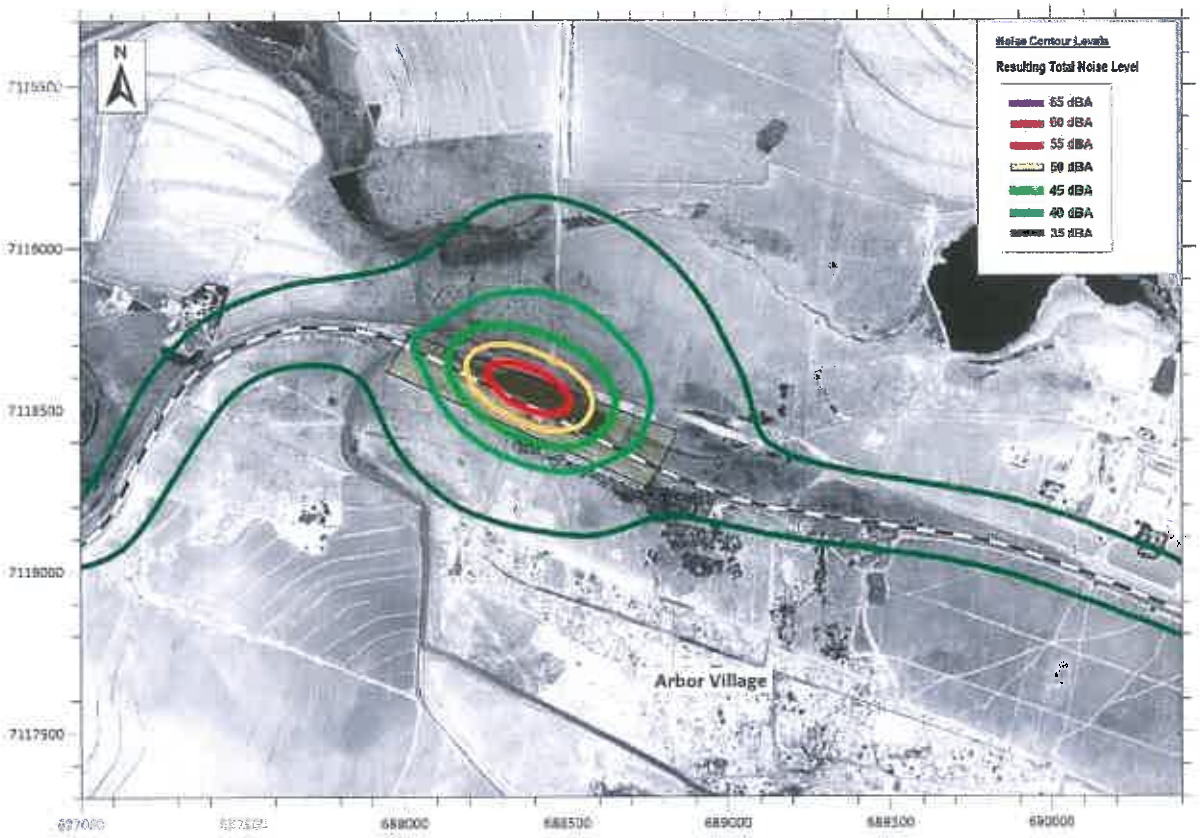

Figure 5.3.1: Phase 1 – Present operations: Day-time ambient noise levels.

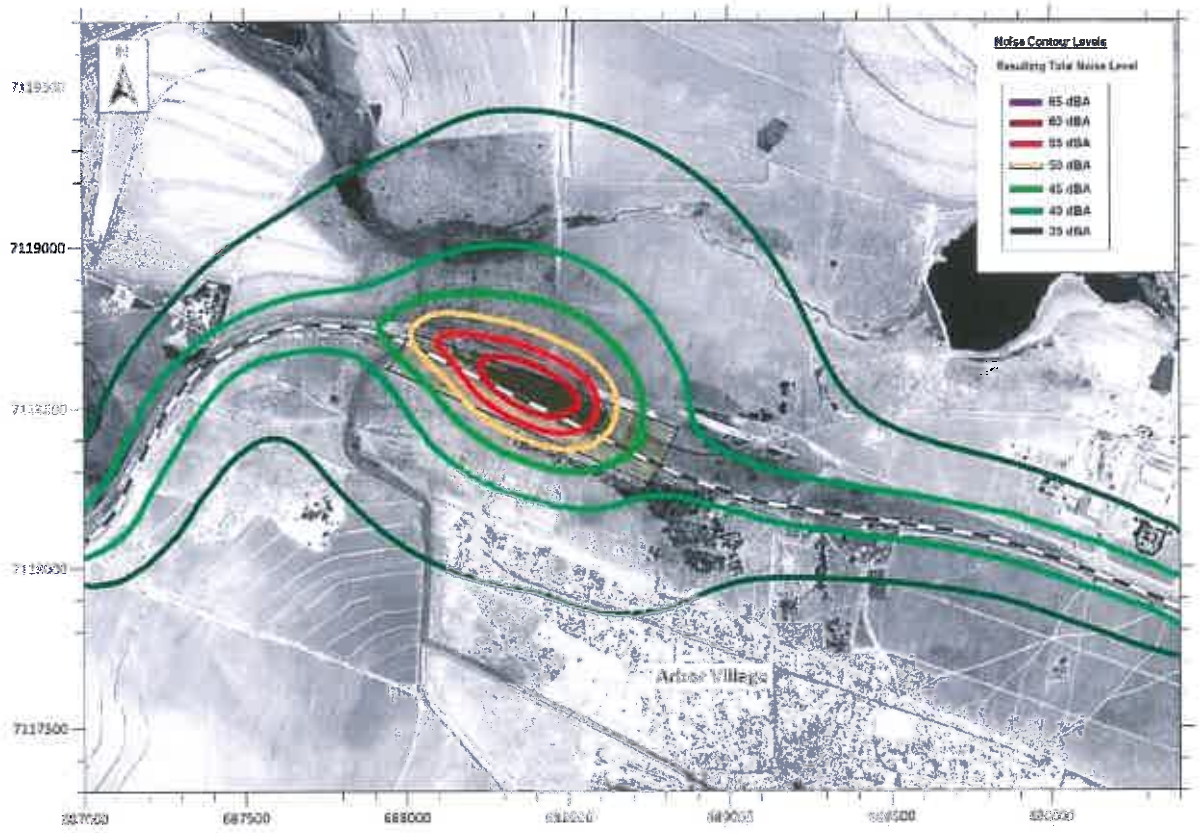

Figure 5.3.2: Phase 1 – Present operations: Night-time ambient noise levels.

The following remarks are of relevance to the results given in Figures 5.3.1 and 5.3.2:

- Both during the day and night the contours representing ambient noise levels of 45 dBA and higher are located in relatively close proximity to the operations at the Arbor coal loading facility;
- None of the nearby farmsteads and Arbor village will be affected by them. The ambient noise levels fall within the day- and night-time levels of 55 dBA and 45 dBA, respectively, identified by SANS 10103 [3] as typical for *'urban districts'*;
- These ambient noise levels are also recommended by the World Health Organisation (WHO) [5] for residential areas during day- and night-time; and
- The noise contours extend further during the night due to meteorological and other atmospheric effects enhancing the propagation of noise during this time period.

5.4 Noise impacts Phase 2: Construction

Please refer to Table 4.3.1 in section 4 for the assumed activities and sources during construction. The noise impact contours are presented in Figures 5.4.1 and 5.4.2.

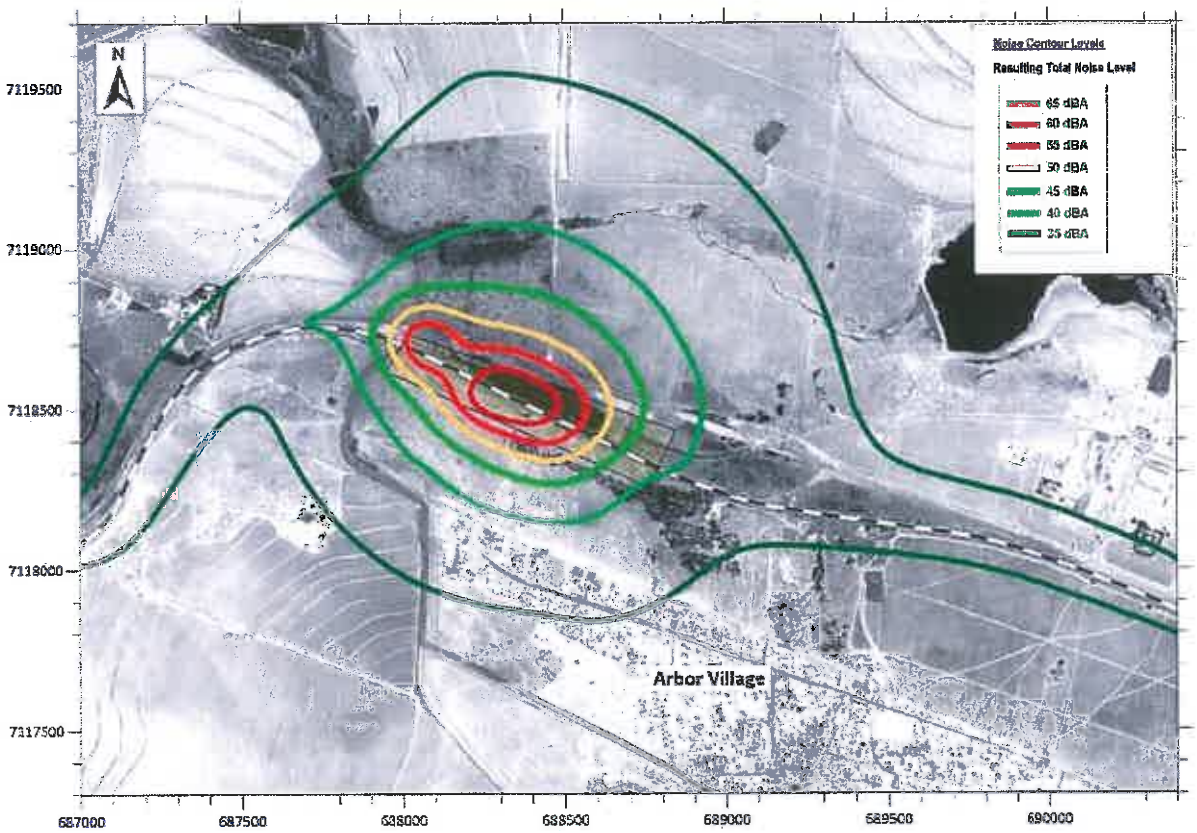

Figure 5.4.1: Phase 2 - Construction: Day-time noise impact expressed as the resulting total ambient noise levels.

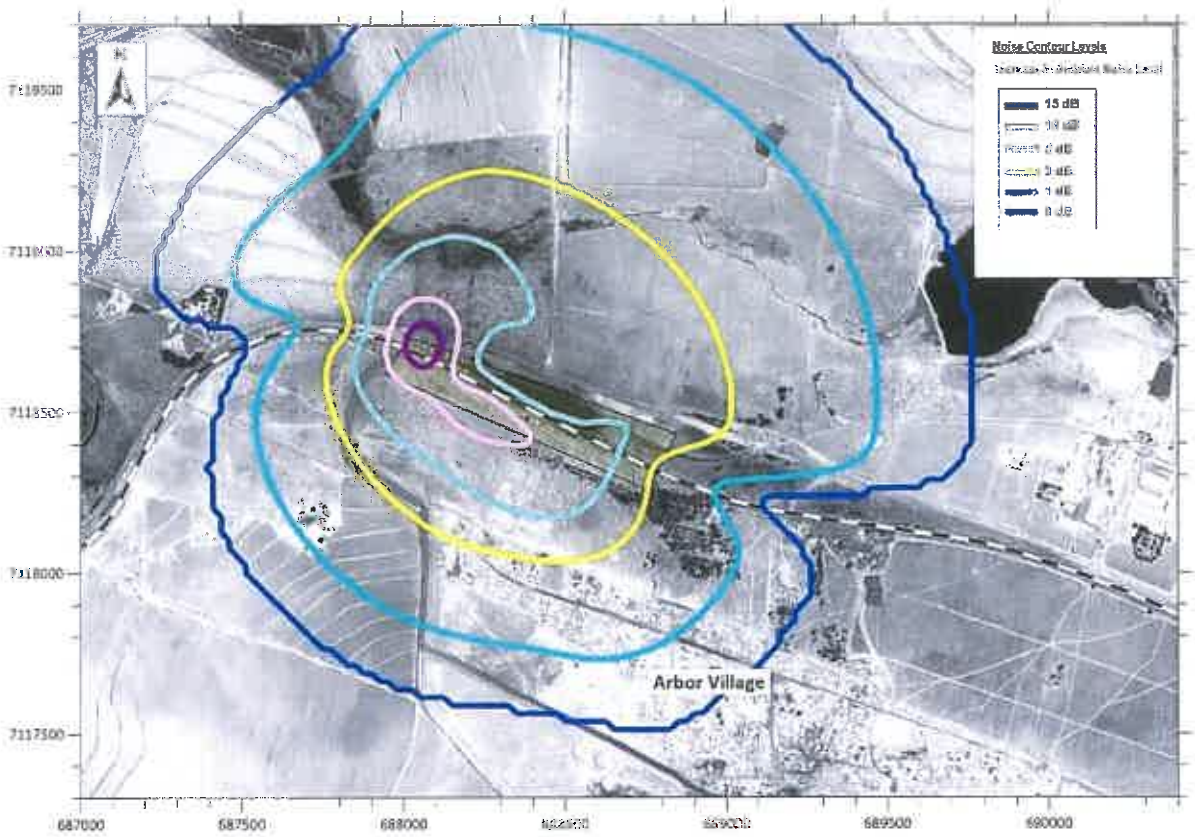

Figure 5.4.2: Phase 2 - Construction: Day-time noise impact expressed as the increase in ambient noise levels.

The following remarks are of relevance to the results given in Figures 5.4.1 and 5.4.2:

- The contours representing ambient noise levels of 45 dBA and higher are located in relatively close proximity to the operations at the Arbor coal loading facility;
- None of the nearby farmsteads and Arbor village will be affected by them. The ambient noise levels fall within the day- and night-time levels of 55 dBA and 45 dBA, respectively, identified by SANS 10103 [3] as typical for *'urban districts'*;
- These ambient noise levels are also recommended by the WHO [5] for residential areas during day- and night-time;
- Although the construction activities will likely be audible, e.g. in the Arbor village, the increase in ambient noise levels will be insignificant; and
- According to Table 5 of SANS 10103 [3] the community to the increases will be *'Little with sporadic complaints'*.

5.5 Noise impacts Phase 3: North and South operational conditions

Please refer to Table 4.3.1 in section 4 for the assumed activities and sources during Phase 3 mining operations. The noise impact contours for the day- and night-time are presented in Figures 5.5.1 to 5.5.4.

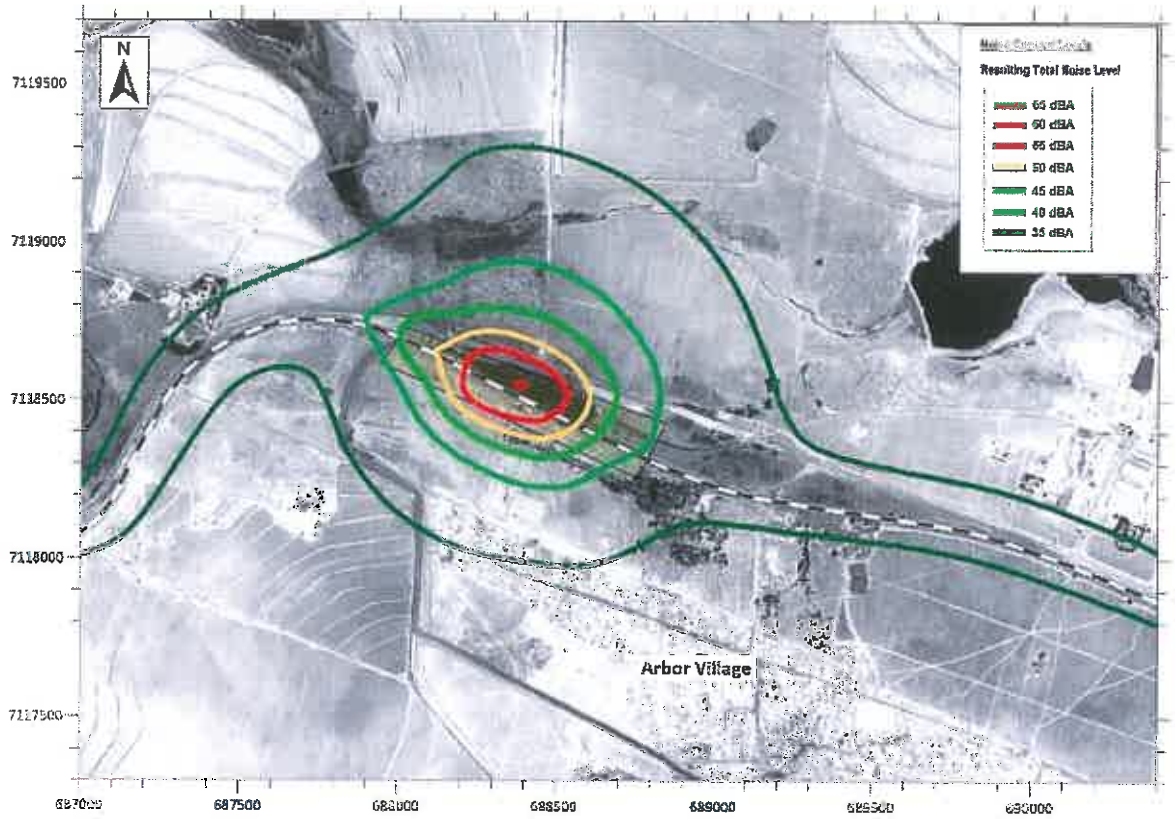

Figure 5.5.1: Phase 3 – Fully operational conditions: Day-time noise impact expressed as the resulting total noise levels.

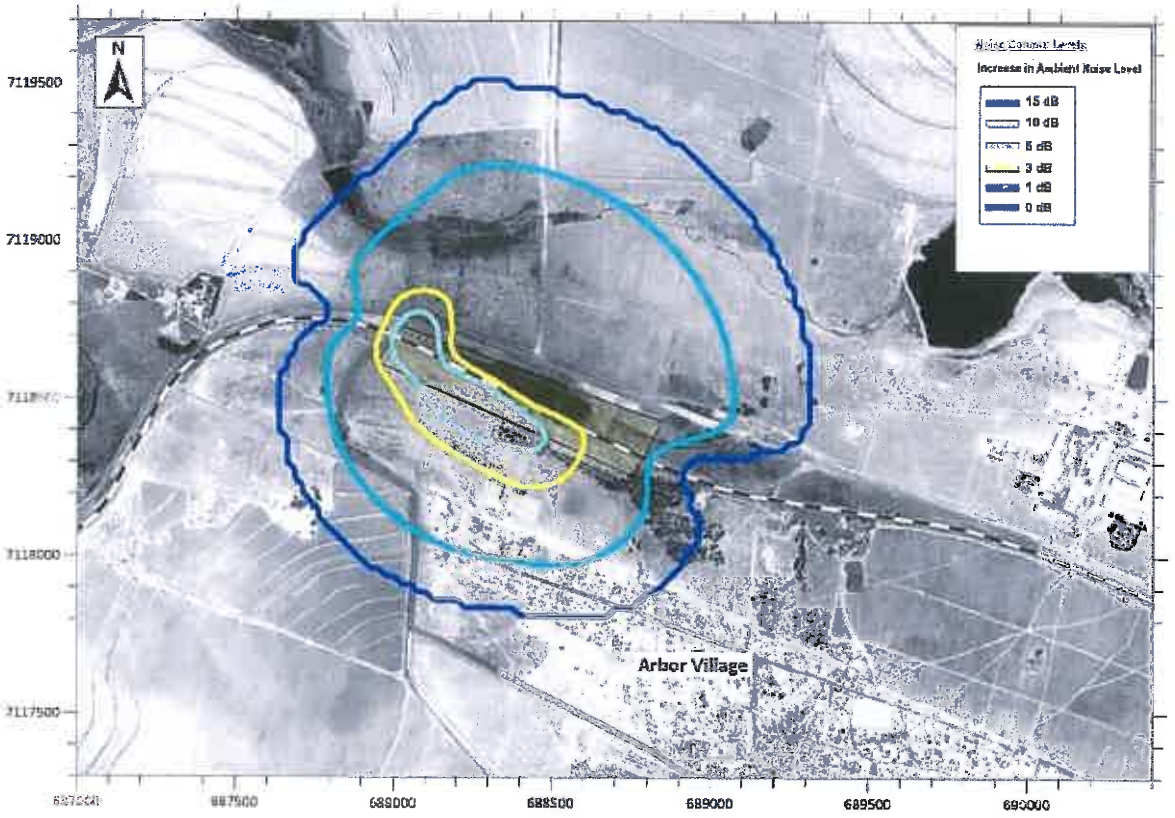

Figure 5.5.2: Phase 3 - Fully operational conditions: Day-time noise impact expressed as the increase in noise levels.

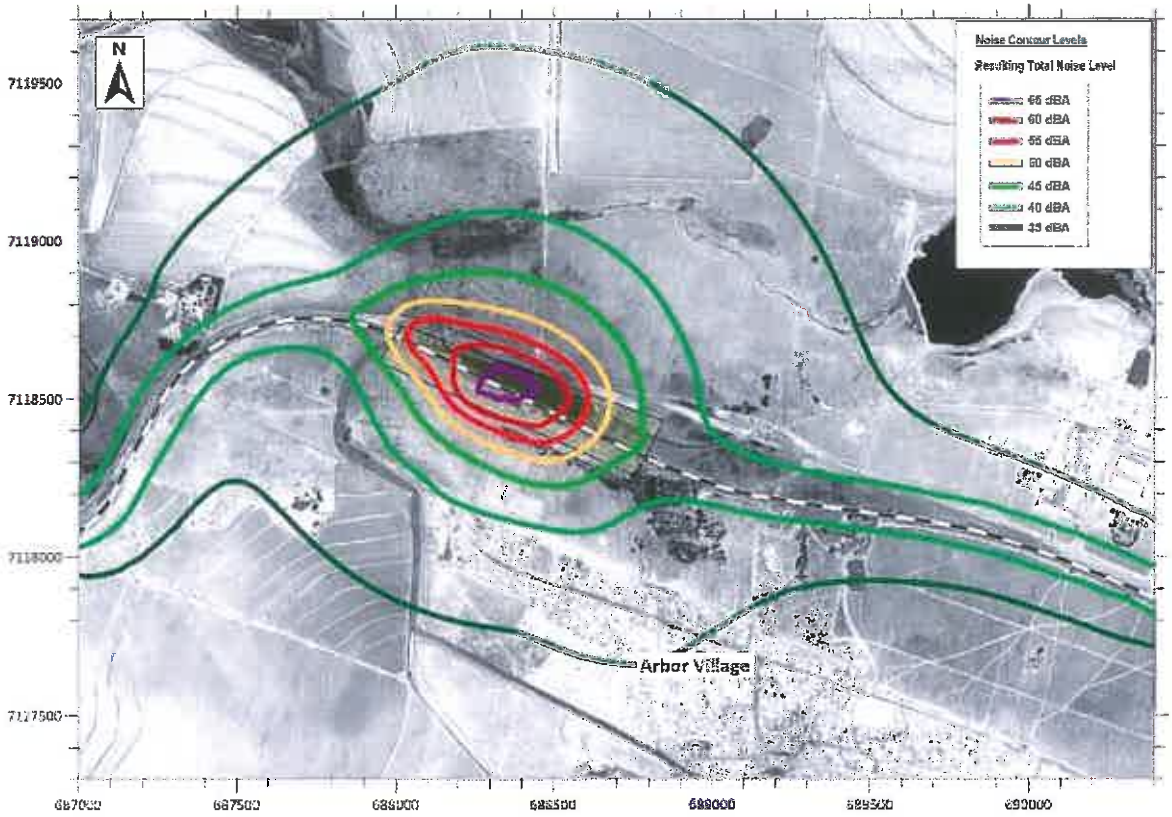

Figure 5.5.3: Phase 3 - Fully operational conditions: Night-time noise impact expressed as the resulting total noise levels.

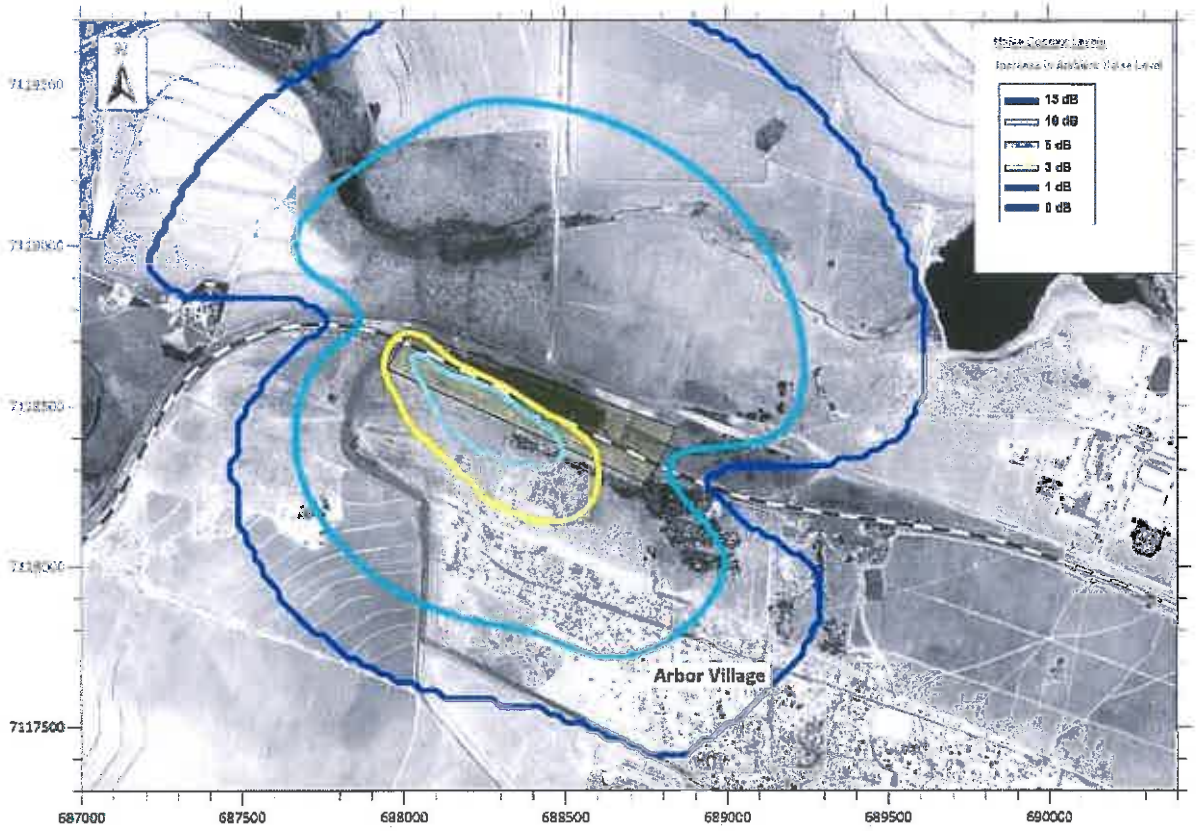

Figure 5.5.4: Phase 3 - Fully operational conditions: Night-time noise impact expressed as the increase in noise levels.

The following remarks are of relevance to the results shown in Figures 5.5.1 to 5.5.4:

- Both during the day and night (Figures 5.5.1 and 5.5.2) the contours representing ambient noise levels of 45 dBA and higher are located in relatively close proximity to the operations at the Arbor coal loading facility;
- None of the nearby farmsteads and Arbor village will be affected by them. The ambient noise levels fall within the day- and night-time levels of 55 dBA and 45 dBA, respectively, identified by SANS 10103 [3] as typical for *'urban districts'*;
- These ambient noise levels are also recommended by the WHO [5] for residential areas during day- and night-time;
- Although the operational activities will likely be audible, e.g. in the Arbor village, the increase in ambient noise levels will be insignificant, both during day- and night-time; and
- According to Table 5 of SANS 10103 [3] the community to the increases will be *'Little with sporadic complaints'*.

5.6 Noise impacts Phase 4: Closure of operations

Please refer to Table 4.3.1 in section 4 for the assumed activities and sources during Phase 4 mining operations. The noise impact contours for the day- and night-time are presented in Figures 5.6.1 and 5.6.2.

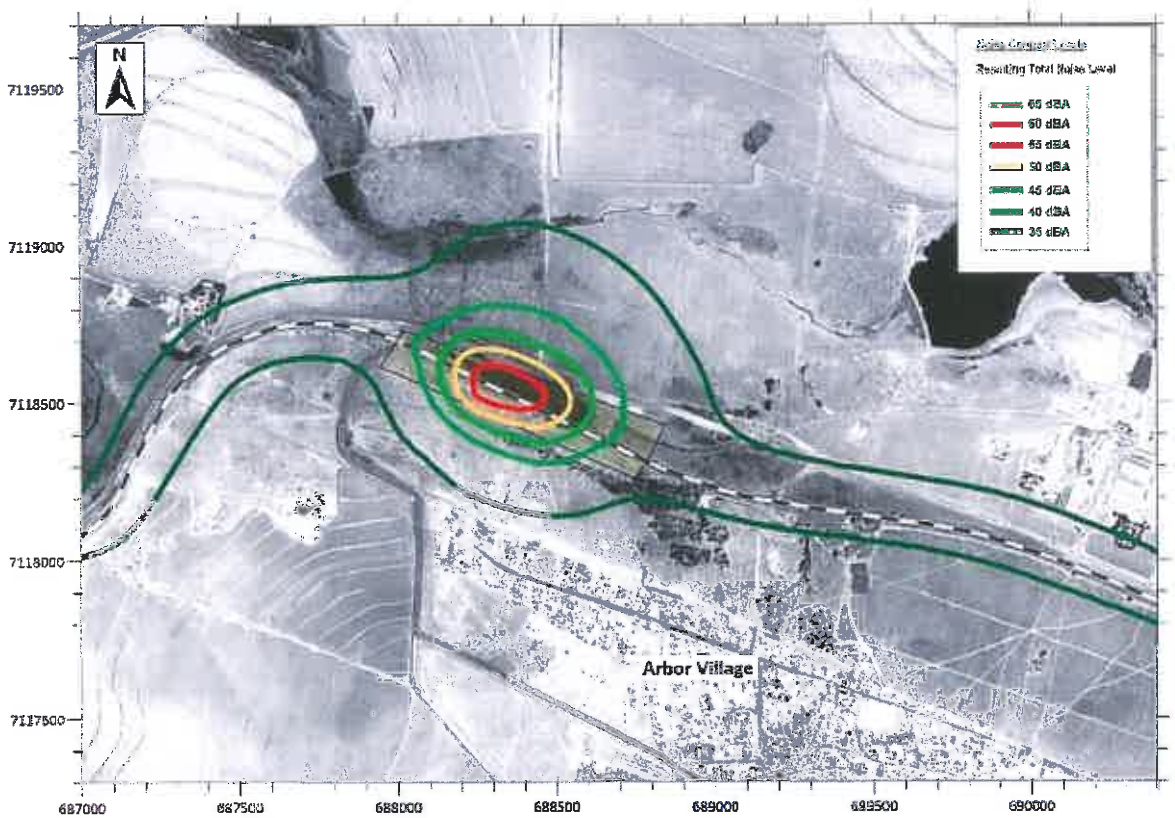

Figure 5.6.1: Phase 4 – Closure of operations: Day-time noise impact expressed as the resulting total noise levels.

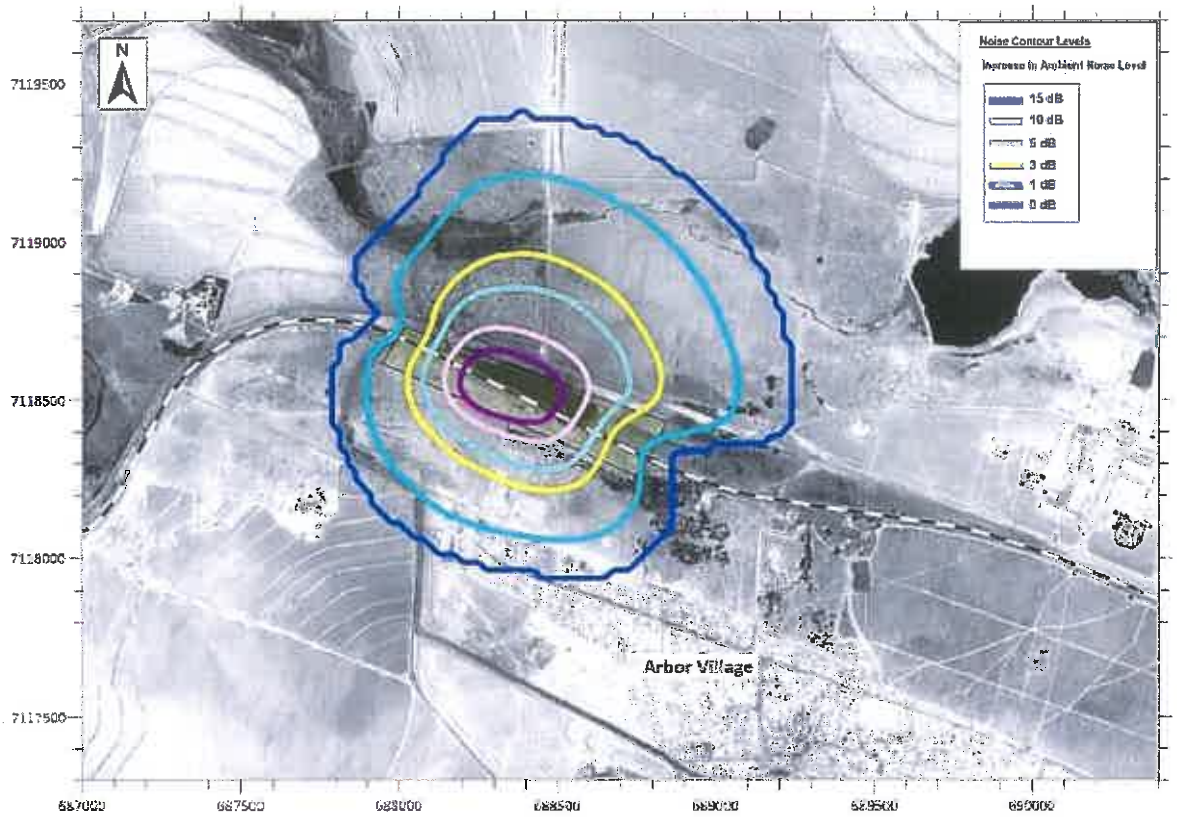

Figure 5.6.2: Phase 4 – Closure of operations: Day-time noise impact expressed as the increase in noise levels.

The following remarks are of relevance to the results shown in Figures 5.6.1 and 5.6.2:

- Both during the day and night (Figures 5.6.1 and 5.6.2) the contours representing ambient noise levels of 45 dBA and higher are located in relatively close proximity to the operations at the Arbor coal loading facility;
- None of the nearby farmsteads and Arbor village will be affected by them. The ambient noise levels are well below the day- and night-time levels of 55 dBA and 45 dBA, respectively, identified by SANS 10103 [3] as typical for *'urban districts'*;
- Although the construction activities will likely be audible, e.g. in the Arbor village, the increase in ambient noise levels will be insignificant; and
- According to Table 5 of SANS 10103 [3] the community to the increases will be *'Little with sporadic complaints'*.

6. SUMMARY OF THE FINDINGS

The findings of the noise impact study are summarised in Table 6.1.

TABLE 6.1
Summary of the findings

Phase	Severity of the noise impact				Community Reaction **	Estimated Overall Severity
	Resulting total noise level		Increase in noise level			
	Day * Criterion 55 dBA	Night * Criterion 45 dBA	Day	Night		
1 Present	Farmsteads and Arbor village well within criterion level	Farmsteads and Arbor village well within criterion level	-	-	-	-
2 Construction	Farmsteads and Arbor village well within criterion level	-	< 3 dB Insignificant	-	'Little with sporadic complaints'	**Low** Day-time only
3 Operations N & S	Farmsteads and Arbor village well within criterion level	Farmsteads and Arbor village well within criterion level	< 3 dB Insignificant	< 3 dB Insignificant	'Little with sporadic complaints'	**Low** Some activities probably audible
4 Closure	Farmsteads and Arbor village well within criterion level	-	< 1 dB Negligible	-	'No response'	**Very Low** Day-time only

Note *: Table 2 of SANS 10103 [3] lists 45 dBA and 35 dBA as typical for 'rural districts' during the day (06:00 to 22:00) and night (22:00 to 06:00), respectively.

Note **: Community reaction in accordance with Table 5 of SANS 10103 [3].

7. NOISE MITIGATION MEASURES

In terms of assessment parameters described in SANS 10103 [3], i.e. the resulting total and increase in ambient noise levels, respectively, the findings indicate that the severity of the of the noise impacts are generally **low**. As a result, the introduction of specific noise mitigation measures is not necessary.

8. CONCLUSIONS

The following conclusions are drawn from the results and findings of noise impact study:

- Although the area between the R555 and the N4 has a rural character, the larger environment is characterised by coal mines, railway lines and roads. The noise emissions from these sources are constantly audible;
- The significance rating of the noise impacts during construction, operational conditions is **Low**, but **Very Low** during the closure phase;
- Due to the low pre-development ambient noise levels it is likely that mining operations will be audible, depending on location and meteorological conditions; and
- However, due to the character of the environment this is unlikely to cause any additional annoyance or disturbance.

9. RECOMMENDATIONS

The following recommendations are made:

- All diesel powered machinery must be in good condition and regularly serviced. Servicing must include the inspection of exhaust and intake mufflers and if necessary, their replacement;
- Any change in the noise emission character of diesel powered equipment must trigger a retirement thereof for the purpose of repair and/or servicing; and
- The replacement of the traditional reversing alarms that emit beeping single frequency sound with devices that emit broadband frequency noise instead is highly recommended.

10. REFERENCES

In this report reference was made to the following documentation:

(1) Model air quality management by-law for easy adoption and adaptation by municipalities, 2010, published under the National Environment Management Air Quality Act, Act 39 of 2004, Government Gazette No. 33342, 2 July 2010.

(2) National Environment Management Air Quality Act, Act 39, 2004, Government Gazette No. 27318, 24 February 2005.

(3) SANS 10103:2008 'The measurement and rating of environmental noise with respect to annoyance and to speech communication', Edition 6.

(4) SANS 10357:2004 'The calculation of sound propagation by the Concawe method'. Edition 1.2.

(5) Guidelines for Community Noise, World Health Organisation, Geneva, 1999.

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APPENDIX A

Measurement instrumentation

11. APPENDIX A: MEASUREMENT INSTRUMENTATION

The measurement instrumentation that was used in this noise study is summarised in Table A-1. The measurement instrumentation complies with the accuracy requirements specified for a Type 1 instrument in:

- SANS 61672-1/IEC 61672-1, *Electro acoustics – Sound level meters – Part 1: Specifications.* **Amdt 1**
- SANS 60942/IEC 60942 (SABS IEC 60942), *Electro acoustics – Sound calibrators.*

TABLE A-1
Measurement instrumentation

Instrument	Type	Serial Number	Date calibrated	Calibration Certificate
Sound analyser	B&K 2250	3004727	11/10/2018	AV\AS-4783
Microphone	B&K 4189	2888663	11/10/2018	AV\AS-4783
Sound level calibrator	B&K 4230	1511916	11/10/2018	AV\AS-4783

The calibration status of the instrumentation was checked before and after each set of measurements against a calibrated signal with a level of 94,0 dB at 1 kHz. In each case the instrument displayed a reading of within 1 dB of the calibrated value. A windshield supplied by the manufacturer of the instrument was used during all the measurements.

APPENDIX B

Sound power levels and assumed meteorological conditions

13. APPENDIX B: SOUND POWER LEVELS AND ASSUMED METEOROLOGICAL CONDITIONS

The sound power emission levels of equipment and processes used in the modelling process are given in Table B-1. The assumed meteorological conditions are given in Table B-2.

TABLE B-1
Sound power levels of equipment and processes

Equipment/Process	Sound power level, dB re 1 pW, in octave frequency band, Hz						
	63	125	250	500	1000	2000	4000
Locomotive	94.1	83.7	75.9	76.5	76.7	70.4	68.7
Wagon	88.9	81.5	75.6	71.7	72.5	61.5	55.3
Road transport truck	119	107	105	102	99	97	92
FEL 966	111.5	107.0	100.8	101.1	96.8	97.0	95.8
Bulldozer D9	102.7	116.2	109.5	108.6	105.9	102.4	96.2
Grader CAT 14h	100.4	111.9	107.8	106.0	103.2	98.6	92.0
Vibrating roller	104.1	111.0	101.3	103.6	104.3	103.3	96.8

TABLE B-2
Modelled meteorological conditions

Parameter	Assumed value	
	Day	Night
Average Temperature:	24 °C	18 °C
Wind speed and direction	1 m/s W	1 m/s W
Humidity	50 % RHD	50 % RHD
Static air pressure	84 kPa	84 kPa
Solar irradiation	700 W/m2	700 W/m2
Cloud cover	2/8	2/8
Acoustically soft ground conditions	60%	60%

APPENDIX C

Glossary of acoustic terminology

14. APPENDIX C: GLOSSARY OF ACOUSTIC TERMINOLOGY

Absorption	The process by which a fluid (such as air), material or structure absorbs sound by dissipating the impinging or transmitted sound energy as heat.
A-weighting	An electronic filter that simulates the human hearing characteristic which is less sensitive to sounds at low frequencies than at high frequencies.
Broad band noise	Noise that contains a wide range of frequencies and cannot be associated with a specific frequency or tone. 'White noise' (like the sound of a radio that is not tuned on a station) is a typical example of broad band noise.
Decibel (dB)	A descriptor that is used to indicate a level determined as 10 times the logarithmic ratio of two quantities of the same physical unit.
dBA	A descriptor that is used to indicate that 10 times the logarithmic ratio of two quantities of the same physical unit has been A-weighted.
Frequency	The characteristic of a time varying signal that describes the number of cycles per second, expressed in Hertz, Hz.
L_{Aeq}	The A-weighted equivalent sound pressure level. This descriptor is internationally used for quantifying and evaluating noise in human-related circumstances. A vast amount of research links this parameter to human physiological and psychological responses.
Level	The property of any parameter that expresses it's magnitude as 10x the logarithm of the ratio of the value of the parameter to a reference value of the same physical unit. The reference value is 20 µPa

	(micro- or $20x10^{-6}$ Pascal, or N/m^2) for a sound pressure level and 1 pW (pico or $1x10^{-12}$ Watt) for a sound power level.
Noise	Unwanted sound
Noise emission	The noise energy that is emitted by a noise source into the environment.
Noise immission	The noise energy that impinges on a receiver.
Octave frequency band	The frequency spectrum is divided into bands with centre frequencies an octave apart from each other, an octave being a doubling in frequency. In practice the standard octave bands most often used are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Used for specifying sound power emission levels of equipment and calculating sound propagation over longer distances.
Sound power level	The level of the sound energy radiated by a given source per unit time. The magnitude does not depend on physical surroundings, e.g. distance, screening, weather. Cannot be directly measured, but has to be calculated from sound pressure level measurements.
Sound pressure level	The level of the varying sound pressure caused by a sound/noise source. The magnitude depends on the physical parameters of the surroundings.