Seriti Power (Pty) Ltd

GEOHYDROLOGICAL REPORT (R267)

New Largo Colliery

41106340-REP-00002
JUNE 2024

CONFIDENTIAL

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New Largo Colliery

REPORT (DRAFT) CONFIDENTIAL

PROJECT NO. 41106340

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WSP

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Phone: +27 11 361 1300

WSP.com

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Prepared by	Talita van Zyl	Talita van Zyl
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Checked by	Sarah Skinner	Sarah Skinner
Signature		Digitally signed by Skinner, Sarah (ZASS05195) DN: cn=Skinner, Sarah (ZASS05195), ou=Active, email=sarah.skinner@wsp.com Date: 7/30/2024 12:50 PM +02'00'
Authorised by	Sarah Skinner	Sarah Skinner
Signature		Digitally signed by Skinner, Sarah (ZASS05195) DN: cn=Skinner, Sarah (ZASS05195), ou=Active, email=sarah.skinner@wsp.com Date: 7/30/2024 12:51 PM +02'00'
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Appendices

APPENDIX A
0BDOCUMENT LIMITATIONS

1. INTRODUCTION

WSP Group Africa (Pty) Ltd (WSP) was appointed by Seriti Coal (Pty) Ltd (Seriti) to assist with the following procedures for New Largo Colliery:

- Undertake the environmental authorisation (EA) application process.
- Undertake the waste management licence (WML) application process.
- Assist with a water use license application (WULA).
- Conduct an Integrated Water and Waste Management Plan (IWWMP).

This report provides the groundwater specialist report as informed by the requirements set out by Annexure D.5. of Regulation 267 (R267) of March 2017[1] for geohydrology specialist, (Government Gazette No. 40713).

1.1. OBJECTIVES

The objectives of the groundwater report were to provide:

- A site-wide update of the groundwater model to accommodate changes in the mining plan and infrastructure layout.
- A groundwater specialist report in support of the waste licence application for the expanded footprint for in-pit discard disposal.
- A groundwater specialist report (R 267) to inform the decant management plan that is used to prepare the wetland offset strategy included in the WULA required by the Department of Water and Sanitation (DWS) to support authorisation of mining through the Honingkrantz Pan.

1.2. MINING TIMELINE

Underground mining of both 2 seam and 4 seam at New Largo commenced before 2012 with opencast mining commencing in 2021 at Pit D and in 2024 at Pit F. Figure 1-1 shows the location of the opencast and underground mining areas. Future opencast pits will be mined between 2025 and 2055 and include Pit A&G (mostly referred to as Pit A), Pit C, Pit D North, Wilge Pit, and Pit H.

Some of the mined-out underground areas are well defined as indicated by the "Underground workings" in Figure 1-1. However, there are also areas where the exact historical extent of mining is unknown. JMA (2023) created 'Non-Defined Previously Mined Areas' (Red Zones) based on a 200 m radius around the adit positions. These Red Zones are also indicated in Figure 1-1.

The future opencast mining schedules received in spatial format for Seam 4 and Seam 2 (2024) are shown in Figure 1-2 and Figure 1-3 respectively. Most of the pits will end the same year for Seam 4 and Seam 2, except where indicated as follows:

- Main Mine:
  - Pit A & G – Mining from FY25 to FY55.

[1] A revision to these regulations (GN 48630 dated 19 May 2023) was published for comment on the 10 March 2023.

- Pit C – Mining from FY25 to FY39.
- Pit D North – Mining from FY39 to FY47 (4 seam will complete in FY46).
- Wilge Pit - from FY25 to FY26.

- Pit D (South) - Mining from FY25 to FY33. Mining started August 2020.
- Pit F - Mining from FY25 to FY41 (4 seam will complete in FY40). Mining started January 2023.
- Pit H - Mining from FY26 to FY36.

1.3. PREVIOUS AUTHORISATIONS

New Largo is authorised by three Water Use Licences (WULs) between 2013 and 2015 to undertake activities that are described as water uses under Section 21 of the National Water Act, 1998 (Act No. 36 of 1998), namely:

- WUL: 04/B20G/ACFGIJ/2538, File: 16/2/7/B200/C528 dated 31 March 2023, which supersedes the WUL dated 11 January 2015 as amended on 25 October 2019.
- WUL: 04/B20G/CI/2246, File: 16/2/7/B200/C528 dated 22 August 2014; and
- WUL: 04/B20F/ACFGI/2310, File: 16/2/7/B200/K524 dated 22 September 2013.

These authorisations include the dewatering of the pits and backfilling of the open pits with coal discard from a dense medium separation (DMS) plant. The WULs authorise DMS discard backfilling into the full extent of the original pit boundaries, as well as the backfilling of destoning plant rejects into Pit H.

The approved environmental management programme report (EMPr) was compiled by Synergistics Environmental Services in 2012. The impact assessment conducted in 2012 was based on a mining plan that covered a larger footprint compared to the current mining plan. The revised mine plan reduces the overall mining footprint and has changed from dragline mining to truck and shovel methods. Furthermore, the 2012 assessment covered the backfilling of DMS plant discard into sections of the pits (see Figure 1-4). Figure 1-4 also indicates the proposed areas for expansion and forms the subject of the current waste management licence application. The impact assessment presented in Section 8 of this report, is aimed at identifying any additional impacts not covered in the approved EMPr (Synergistics Environmental Services, 2012).

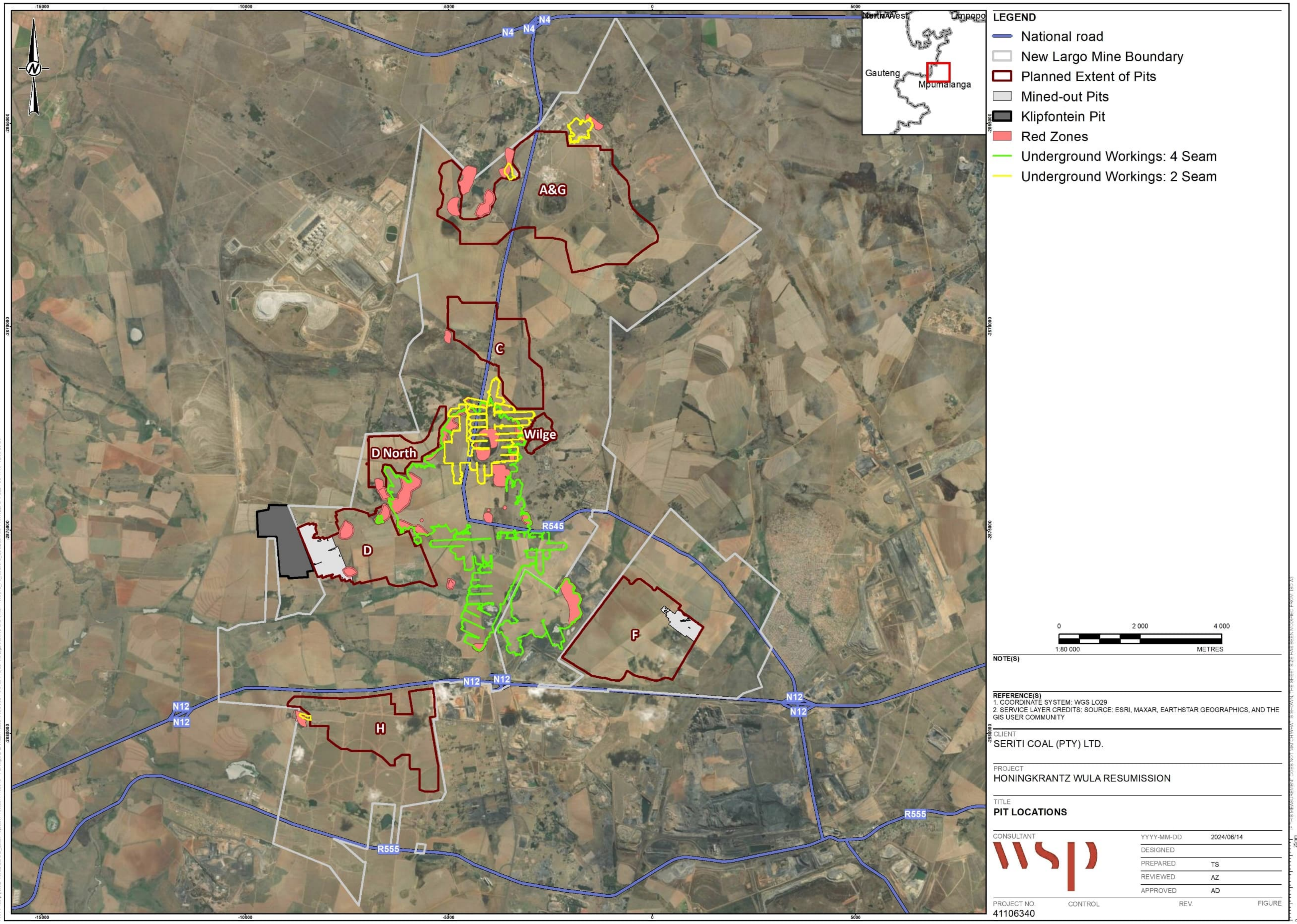


Figure 1-1 - Location of New Largo Pits

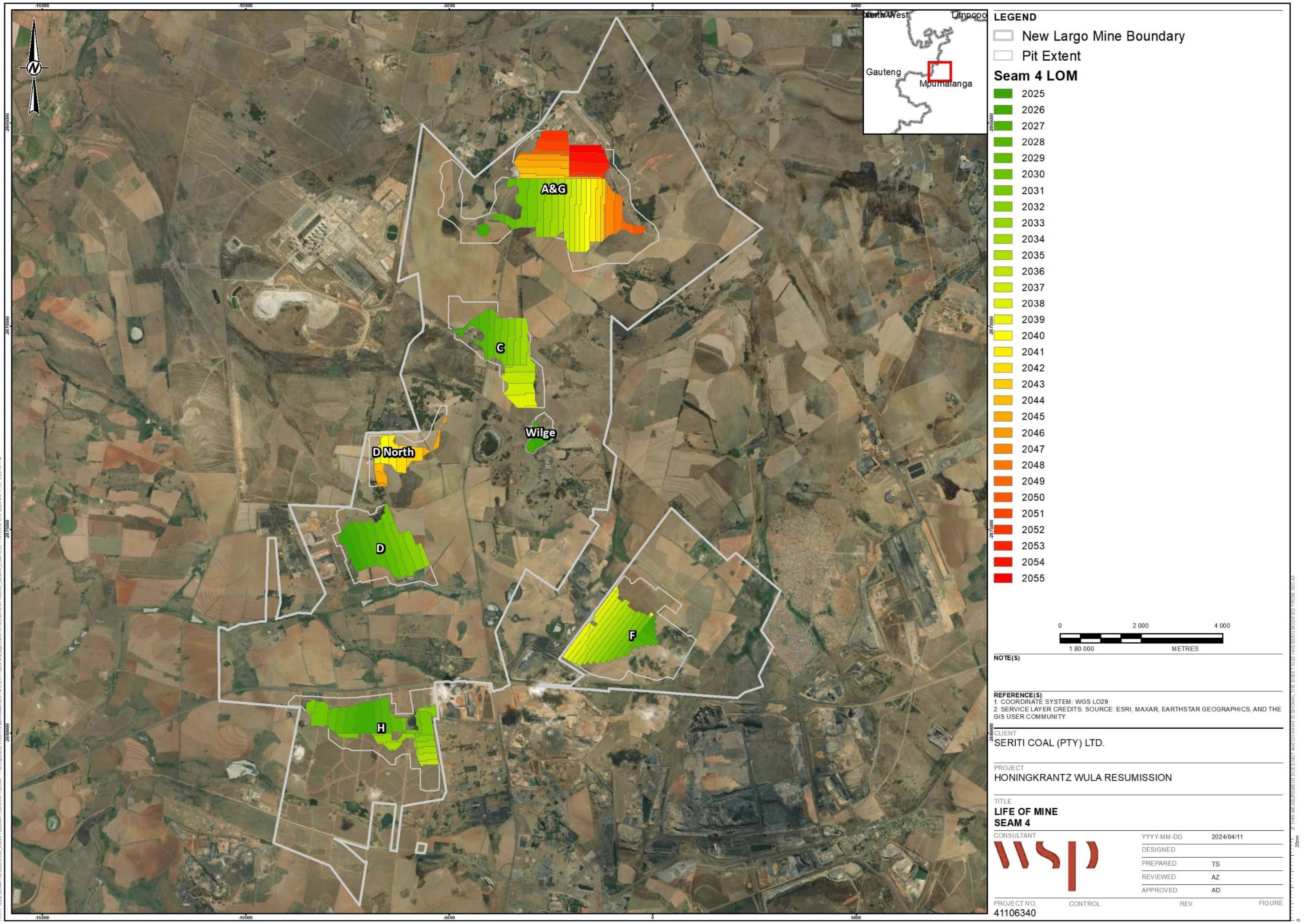


Figure 1-2 - Mining Schedule Seam 4

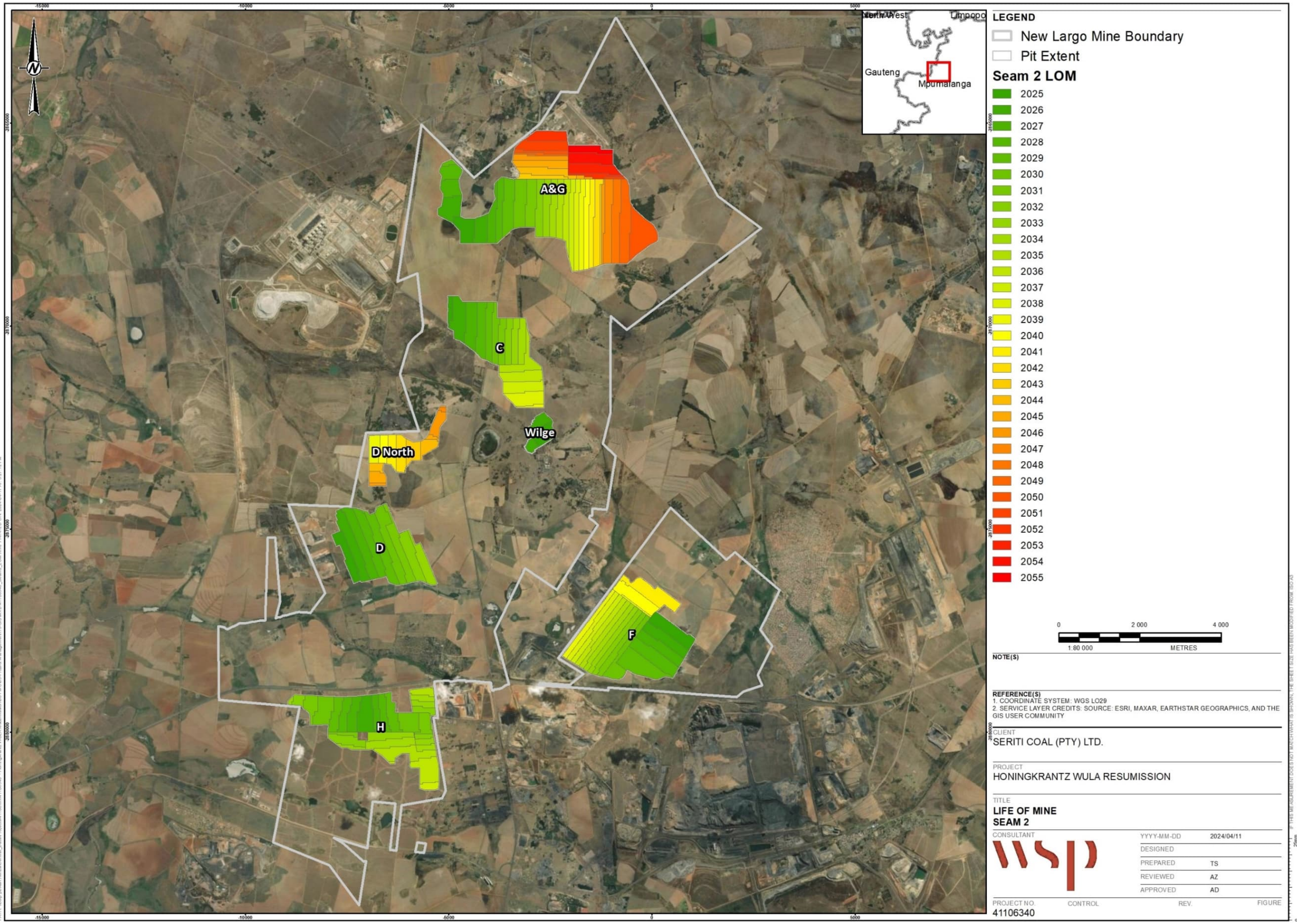


Figure 1-3 - Mining Schedule Seam 2

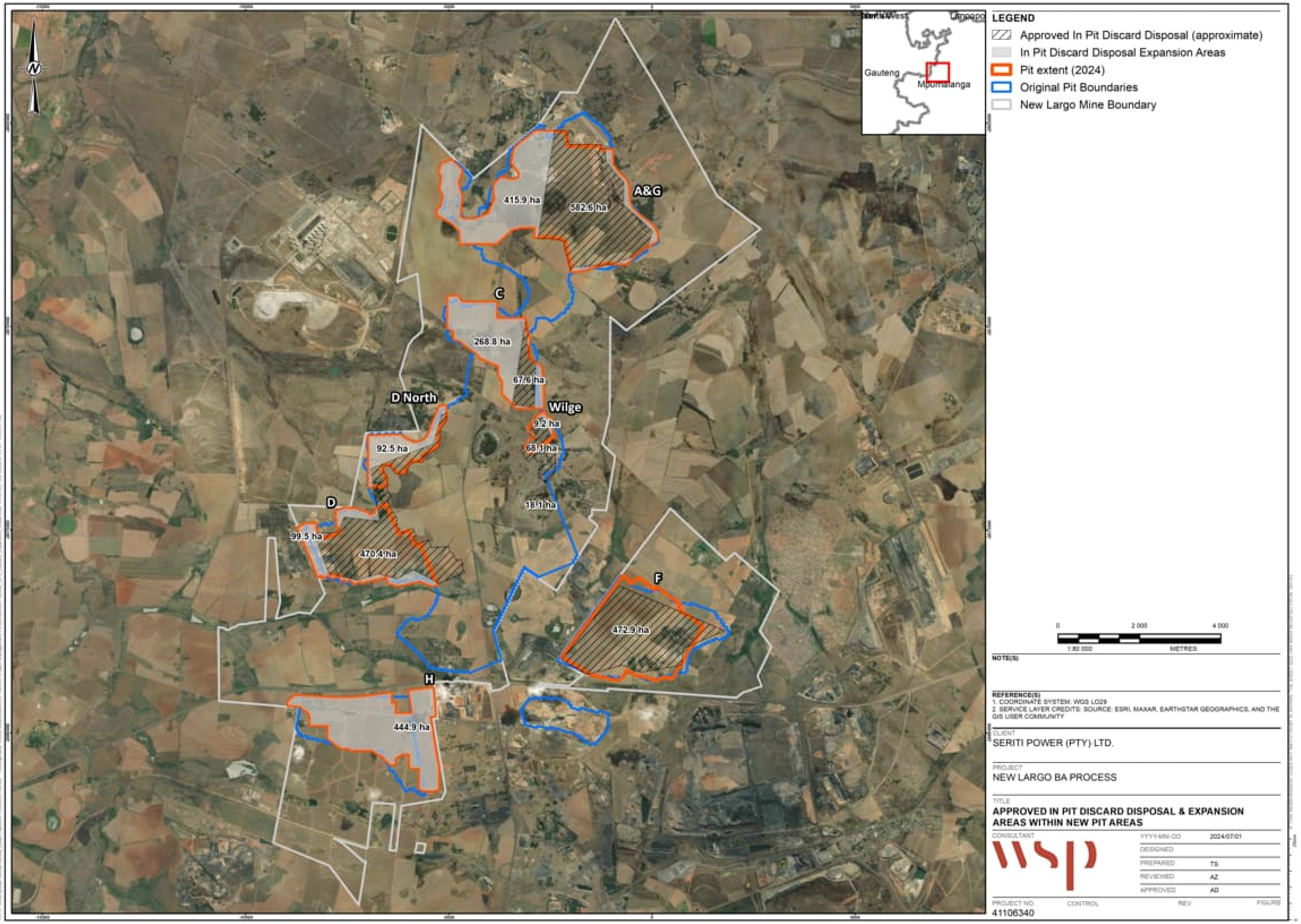


Figure 1-4 - Discard disposal areas approved by the EMPr in relation to the revised mining plan (note: the WULs authorise the full extent of the original pit boundaries)

1.4. BACKFILLING OF PITS

The pits will be backfilled with overburden, discard from a DMS plant/s and/or rejects from crusher/destoning plants as listed in Table 1-1.

Table 1-1 – Backfill material used for pits

PIT	Backfill material
Pit A&G	DMS discard and overburden
Pit C	DMS discard and overburden
Pit D	Destoning plant rejects and overburden
Pit D-North	DMS discard and overburden
Pit F	Destoning plant/crusher rejects, with potential backfilling with DMS discard in future, and overburden
Pit H	Destoning plant/crusher rejects and overburden
Wilge Pit	Overburden

1.5. MINE DEWATERING

Dewatering volumes from the following existing pits were received from New Largo:

- Pit D North from November 2020 to December 2023.
- Pit D South from August 2020 to January 2024.
- Adit Pumping from March 2023 to July 2023.
- Pit F from January 2023 to January 2024.

It is understood that that the pumped water will go to the various pollution control dams. The monthly pumping volumes are plotted in Figure 1-5. The average pumping rate at Pit D is 19.1 ML/month while the average pumping rate at Pit F is 14.2 ML/month. Small volumes (< 3 ML/month) were pumped from Pit F borehole between May 2023 and February 2024.

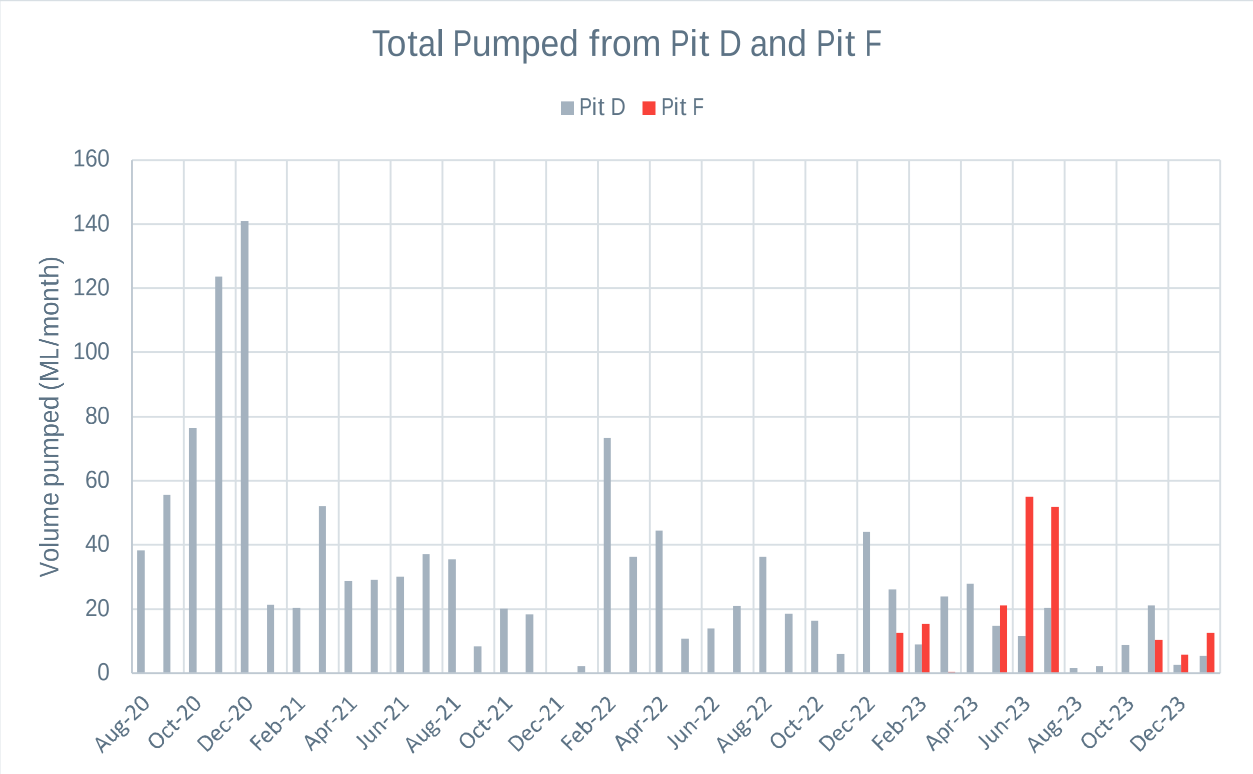


Figure 1-5 - Pumping from Pit D and Pit F

2. GEOGRAPHICAL SETTING

The New Largo coal resource lies between the N4 and N12 national freeway, some 30 kilometres west of eMalahleni and 100 kilometres east of Johannesburg in the Mpumalanga Province.

The full extent of the New Largo Mining Rights Area (MRA) extends from the N4 (Pretoria-Witbank National Road) to the south of the N12 (Johannesburg-Witbank National Road). The location of New Largo and the surrounding mines are shown in Figure 2-1.

Klipfontein mine is situated west of New Largo Pit D. The Klipfontein Pit has been mined-out and is currently backfilled, but not rehabilitated[2]. The barrier pillar between Klipfontein Pit and Pit D has been mined through, forming one large opencast mining area at present.

Other mining areas surrounding New Largo include Klipspruit to the east and Khutala to the south, but they are not directly linked to the New Largo mining areas from a groundwater perspective. There is also the old mined-out Vlakfontein underground mine located west of Pit F.

2.1. TOPOGRAPHY AND DRAINAGE

The topography ranges in elevation from 1500 mamsl to 1600 mamsl.

[2] Status assumed based on Google imagery of 6 March 2024.

The area is situated on the catchment boundary between quaternary catchments B20F and B20G.The south-western parts of New Largo (B20F) drain west towards the north flowing Wilge River, while the north-eastern parts of New Largo (B20G) drain east, north-east, and North towards the Saalboom Spruit. Figure 2-2 shows a map with topography and drainage catchments. Both these catchments eventually flow into the Loskop Dam.

According to (DWS, 2016) New Largo is situated in three management units (MU20, MU21 & MU22) as indicated in Figure 2-3. MU22 represents catchment B20F that flows into the Wilge Dam some 25 km downstream. MU20 flows towards MU21 and ultimately to the Loskop Dam which is 65 km downstream.

The primary users of surface water are for irrigation, formal and informal domestic usage, and livestock watering.

The Integrated Water and Waste Management Plan for New Largo Colliery (Golder, 2022c) describes the surface water monitoring programme.

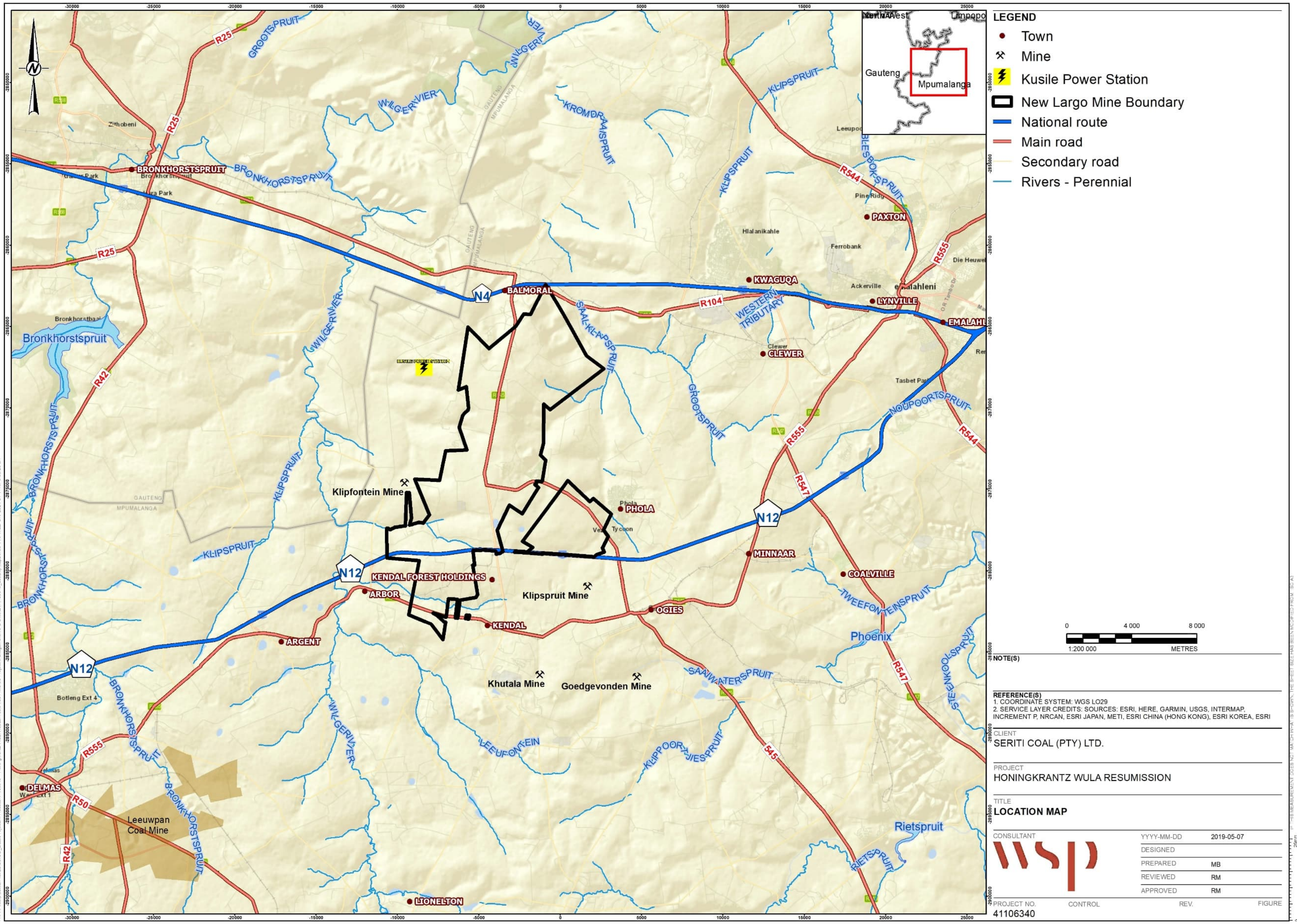


Figure 2-1 - Location of New Largo Colliery

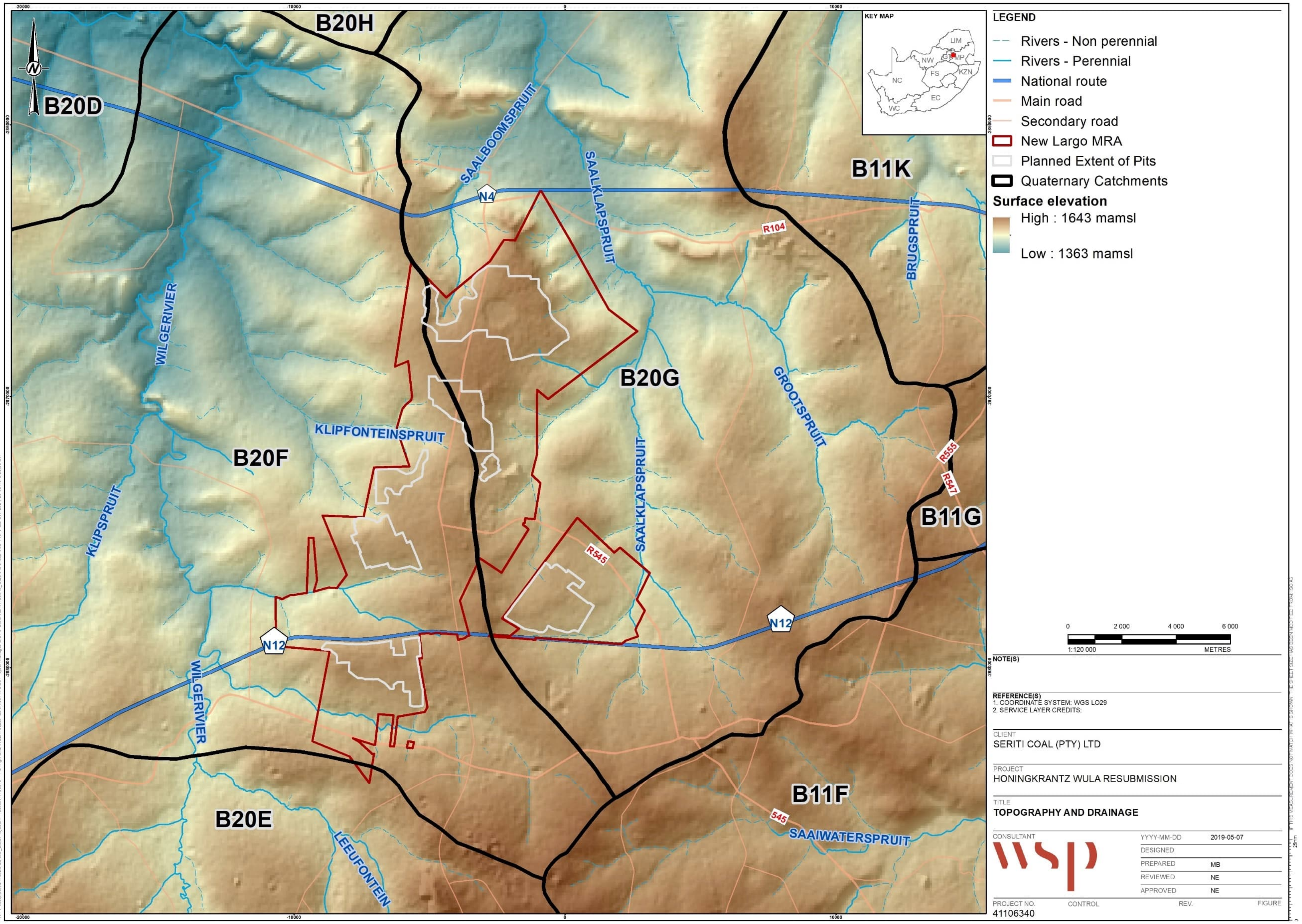


Figure 2-2 - Topography and drainage

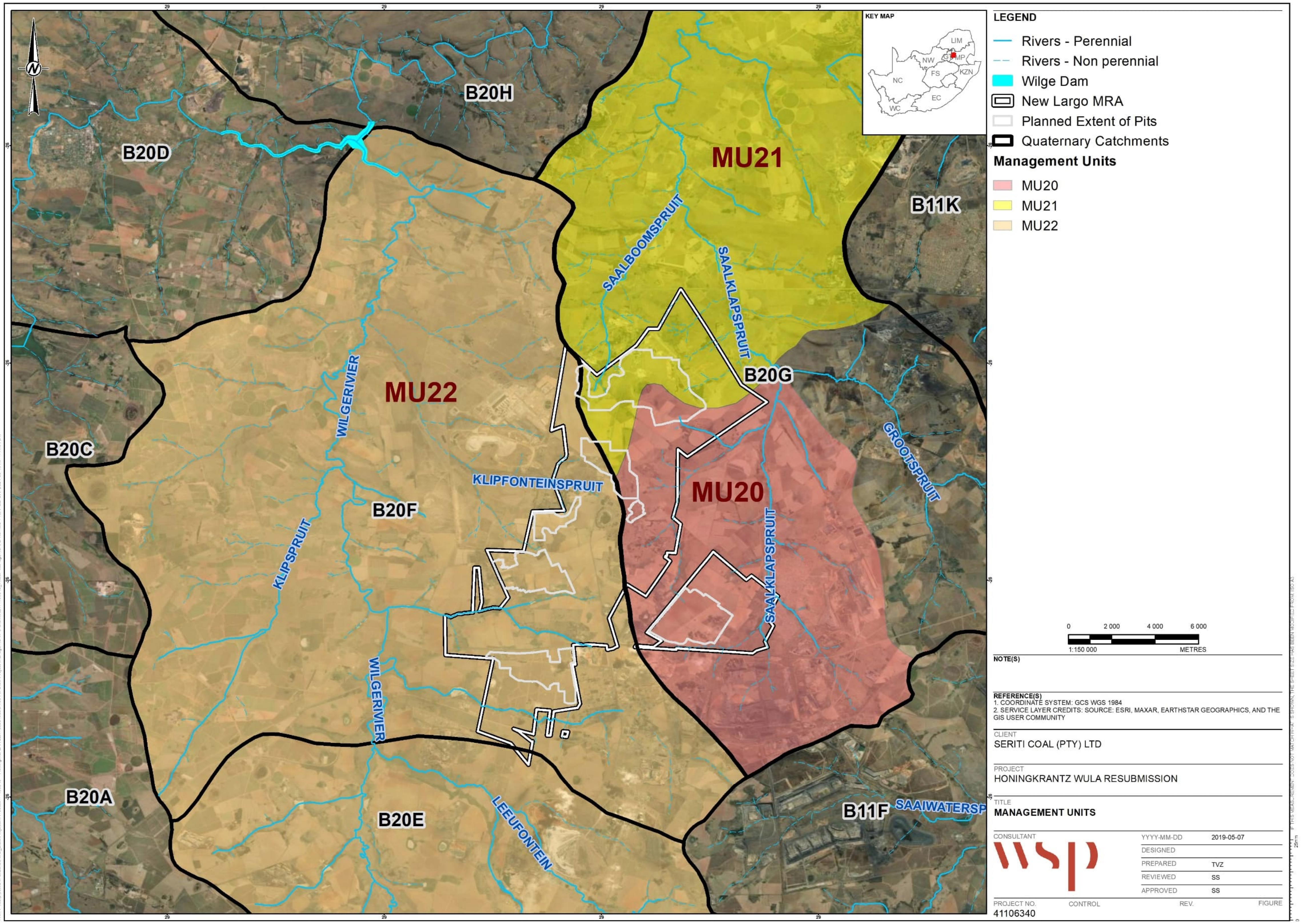


Figure 2-3 - Management units

2.2. CLIMATE

New Largo is located in the Mpumalanga Highveld region where the climate is characterized as generally dry. Summers are warm and hot with an average daily high temperature of approximately 27ºC (with occasional extremes of up to 35ºC). Winters are mild and cold with an average daily high of approximately 15ºC (with occasional extremes of up to -10ºC). Frost and mist are frequently experienced during the winter months on the Mpumalanga Highveld.

Golder (2020) conducted a study of the rainfall in the area. They found 5 rainfall stations with long term rainfall records (more than 50 years of rainfall) in a 50 km radius around New Largo. The mean annual precipitation (MAP) ranges from 667 mm/a to 746 mm/a. (WSP, 2023a) described the historical rainfall at Ogies where the MAP from 1910 to 2000 was 743 mm/a. For this study, the Khutala rainfall from 2010 to 2023 (MAP of 697 mm/a) and the Klipspruit rainfall from 2014 to 2023 (MAP of 718 mm/a) were plotted together with the Ogies data (Figure 2-4). As expected for the highveld, the highest rainfall months are November to January.

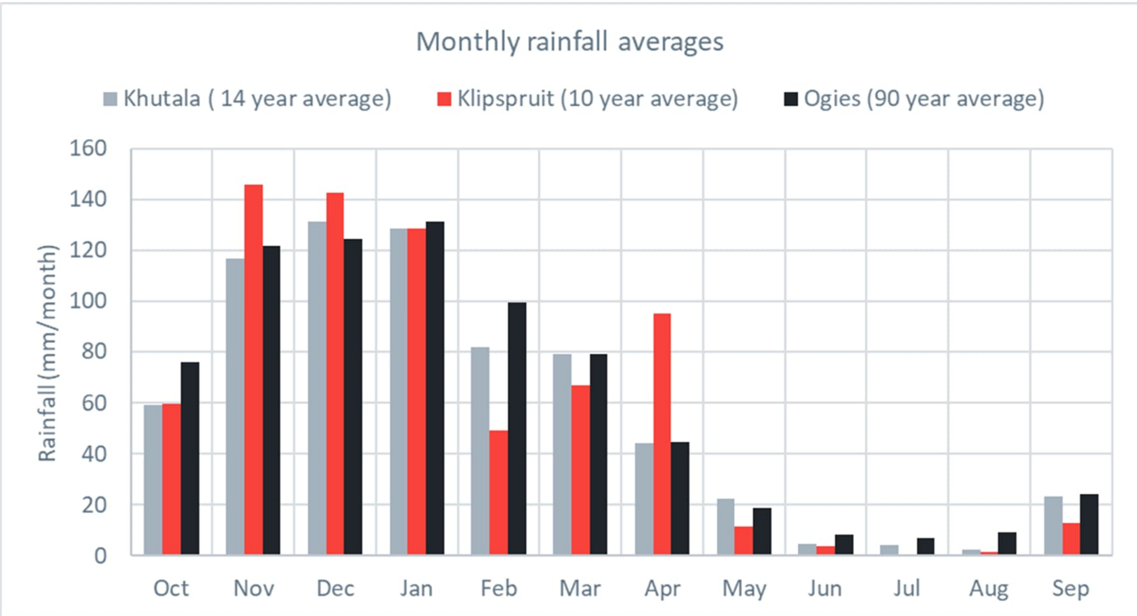


Figure 2-4 - Average monthly rainfall

The Cumulative Rainfall Departure (CRD) provides an indication of the responsivity of the aquifer to rainfall and is indicated in Figure 2-5.

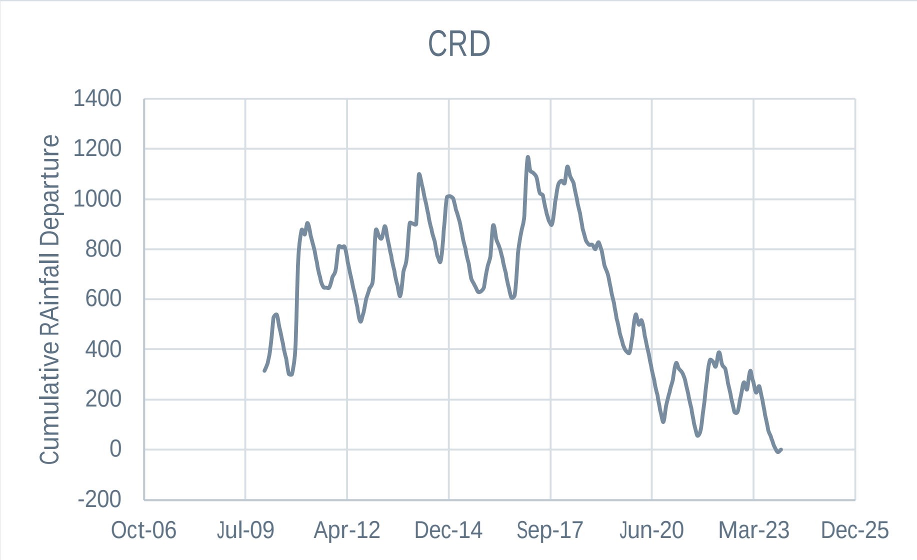


Figure 2-5 - CRD using Khutala rainfall data (selected for the longest recent dataset)

3. SCOPE OF WORK

The scope of work included the following:

- Hydrocensus to obtain additional information on groundwater users on the 22nd and 23rd of February 2024 by WSP Team (Mr N Erasmus).
- Review of the existing monitoring, latest groundwater model report (Groundwater Square, 2021) and additional information as may be available from the mine.
- Updated source terms as provided by WSP (2024).
- Packaging of existing information following the framework as set out by Annexure D.5. of Regulation 267 (R267) of March 2017 for geohydrology specialist framework.
- Updated impact assessment. The impact assessment discussed in section 8 of this report, is aimed at updating the impact assessment in terms of the original EIA (Synergistics Environmental Services, 2012).

3.1. DATA GAPS AND LIMITATIONS

The following data gaps and limitations were noted as part of the study:

- The study is based on available data and is informed by the hydrogeological reports listed in section 4.1.
- Several boreholes were identified as being used by surrounding farmers, many of which had no water level information. The water table depth of these boreholes were included in the analysis and calibration of the model; however, any abstractions by farmers were excluded from the model.
- There were data gaps in the groundwater monitoring information in terms of borehole depth, installed equipment and status, for the older boreholes.
- Monitoring data for dewatering rates from the pits over time were not provided. The depth of water elevation for the sumps is not indicated.

- Water level data was available from the groundwater monitoring reports. Whilst several of the boreholes are surveyed, elevation data is estimated based on the latest regional contour information. Water levels are assumed to be reported as metres below surface (groundwater).

4. METHODOLOGY

4.1. DESKTOP STUDY

A desktop study review of all available information and reports was conducted. A full list of the documents reviewed as part of the desktop study is provided in Section 14. Table 4-1 lists key information sources and any remarks r assumptions associated therewith.

Table 4-1 – Data requested and received

Format	Data item	Received from client	Remarks / Assumptions
Spatial data (DXF, DWG or Shapefile format)	Surface Contours or XYZ point data	No	National Geospatial Information was used (5 m contours)
	Mine Boundaries	Yes	
	Mine Infrastructure and site layout	Yes	
	Borehole locations (coordinates)	Yes	Elevations will be based on the elevations used in the groundwater model
	Mine plan and schedule for underground and open pits	Yes	
	Mine geology and Geological block model - XYZ	No	Used Council for Geoscience (CGS) maps and spatial data
	Mapped structures (Faults / Dykes)	No	Used CGS data
	Mapped subsidence areas	No	Excluded from investigation
	Remote sensing imagery	No	Used available data via Arc GIS and Google Earth
	KMZ file to confirm location	Yes	
Climate (Excel format)	Daily rainfall over time	Yes, From 2022 to 2024.	From January 2022 to February 2024. Long-term average values from nearby stations will be assumed for prediction of future rainfall.
Groundwater (Excel format or other indicated format)	Groundwater monitoring data both water level and quality, historical (time series) and latest	Yes	From 2022 to 2024.
	Quantified aquifer hydraulic parameters, existing aquifer testing data	Yes	Various reports
	Dewatering data (pumping rates) over time	Received dewatering data for Pit D and F.	No pumping from boreholes
	Existing Water balance	Yes	

Format	Data item	Received from client	Remarks / Assumptions
	Borehole logs (PDF)		Sourced from JMA (2012) report
	Existing Geophysical Survey data	No	The R267 framework will note that geophysics are not required as there are sufficient existing monitoring boreholes
	Mining activities including dewatering and/or groundwater abstraction within 1km of the investigation area	No	No access to pumping information from surrounding mines
Mining (Excel format)	Tonnages mined over time	Yes	
	Water pumped into and out of mining areas	Yes	Water circuit? Operation and closure – post closure?
Reports	Latest groundwater monitoring reports	Yes	
	Geohydrology specialist reports	Yes	JMA (2012) Delta H (2014) Golder (2020a, 2020b, 2021)
	Existing Geophysical Survey Reports	No	Assumed that this is not available. See above note
	Geochemical reports	Yes	Additional source terms are pending and are required by the date scheduled in order to complete the modelling
	Other relevant reports such as IWWMP, EIA, EMPR, WUL, RSIP	Yes	Discussed in further detail below.
	Geological reports	Yes	

4.2. HYDROCENSUS

New Largo is located between other coal mines and Kusile Power Station. Klipfontein mine is directly west of New Largo's Pit D, which is an extension of the Klipfontein Pit.

Other mining areas surrounding New Largo include Klipspruit to the east and Khutala to the south, but they are not directly linked to the New Largo mining areas. There is also the old mined-out Vlakfontein underground mine located west of Pit F.

4.2.1. PRE-MINING HYDROCENSUS

JMA (2012) conducted a hydrocensus adjacent to the proposed pit areas at New Largo, during which ground water samples were collected from numerous adjacent landowners and from geohydrological investigative boreholes. It is noted that the area had already been altered by previous underground mining at the time.

A total of 309 points were sampled, 46 of these were fountains and 236 were groundwater samples.

The following water uses were listed by JMA (2012):

- Mining activities from surrounding mines.
- Existing agricultural activities.
- Nearby sand mining and coal washing plant.

4.2.2. HYDROCENSUS 2022

In November 2018 Aquatico Scientific conducted a hydrocensus that focussed on the area surrounding Pit D and Pit H. This was followed in 2022 by a survey of the status of five historical New Largo boreholes by GPT intercepting the underground workings. No significant changes in water quality were observed between the 2012 and 2018 data. The measured groundwater levels from these five boreholes ranged from 0.32 mbgl to 28.35 mbgl and two decant points were identified including :

- Decant 1 into the Klipfonteinspruit with an estimated flow rate of 125 L/s.
- Decant 2 into the Holfonteinspruit was observed, but the flow rate was too low to measure.

4.2.3. HYDROCENSUS 2024

Groundwater monitoring is undertaken mostly bi-annually by the mine for environmental compliance.

WSP conducted a hydrocensus in and around New Largo during February 2024, to locate and verify the status of pre-selected current monitoring boreholes as well as to locate new boreholes around Pit F and Pit H as current data does not reflect the groundwater conditions in these areas.

WSP's hydrogeologist was assisted by a mine representative. Nevertheless, it was not possible to get access to all the farms as indicated by Figure 4-1.

Figure 4-1 - Access denied

Fourteen (14) boreholes were visited and confirmed during the hydrocensus and one (1) fountain Table 4-2 and Figure 4-1). Of these, five (5) boreholes and the spring were identified as being in use primarily for livestock watering although three (3) of them were also used for domestic supply. The headworks were covered in most of the groundwater user boreholes and water levels could therefore not be confirmed during the hydrocensus. Fourteen (14) monitoring boreholes were confirmed to be present of which ten (10) were in good or fair condition. The water quality data is discussed in Section 5.6. Monitoring and hydrocensus boreholes are indicated in Figure 4-2.

Table 4-2 – Hydrocensus Boreholes, 2024 for New Largo

BH-Nr	Latitude	Longitude	SWL (depth below surface in m)	Date	Photo	Comment
TF-BH1	-25.98885	29.00972	4.02	22/02/24		Submersible pump. Used by farmer for livestock. Sampled. Private BH.
TF-BH2	-25.98877	29.00952	-	22/02/24		Submersible pump. Used for livestock watering. Headworks are covered by a closed system with no access to measure water level. Private BH.
TF-BH3	-25.99183	29.01575	4.73	22/02/24		Domestic and Livestock use. Submersible pump. Sampled. Private BH

BH-Nr	Latitude	Longitude	SWL (depth below surface in m)	Date	Photo	Comment
LGB-24	-25.98121	28.95447	7.35	22/02/24		Old monitoring BH. Next to road, no cap and bent casing. Poor condition.
KBH-6	-25.99597	28.91508	10.02	22/02/24	No record	Monitoring BH. Not on WSP map. Newly found. Good condition.
KF-6	-25.99617	28.95121	7.95	22/02/23		Monitoring BH, bad condition, no cap.
LGW-B13	-25.99571	28.93668	11.11	22/02/24		Open BH, no cap, Fair condition.

BH-Nr	Latitude	Longitude	SWL (depth below surface in m)	Date	Photo	Comment
KB-H8	-25.99765	28.91834	8.98	22/02/2024		Monitoring borehole not previously identified. Good condition
SF-01	-25.96432	29.02099	-	22/02/24		Closed system - could not measure water level. Good condition. Siro Farms
SF-02	-25.96353	29.02349	43.87	22/02/24		Good condition, livestock, and domestic use.
SF-03	-25.96199	29.02423	21.14	22/02/24		Livestock and Domestic use. Good condition. Weak BH, mostly for household use.

BH-Nr	Latitude	Longitude	SWL (depth below surface in m)	Date	Photo	Comment
NSW-10	-26.02538	28.94622	12.42	23/02/24		Monitoring borehole close to Pit H. Fair condition, cap not locked.
NSW-6	-26.04442	28.94413	-	23/02/224		Monitoring borehole blocked by bees. Could not measure or sample.
KF-F1	-26.01651	28.95065	-	23/02/24	No record	Fountain (spring). Small community uses it for water.
FF1	-25.95202	28.97419	9.60	23/02/24	No record	Old BH for farmhouse. No pump, farmer reported that the pump was stolen. Borehole is no longer in use as there are no occupants.

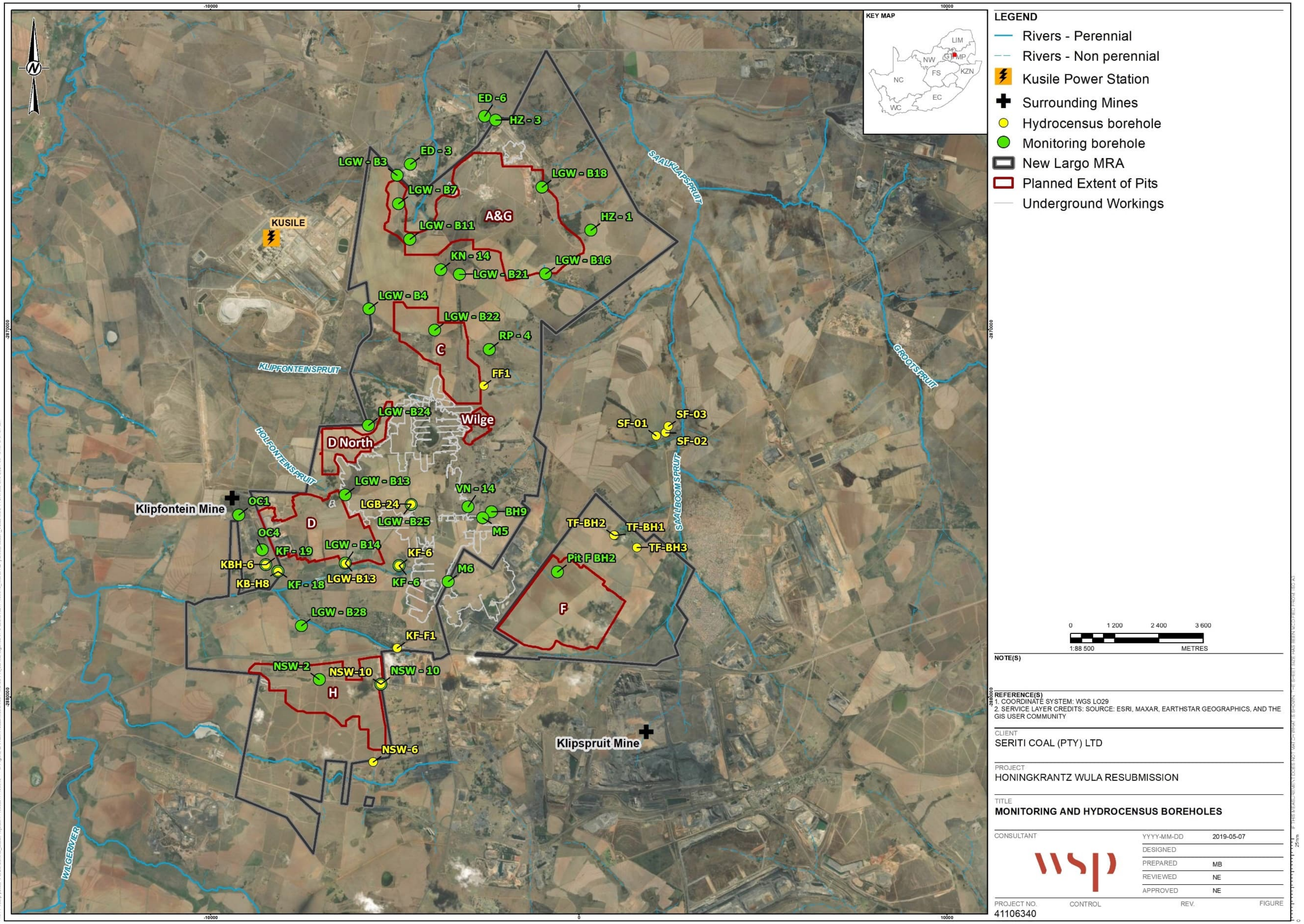


Figure 4-2 - Location of monitoring and hydrocensus boreholes

4.3. GEOPHYSICAL SURVEY AND RESULTS

Geophysics is not required as there are sufficient existing monitoring boreholes.

4.4. DRILLING AND SITING OF BOREHOLES

Information on boreholes were sourced from various reports. JMA (2012) provided borehole logs for the LGW boreholes that were drilled in 2007. Most of these boreholes were drilled to a depth of 30 m with the following exceptions:

- LGW-B13 was drilled to a depth of 40 m.
- LGW-B18 was drilled to a depth of 36 m.

No detail was available for the other boreholes. The locations of the monitoring boreholes are indicated in Figure 4-2 and the list of coordinates are indicated in Table 4-3.

4.5. AQUIFER TESTING

Aquifer testing in the form of falling head and slug tests were conducted in the new monitoring boreholes to establish the aquifer hydraulic conductivities. Results from JMA (2005) and Groundwater Square (2021) are summarised below:

- 0.03 m/d in the consolidated rock matrix and 1.0 m/day where fractures were observed (JMA, 2005).
- 0.002 to 6.71 m/day and 0.98 m/day on average in monitoring boreholes (Groundwater Square, 2021).

JMA (2012) conducted slug tests at 15 boreholes at New Largo and calculated the hydraulic conductivity and transmissivity values. Additional data was sourced from the adjacent Seriti mines of Klipspruit and Khutala as follows:

- Hydraulic conductivity (K) and transmissivity (T):
    - JMA (2012): New Largo average K: 0.76 m/d (ranging from 0.01 m/d to 7.6 m/d).
    - JMA (2012): New Largo average T: 5.06 m^2/d (ranging from 0.04 m^2/d to 42 m^2/d).
    - (Golder, 2017) Klipspruit K values varied from 0.002 m/day to 10.04 m/day.
    - (Golder, 2017) Klipspruit T values varied from 0.3 m^2/day to 1 m^2/day.
    - (WSP, 2023b) Khutala K values vary from 0.04 m/d to 0.06 m/d.
    - (WSP, 2023b) Khutala T values for the undisturbed aquifer varied from 1.1 m^2/day to 1.7 m^2/day. (WSP, 2023b) Khutala T values for backfilled overburden varied from 115 m^2/day to 5 700 m^2/day.
- Specific storage (Ss):
    - JMA (2012): New Largo Ss range from 0.01 to 0.001.
    - Delta H (2014): New Largo average Ss is 0.0012.
    - (WSP, 2024a) Klipspruit average Ss is 1×10^{-5}.
    - (WSP, 2023b) Khutala Ss range from 0.001 to 1×10^{-5}.

Table 4-3 – Borehole coordinates

Borehole ID	Locality	Latitude	Longitude	Bore-hole depth (mbgl)	Diameter (mm)	Water Strike (mbgl)	Water Strike Lithology	Blow Yield (L/s)
BH9	New Largo Monitoring Borehole	-25.98304	28.97625					
ED - 3	West of Pit A	-25.89773	28.95434					
ED -6	North of Pit A	-25.88588	28.97445					
HZ - 1	East of Pit A	-25.9139	29.00326					
HZ - 3	North of Pit A	-25.8868	28.97742					
KF - 18	South-West of Pit C	-25.99764	28.91837					
KF - 19	South-West of Pit C	-25.99598	28.91506					
KF -6	Southern Extent of Pit C	-25.9962	28.95118					
KN - 14	South-West of Pit A	-25.92353	28.96256					
LGW - B11	Western Extent of Pit A	-25.91609	28.95413	30	165	6.92	Shale	0.15
LGW - B13	Western Extent of Pit C	-25.97885	28.93662	40	165	19.16	Sandstone and shale	
LGW - B14	South-Western Extent of Pit C	-25.9956	28.93662	30	165	11.55	Tillite	0.17
LGW - B16	South-Eastern Extent of Pit A	-25.9246	28.99099	30	165	7.79	Clay	0.35
LGW - B18	North-East of Pit A	-25.90331	28.99002	36	165			
LGW - B21	Southern Extent of Pit A	-25.92468	28.9676	30	165	13.31	Grit	0.02
LGW - B22	Central Extent of Pit B	-25.93843	28.96086	30	165	18.46	Sandstone	
LGW - B28	South West of Pit C	-26.01099	28.92471	30	165	5.19	Lava	
LGW - B3	Western Extent of Pit A	-25.9004	28.95069	30	165	8.72	Shale	0.17
LGW - B4	West of Pit B	-25.93321	28.94305	30	165	6.74	Clay	6.67
LGW - B7	Western Extent of Pit A	-25.90736	28.95112	30	165	13.87	Shale	0.15
LGW -B24	North-West of Pit C	-25.96176	28.94293	30	165	4.95	Clay	0.05
LGW -B25	Central Extent of Pit C	-25.98122	28.95449	30	165	3.4	Clay	
M5	New Largo Monitoring Borehole	-25.9845	28.97389					
M6	New Largo Monitoring Borehole	-26.00014	28.96453					
NSW - 10	Eastern Extent of Pit F	-26.02538	28.94624					

Borehole ID	Locality	Latitude	Longitude	Bore-hole depth (mbgl)	Diameter (mm)	Water Strike (mbgl)	Water Strike Lithology	Blow Yield (L/s)
NSW-2		-26.0242	28.92957					
OC1	Pit D Monitoring Borehole	-25.98377	28.90772					
OC4	Pit D Monitoring Borehole	-25.99231	28.91405					
RP - 4	East of Pit B	-25.94314	28.97566					
VN - 14	Eastern Region of Pit C	-25.98178	28.96991					
Pit F BH2	Pit F near workshop/office complex	-25.997748	28.994185					

4.6. SAMPLING AND CHEMICAL ANALYSES

Monitoring data received from New Largo includes monitoring data conducted by:

- Waterlab from January 2022 to August 2022.
- Aquatico from October 2022 to present.

The monitoring network is discussed in further detail in Section 5 and 9. Most of the monitoring boreholes are sampled bi-annually for water quality analysis, but not consistently. Water level data measurements are more regular. Since October 2023, monthly water levels were recorded at 29 boreholes.

Groundwater quality parameters that are analysed include pH, electrical conductivity (EC), Total Dissolved Solids (TDS), Total hardness, total alkalinity, calcium, magnesium, potassium, sodium, sulfate, chloride, nitrate, ammonia, fluoride, manganese.

A map showing the network of the groundwater monitoring locations is presented in Figure 4-2.

4.7. GROUNDWATER RECHARGE CALCULATIONS

Groundwater effective recharge is estimated to be between 1 and 3 % of Mean Annual Precipitation (MAP) of 725 mm/a. A similar recharge (2 – 7% of MAP) was estimated by using the natural chloride concentrations in groundwater of 10 – 25 mg/l. The recharge used by WSP for the regional model assumed 2% MAP for the pre-mining / shallow regional aquifer. A higher recharge was assigned for the open cast backfill (12%) and lower recharge for the deeper aquifer (1%).

Vermeulen and Usher (2006) mentioned that between 1 and 3% of the rainfall above bord-and-pillar mining in Karoo formations infiltrate into the mine. However, they found in a study of five collieries in Mpumalanga that the recharge above bord-and-pillar mining is between 5 and 10% of MAP. (JMA, 2012) estimated the recharge to be between 6.5 and 10% of the mean annual precipitation (MAP). (Golder, 2021) reported that the recharge to the groundwater system is estimated to be between 3% and 7% of the MAP. These estimates seem to be high compared regional recharge used for groundwater models in the area:

- (Delta H, 2014) used 5% of MAP (37 mm/a) as the estimated recharge for their groundwater model.
- (WSP, 2023b) used a recharge of 1% to 2% of MAP for the Khutala groundwater model.
- (Golder, 2017) used an even lower recharge of 0.7% of MAP or 4.8 mm/a for the Klipspruit groundwater model.

4.8. GROUNDWATER MODELLING

Groundwater modelling is updated by WSP as part of this assessment and is detailed in Section 7.

4.9. GROUNDWATER AVAILABILITY ASSESSMENT

Groundwater is dewatered from the active pits at New Largo and surrounding mines. Groundwater is utilized by the surrounding communities for domestic water supply and livestock watering. Kusile Power station is a potential water user. Borehole yields in the shallow aquifers are generally low (less than 0.3 l/s) and expected to vary from dry to 2 l/s in the deeper fractured aquifer system. A range of 0.1 to 0.5 l/s is presented in the 1:500 000 hydrogeological map series (Figure 6-2) for the intergranular and fractured rock lithologies with potentially higher yields (0.5 - 2 l/s) noted for the area to the east of Pit A and Pit C.

5. PREVAILING GROUNDWATER CONDITIONS

5.1. GEOLOGY

5.1.1. REGIONAL GEOLOGY

The geology of the New Largo area primarily comprises of sedimentary rocks belonging to the Karoo Supergroup, consisting of the Dwyka, Ecca and Beaufort Groups capped by the Drakensburg Basalt Group.

The study area consists mainly of the Vryheid Formation (part of the Ecca Group) and consists of sandstone, shale and subordinate coal beds The Vryheid Formation in the north-eastern Witbank Coalfield contains five coal seams, 1 Seam (deepest) at the base to 5 Seam at the top.

A generalized lithology is presented in Figure 5-1.

5.1.2. LOCAL GEOLOGY

In the New Largo area, the Vryheid Formation (Pv) consists of thick beds of yellowish to white cross-bedded sandstone and grit, alternating with beds of soft sandy shale and coal seams. At surface the geology in the north and far west of the New Largo mine lease area is marked by numerous fine to medium-grained diabase intrusives (V-di). The geological map is indicated in Figure 5-1.

The depth of weathering is generally between 7 and 15m. Only the 2 Seam and 4 Seam are economically viable resources in the New Largo area. There are only limited known dyke intrusions and no significant faulting at New Largo. The Ogies dyke is situated south of New Largo.

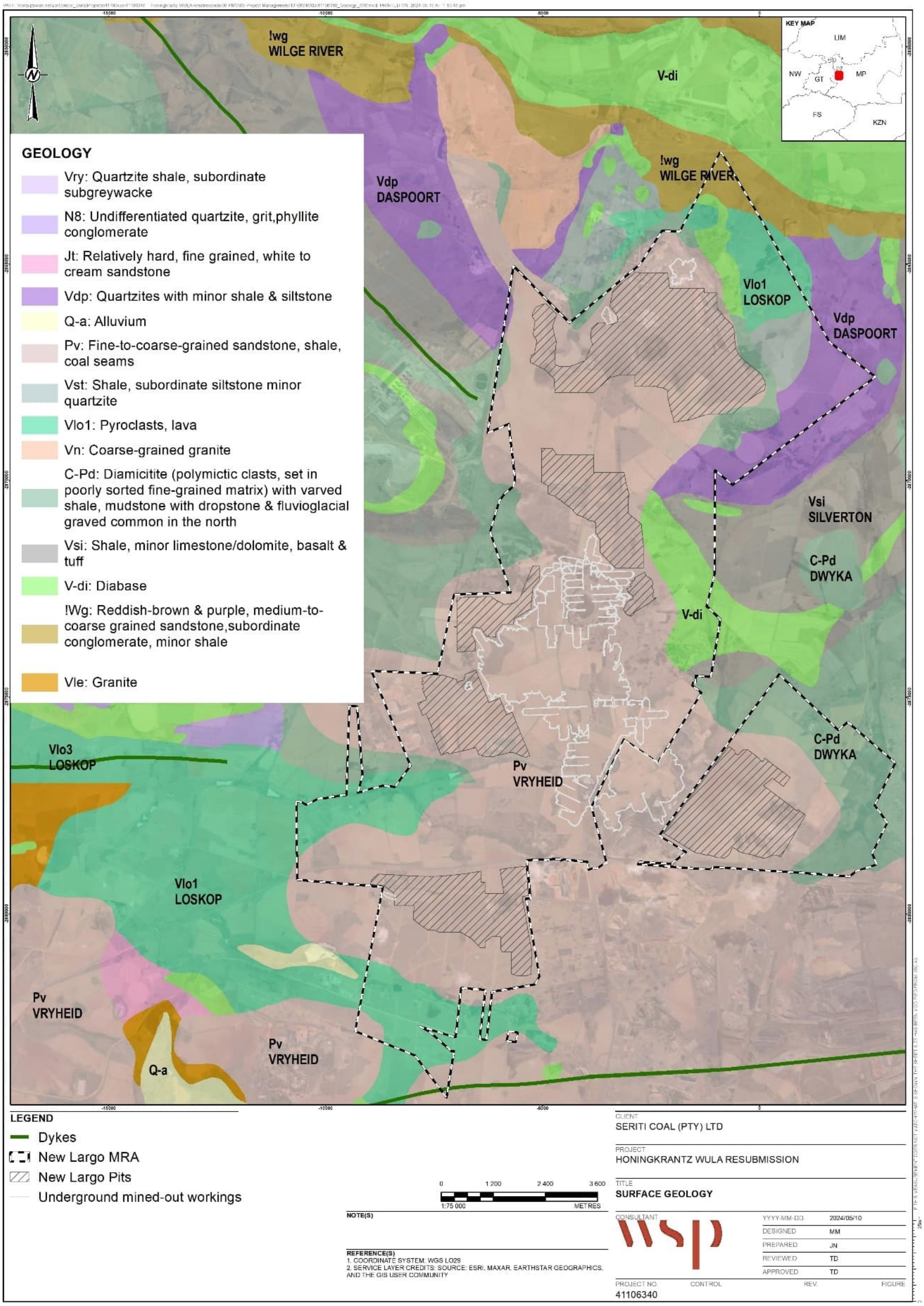


Figure 5-1 - Geology map

Depth (m)	Lithology
1	Clay
2	Clay
3	Clay
4	Clay
5	Clay
6	Clay
7	Silt
8	Silt
9	Silt
10	Silt
11	Shale
12	Coal
13	Sandstone
14	Coal
15	Coal
16	Coal
17	Shale
18	Shale
19	Sandstone
20	Sandstone
21	Sandstone
22	Shale
23	Shale
24	Shale
25	Shale
26	Shale
27	Coal
28	Coal
29	Coal
30	Coal
31	Coal
32	Coal
33	Shale
34	Shale
35	Shale
36	Coal
37	Coal
38	Shale
39	Tillite
40	Tillite

Figure 5-2 - General stratigraphy

5.2. ACID GENERATION CAPACITY

The acid generation capacity was assessed as part of the source terms for the groundwater model by WSP in 2024. The geochemistry results are still underway and will only be confirmed in August 2024.

5.3. HYDROGEOLOGY

JMA (2012) reported the presence of two dominant hydrogeological units intersected during the drilling of their investigation boreholes at New Largo, namely:

- A laterally extensive shallow weathered zone aquifer.
- More localised deeper fractured aquifer systems.

This is difficult to verify from water level data as most of the boreholes are relatively shallow and all the water levels seem to be connected. Borehole KN-14 is an exception, however, the reason for the very deep water levels at KN-14 is uncertain.

The more prominent of these is the laterally extensive shallow weathered zone aquifer, which occurs in the weathered and weathering related fractured zone within the Vryheid (Karoo Supergroup) and Pretoria Group (Transvaal Supergroup) lithologies (JMA, 2012). The average vertical thickness of this aquifer zone is approximately 21 meters, and it is considered to store and transport the bulk of groundwater, displaying unconfined to semi-confined piezometric conditions.

Localised fractured aquifers are restricted to contact zones between intrusive diabase bodies and the host rock. These semi-confined aquifers may have high yields in places but have limited storage, which will be drained laterally or vertically from the storage of the neighbouring weathered zone aquifer (JMA 2012). Aside from these isolated fracture zone aquifers, groundwater flow occurs preferentially in shallow weathered zone and bedding parallel fracturing along joints at depth.

Where present, alluvial strata will also be capable of storing and transmitting groundwater (Delta H, 2014). Although not considered a natural aquifer, significant volumes of water are stored in the mined-out underground workings in the 4 Seam and 2 Seam of New Largo.

5.3.1. UNSATURATED ZONE

The unsaturated zone varies across the site, encompassing the zone above the water table. The unsaturated zone is thinner closer to rivers, pans and wetlands and thicker at the catchment boundaries. There is limited hydraulic information available for the unsaturated zone.

5.3.2. SATURATED ZONE

The saturated zone encompasses the section below the water table. Two aquifers are identified at New Largo:

- A shallow zone occurring in the transitional soil and weathered bedrock zone or sub-outcrop horizon comprising yields of < 0.3 l/s (Du Toit *et al*, 1998).
- Deeper zones associated with fractures, fissures and joints and other discontinuities within the consolidated Karoo bedrock and associated intrusive structures. Yields range from 0 to 2 l/s (Du Toit *et al*, 1998).

Groundwater has also accumulated in the old underground workings.

The hydraulic conductivity (k) of an aquifer is a measure of the ease with which ground water can pass through the aquifer system and is expressed in m/day. The transmissivity (T) of an aquifer represents the ground water flow potential through the entire saturated zone and it is the product of the average hydraulic conductivity and the thickness of the saturated portion of the aquifer and is expressed in m^2/d.

5.4. GROUNDWATER LEVELS

5.4.1. SHALLOW AQUIFER

The surface topography was plotted against the water levels measured in December 2023. Figure 5-3 and shows that the correlation is good with an R^2 value of 88.5%. This implies that the water levels obtained from the regional (shallow) aquifer will generally follow the topography except where influenced by surrounding mining activities.

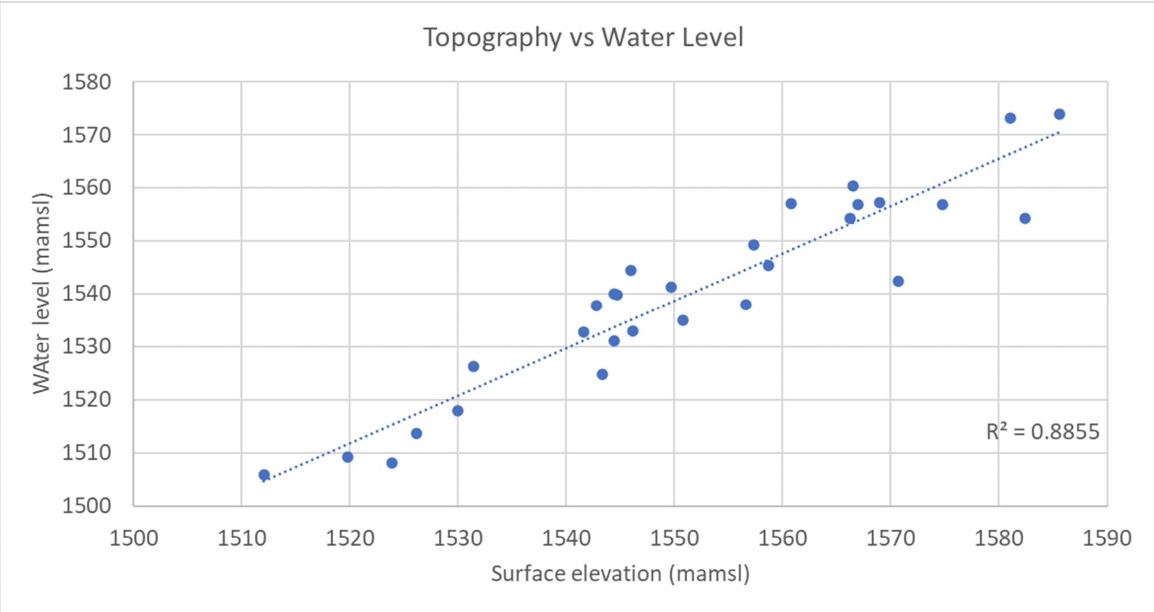


Figure 5-3 - Topography vs Water Level

There are a total of 29 monitoring boreholes from which groundwater levels are measured monthly. Data was provided from 2022 to present.

The Cumulative Rainfall Departure (CPD) provides an indication of the responsivity of the aquifer to rainfall. Due to a lack of long-term water level data, it is difficult to indicate how the water level responds to the CRD, however, for most boreholes it is evident that there is a high correlation between CRD and water levels. Examples of these are:

- ED6 (Figure 5-4).
- LGW-B28 (Figure 5-5).
- LGW-B3 (Figure 5-6).

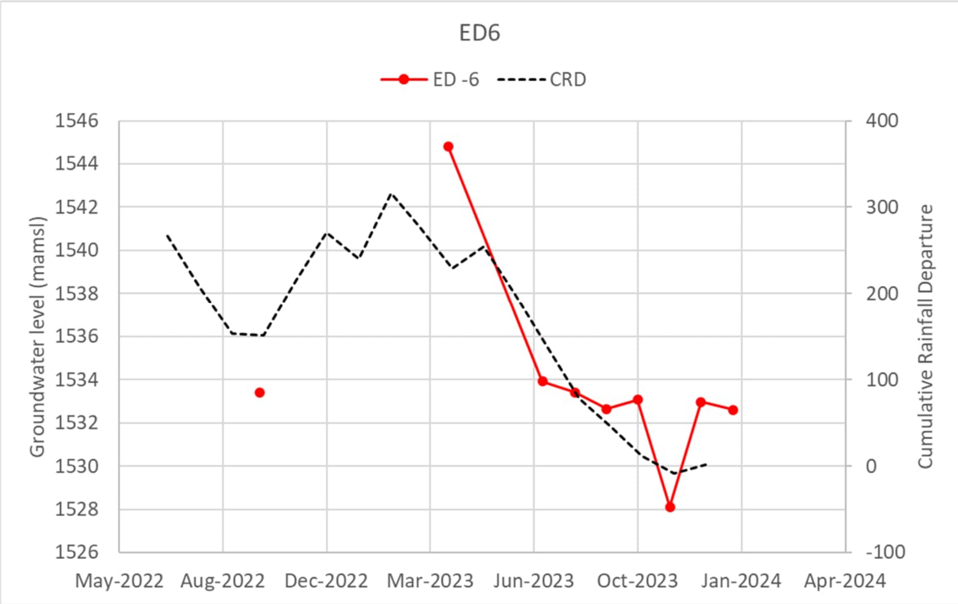


Figure 5-4 - ED6 water level compared with CRD

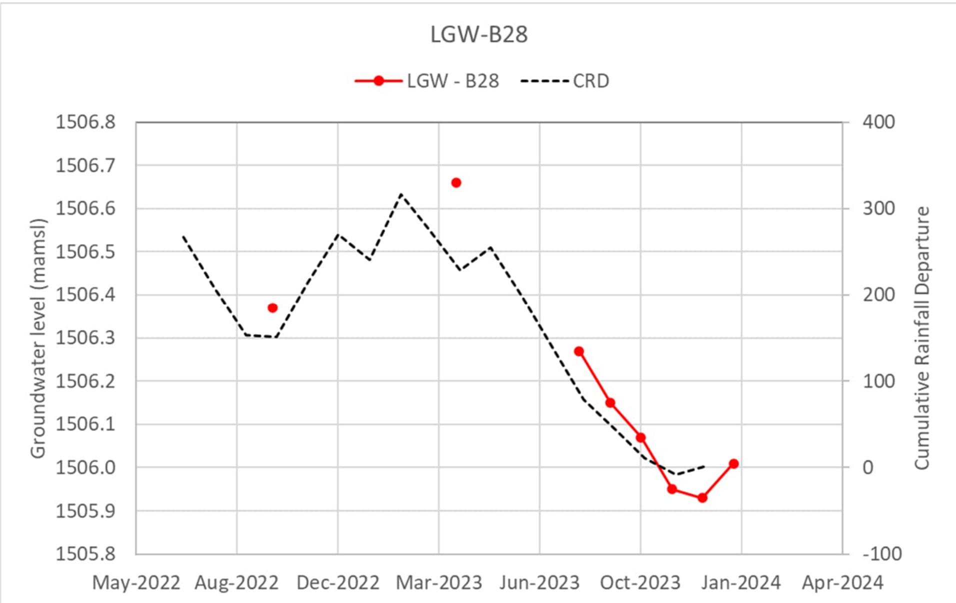


Figure 5-5 - LGW-B28 water level compared with CRD

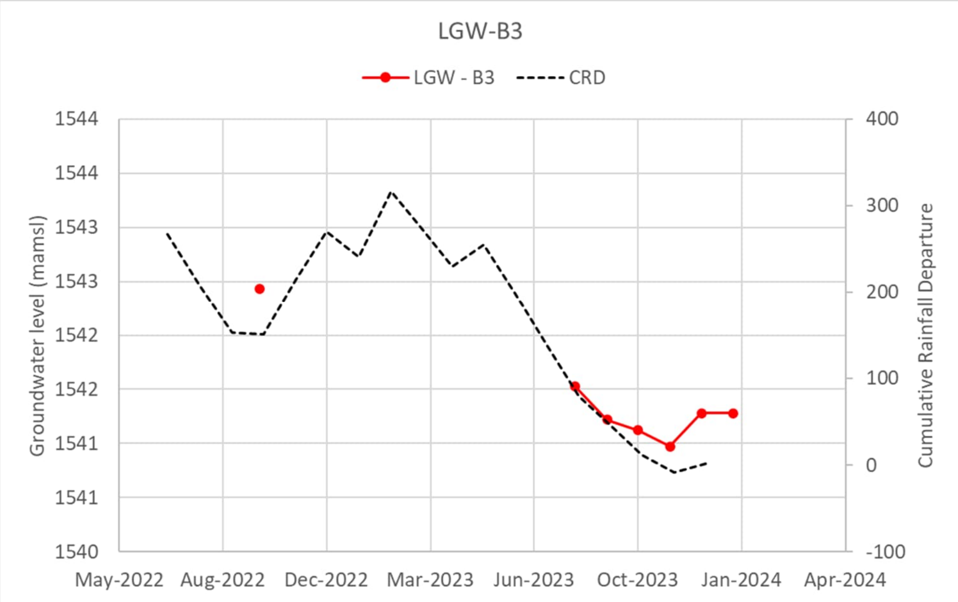


Figure 5-6 - LWG-B3 water level compared with CRD

The groundwater flow contours were interpolated from water levels measured in December 2023 (Figure 5-7). Groundwater generally flows from high elevations towards the surface drainages. The New Largo project lies on a topographical high, with water draining to the east and west along the sub-catchment in the direction of the Saalklap Spruit (B20G) and Wilge River (B20F) respectively.

WSP assessed the groundwater levels by grouping them according to monitoring boreholes located in the vicinity of each Pit outline. The boreholes associated with each pit are indicated in Figure 5-8.

The water level information is summarized below:

- Pit A
- Seven boreholes were identified in the vicinity of Pit A: ED6, HZ1, HZ3, LGW-B16, LGW-B18, LGW-B21, and KN-14.
  - ED6 - Depth to groundwater varies from 12.74 to 18.05 mbgl, with an outlier for April 2023 when the groundwater level was recorded as 1.35 mbgl.
  - HZ1 - Depth to groundwater varies from 15.1 to 15.8 mbgl, except for the December 2023 level which was at 5.7 mbgl.
  - HZ3 - Depth to groundwater varies from 10.0 to 11.6 mbgl.
  - LGW-B16 is located near a river and therefore the water level is shallow, varying between 2.7 and 4.5 mbgl.
  - LGW-B18 - Depth to groundwater varies from 9.3 to 10.1 mbgl.
  - LGW-B21 - Depth to groundwater varies from 9.1 to 16.9 mbgl.
  - KN-14 has the deepest water level in the area, potentially linked to underground workings as it is located close to a shaft. The water level varies from 43.7 to 48.8 mbgl, with one outlier for December 2023 when the water level was reported as 28.1 mbgl.
- Pit G
  - Three boreholes were identified in the vicinity of Pit G: LGW-B3, LGW-B7, and LGW-B11.
  - LGW-B3- Depth to groundwater varies from 7.2 to 8.6 mbgl.

- LGW-B7- Depth to groundwater varies from 10.8 to 14.0 mbgl.
- LGW-B11- is located near a pan and therefore the water level is shallow, varying from 3.4 to 3.9 mbgl.

- Pit C

  - Three boreholes were identified in the vicinity of Pit G: LGW-B4, LGW-B22, and RP4.
  - LGW-B4 - Depth to groundwater varies from 4.3 to 5.5 mbgl.
  - LGW-B22 - Depth to groundwater varies from 15.6 to 18.2 mbgl.
  - RP4 - Depth to groundwater varies from 3.4 to 4.9 mbgl.

- Pit D

  - Nine boreholes were identified in the vicinity of Pit G: LGW-B13, LGW-B14, LGW-B24, OC1, OC4, KF6, KF18, KF19, and M6.
  - LGW-B13 - Depth to groundwater varies from 18.3 to 18.7 mbgl.
  - LGW-B14 - Depth to groundwater varies from 11.3 to 12.1 mbgl.
  - LGW-B24 - Depth to groundwater varies from 3.5 to 5.1 mbgl.
  - OC1 - Depth to groundwater varies from 13.1 to 18.5 mbgl.
  - OC4 - Depth to groundwater varies from 12.9 to 18.6 mbgl.
  - KF6 - Depth to groundwater varies from 7.3 to 8.4 mbgl.
  - KF18 - Depth to groundwater varies from 4.6 to 11.4 mbgl.
  - KF19 - Depth to groundwater varies from 3.8 to 12.8 mbgl.
  - M6 - Depth to groundwater varies from 20.2 to 28.8 mbgl. This is the deepest water level in the area, potentially linked to underground workings. However, on plan view, this borehole seems to be just outside the underground workings.

- Wilge Pit

  - Three boreholes were identified in the vicinity of Wilge Pit: LGW-B25, BH9, and M5.
  - LGW-B25 - Depth to groundwater varies from 7.6 to 8.0 mbgl.
  - BH9 is 286 m north-east of M5, but the water levels differ with are ~ 15 m.
  - BH9 - Depth to groundwater varies from 0.4 to 1.5 mbgl. These shallow water levels suggest a wetland area but needs to be confirmed.
  - M5 is drilled into the 4 Seam of the underground mine workings and show water level depths from 15.8 to 16.8 mbgl.

- Pit H

  - Three boreholes were identified in the vicinity of Pit H: LGW-B28, NSW2, and NSW10.
  - LGW-B28 - Depth to groundwater varies from 5.4 to 6.1 mbgl.
  - NSW2 - Depth to groundwater varies from 5.0 to 6.1 mbgl.
  - NSW10 - Depth to groundwater varies from 3.4 to 4.9 mbgl.

- Pit F

  - The only monitoring borehole in the vicinity of Pit F is Pit F BH2.
  - Depth to natural groundwater level varied from 7.77 to 8.94 mbgl in this borehole.

The groundwater level measurements from July 2023 to Jan 2024 are presented in Table 5-1. Water level elevation indicates surface elevation minus depth to groundwater.

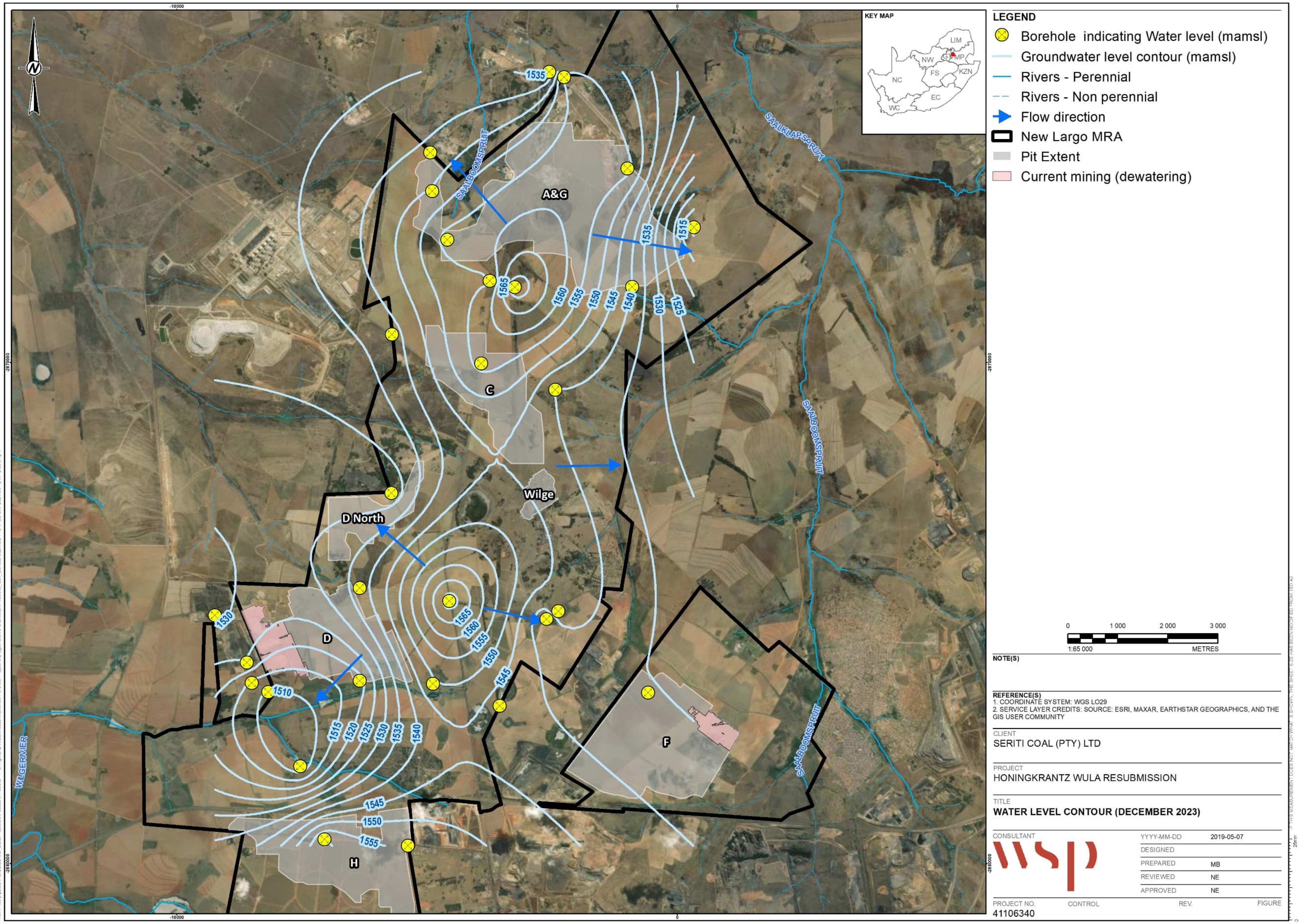


Figure 5-7 - Groundwater Level Map for New Largo

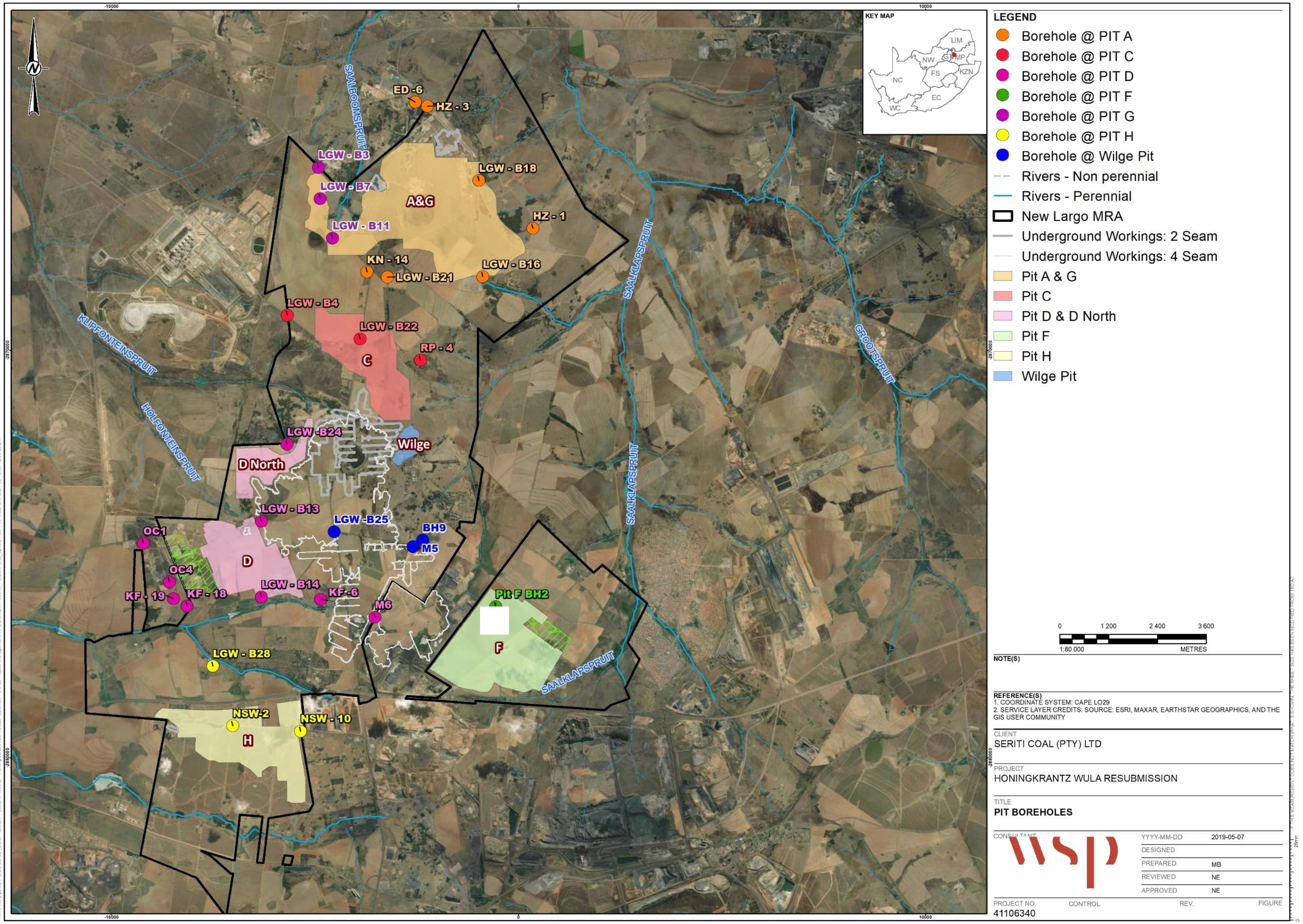


Figure 5-8 - Boreholes associated with pits

Table 5-1 – Groundwater Levels Jul 2023 – January 2024

Pit	BH_ID	Latitude	Longitude	Surface elevation (from 5 m contours)	Water level depth (m) Jul 23	Water level elevation* (mamsl) Jul 23	Water level depth (m) Aug 23	Water level elevation* (mamsl) Aug 23	Water level depth (m) Sept 23	Water level elevation* (mamsl) Sept 23	Water level depth (m) Oct 23	Water level elevation* (mamsl) Oct 23	Water level depth (m) Nov 23	Water level elevation* (mamsl) Nov 23	Water level depth (m) Dec 23	Water level elevation* (mamsl) Dec 23	Water level depth (m) Jan 24	Water level elevation* (mamsl) Jan 24
Pit A	ED -6	-25.88588	28.97445	1546.16	12.25	1533.91	12.74	1533.42	13.52	1532.64	13.1	1533.06	18.05	1528.11	13.2	1532.96	13.55	1532.61
	HZ - 1	-25.9139	29.00326	1523.91							15.11	1508.8	15.38	1508.53	15.85	1508.06	5.72	1518.19
	HZ - 3	-25.8868	28.97742	1568.98	10.01	1558.97	10.88	1558.1	11.63	1557.35	11.58	1557.4	11.63	1557.35	11.7	1557.28	11.52	1557.46
	LGW - B16	-25.9246	28.99099	1544.41	2.72	1541.69	2.82	1541.59	3.3	1541.11	3.6	1540.81	4.05	1540.36	4.43	1539.98	4.45	1539.96
	LGW - B18	-25.90331	28.99002	1566.99					10.08	1556.91	10.05	1556.94	9.32	1557.67	10.14	1556.85	9.63	1557.36
	LGW - B21	-25.92468	28.9676	1585.57	9.06	1576.51	9.36	1576.21	16.93	1568.64	10.33	1575.24	10.31	1575.26	11.64	1573.93	11.69	1573.88
Pit C	LGW - B22	-25.93843	28.96086	1574.73	15.62	1559.11	16.15	1558.58	12.88	1561.85	17.18	1557.55	17.LGW53	1557.2	17.81	1556.92	18.16	1556.57
	LGW - B4	-25.93321	28.94305	1542.82	4.69	1538.13	4.29	1538.53	4.54	1538.28	4.67	1538.15	4.78	1538.04	5.03	1537.79	5.48	1537.34
	RP - 4	-25.94314	28.97566	1544.67	3.6	1541.07	3.41	1541.26			4.25	1540.42	4.59	1540.08	4.88	1539.79		
Pit D & D North	KF - 18	-25.99764	28.91837	1519.81			9.04	1510.77	11.42	1508.39	10.8	1509.01	10.91	1508.9	10.5	1509.31	10.63	1509.18
	KF - 19	-25.99598	28.91506	1526.16			10.4	1515.76	12.75	1513.41	12.56	1513.6	12.43	1513.73	12.5	1513.66	12.56	1513.6
	KF -6	-25.99617	28.95121	1557.35	8.26	1549.09	8.26	1549.09	8.33	1549.02	8.3	1549.05	8.36	1548.99	8	1549.35	8.03	1549.32
	LGW - B13	-25.97885	28.93662	1556.57			18.63	1537.94	18.68	1537.89	18.67	1537.9	18.68	1537.89	18.69	1537.88	18.72	1537.85
	LGW - B14	-25.9956	28.93662	1529.93			11.54	1518.39	12.02	1517.91	11.79	1518.14	11.92	1518.01	12.03	1517.9	12.05	1517.88
	LGW - B24	-25.96176	28.94293	1531.44			4.03	1527.41	4.44	1527	4.62	1526.82	4.95	1526.49	5.13	1526.31		
	M6	-26.00014	28.96453	1570.69			28.27	1542.42	28.81	1541.88	28.22	1542.47	28.27	1542.42	28.23	1542.46	20.15	1550.54

Pit	BH_ID	Latitude	Longitude	Surface elevation (from 5 m contours)	Water level depth (m) Jul 23	Water level elevation* (mamsl) Jul 23	Water level depth (m) Aug 23	Water level elevation* (mamsl) Aug 23	Water level depth (m) Sept 23	Water level elevation* (mamsl) Sept 23	Water level depth (m) Oct 23	Water level elevation* (mamsl) Oct 23	Water level depth (m) Nov 23	Water level elevation* (mamsl) Nov 23	Water level depth (m) Dec 23	Water level elevation* (mamsl) Dec 23	Water level depth (m) Jan 24	Water level elevation* (mamsl) Jan 24
	OC1	-25.98377	28.90772	1544.41	18.48	1525.93	13.13	1531.28	13.25	1531.16	13.26	1531.15	13.32	1531.09	13.31	1531.1		
	OC4	-25.99231	28.91405	1543.34	12.92	1530.42	18.52	1524.82	18.56	1524.78	17.6	1525.74	18.58	1524.76	18.59	1524.75		
Pit F	Pit F BH2	-25.9936	28.99238	1544.15	7.77	1536.38	7.81	1536.34	8.51	1535.64	8.58	1535.57	8.69	1535.46	8.94	1535.21		
Pit G	LGW - B11	-25.91609	28.95413	1560.76	3.37	1557.39	3.88	1556.88	3.49	1557.27	3.55	1557.21	3.48	1557.28	3.66	1557.1	3.57	1557.19
	LGW - B3	-25.9004	28.95069	1549.68		1549.68	8.15	1541.53	8.46	1541.22	8.56	1541.12	8.71	1540.97	8.4	1541.28	8.4	1541.28
	LGW - B7	-25.90736	28.95112	1558.72	13.25	1545.47	13.31	1545.41	13.28	1545.44	13.34	1545.38	13.41	1545.31	13.3	1545.42	13.98	1544.74
Pit H	LGW - B28	-26.01099	28.92471	1512.03			5.76	1506.27	5.88	1506.15	5.96	1506.07	6.08	1505.95	6.1	1505.93	6.02	1506.01
	NSW - 10	-26.02538	28.94622	1566.25			11.77	1554.48	11.86	1554.39	11.81	1554.44	11.56	1554.69	11.94	1554.31	11.91	1554.34
	NSW-2	-26.0242	28.92957	1566.51					6.02	1560.49			6.09	1560.42	6.14	1560.37		
Wilge/ UG workings	BH9	-25.98304	28.97625	1545.94			0.54	1545.4	0.38	1545.56	1.25	1544.69	1.34	1544.6	1.47	1544.47	1.02	1544.92
	LGW - B25	-25.98122	28.95449	1581.04			7.74	1573.3	8.01	1573.03	8	1573.04	7.99	1573.05	7.84	1573.2	7.89	1573.15
	M5	-25.9845	28.97389	1550.81			16.82	1533.99	16.83	1533.98	16.82	1533.99	16.83	1533.98	15.84	1534.97	16.82	1533.99
UG workings/ Pit A area	KN - 14	-25.92353	28.96256	1582.41	43.86	1538.55	43.73	1538.68	43.78	1538.63	43.89	1538.52	43.96	1538.45	28.11	1554.3	48.85	1533.56

**Water level elevation = surface elevation minus water level depth*

5.4.2. DEEPER AQUIFER

According to and extraction from a report by Hodgson (reference unknown) supplied by New Largo, the deeper aquifer lies within the consolidated formations below the weathered rocks. Dual porosity conditions occur, with groundwater in the formation and in the fractures, cracks and joints within these rocks. The coal itself also yields limited amounts of water.

5.4.3. UNDERGROUND MINING

Water level data (2023 and 2024) indicates that the water level in the underground mining areas has recovered after mining ceased some time before 2012. However, some boreholes still indicate deep water levels. (Delta H, 2014) states that there is a set of water levels measured in the deeper fractured underground mining.

According to New Largo, only boreholes LGW-B13 and M5 are drilled into the underground workings. These boreholes have water levels of more than 15 mbgl. Other boreholes with deep water levels are:

- KN-14 (in the vicinity of Pit A) with levels of between 28 and 44 mbgl. This borehole is located outside the New Largo underground workings but potentially linked to underground workings as it is located close to a shaft. It is not within the 'Non-Defined Previously Mined Areas' (Red Zones) delineated by (JMA, 2023). The Red Zones could be updated to include the area of KN-14.
- LGW - B22 (Pit C) has water levels between 12 and 18 mbgl.
- M6, OC1 and OC4 also have deep water levels, but this is attributed to mining at Pit D and Klipfontein Pit.

5.5. GROUNDWATER POTENTIAL CONTAMINANTS

Based on the geochemistry assessment, the main potential contaminants of concern are identified as acidity (pH) and sulfate.

5.6. GROUNDWATER QUALITY

The earliest groundwater quality data available is sourced from JMA, 2012 with the latest water quality data sourced from the monitoring program (2023) and collected during the hydrocensus (February 2024).

- Baseline water quality as determined from unimpacted boreholes in the area.
- Whilst the reserve has also been determined for the Olifants and Letaba catchment (GN 41887, September 2018), there are no priority sites specified and groundwater quality objectives are therefore not specified. The reserve typically considers the target water quality in terms of Classes associated with domestic use. DWAF, 1998[3], Class 2 marginal water quality for domestic use is therefore included in Table 5-2 for comparison.

[3] Department of Water Affairs and Forestry, 1998, Quality of Domestic Water Supplies: Volume 1 Assessment Guide. Marginal Water quality – may be used without health effects by most individuals but can cause effects in some individuals in sensitive groups or after lifetime use.

- Since there are no RQOs specific to catchments B20F and B20G, the Water Quality Protection Limits (WQPLs) for the Upper Olifants sub-catchment (DWS, 2016) as published in Government Gazette no 466 of 22 April 2016 are included for reference. Note that the WQPLs for MU22 is more stringent than the WQPLs for MU20 and MU21.
- The SANS 241-2015 standard for drinking water is included for reference as GPT (annual monitoring reports) refer to this standard in the reporting. It is emphasized water is not utilized for drinking purposes from the monitoring boreholes and these reference values are only for comparison purposes.
- Generally, the groundwater quality of the monitoring boreholes ranged from good to poor where boreholes comprise locally elevated concentrations in respect to total dissolved solids (TDS), manganese and sulfate. GPT (2022) note that total suspended solids, electrical conductivity (EC), TDS nitrate, F, ammonia, and iron are locally elevated in the Decant 2 sample.

The analytical results of the 6 WSP hydrocensus groundwater samples as well as groundwater samples monitored by New Largo in October 2023 were plotted spatially for TDS in Figure 5-9, for Nitrate in Figure 5-10, and for Sulfate in Figure 5-11. The sections below describe the water qualities for each of the management units and these are compared to the reference concentrations as summarised in Table 5-2.

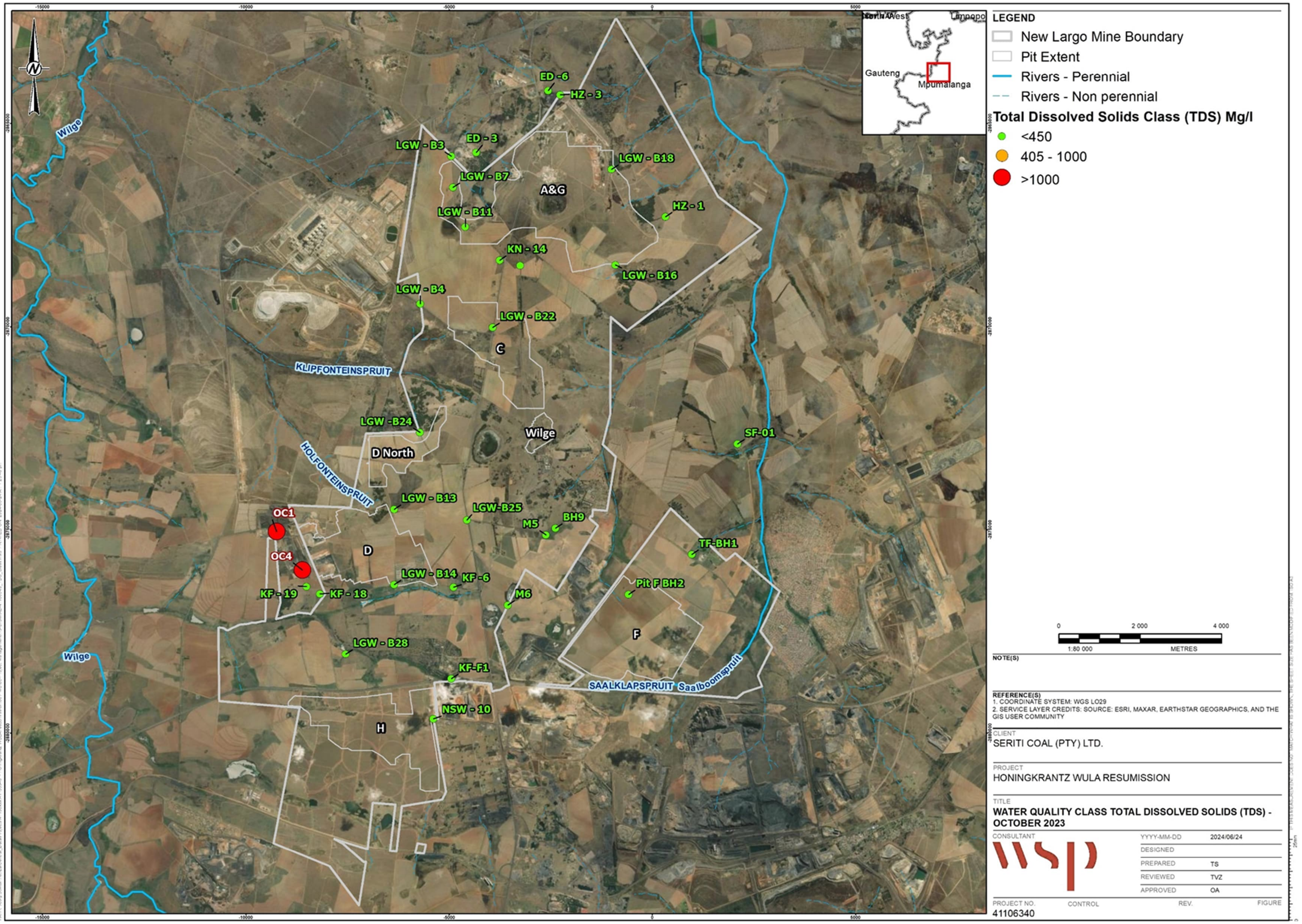


Figure 5-9 - Observed TDS concentrations (October 2023)

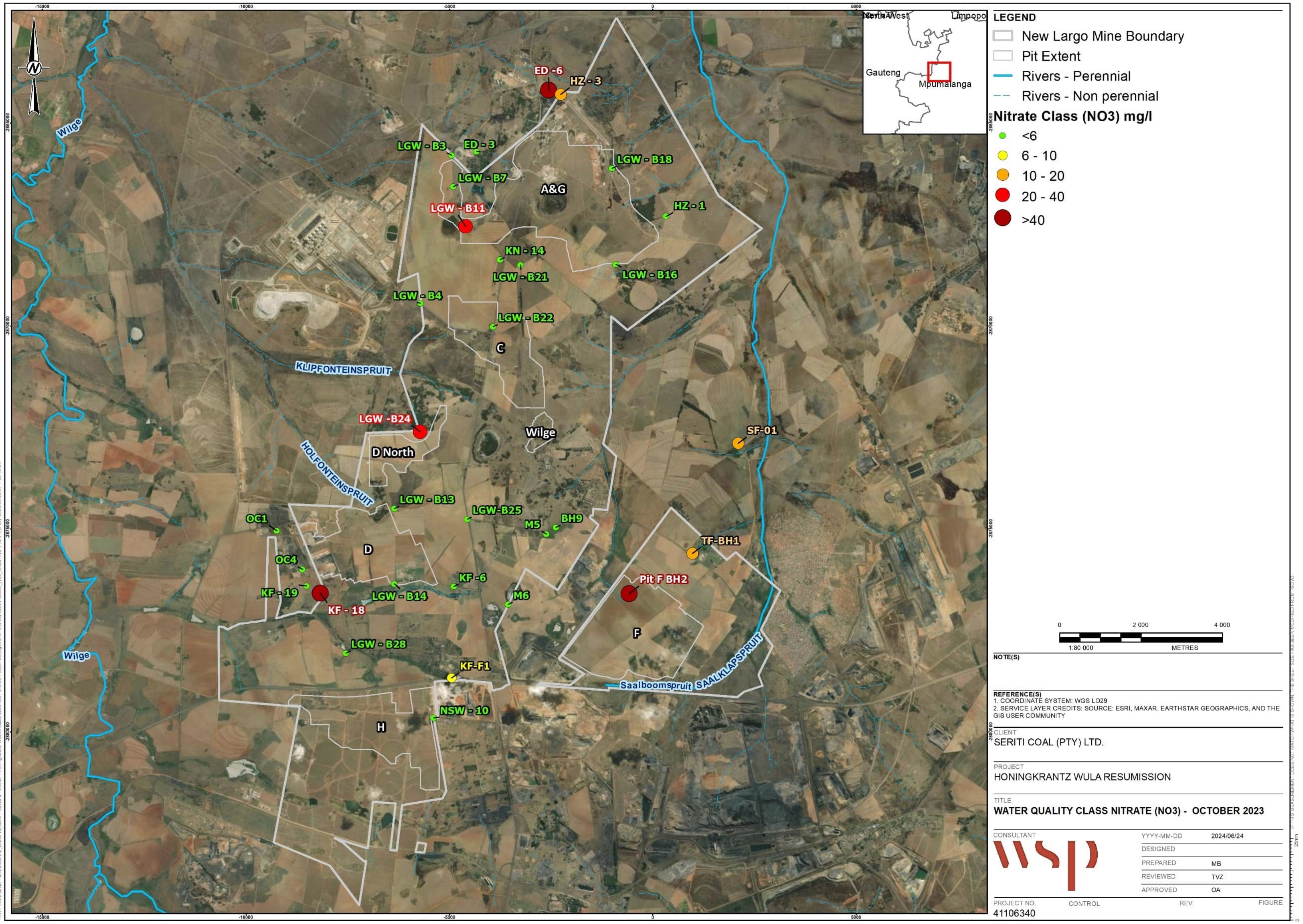


Figure 5-10 - Observed Nitrate concentrations (October 2023)

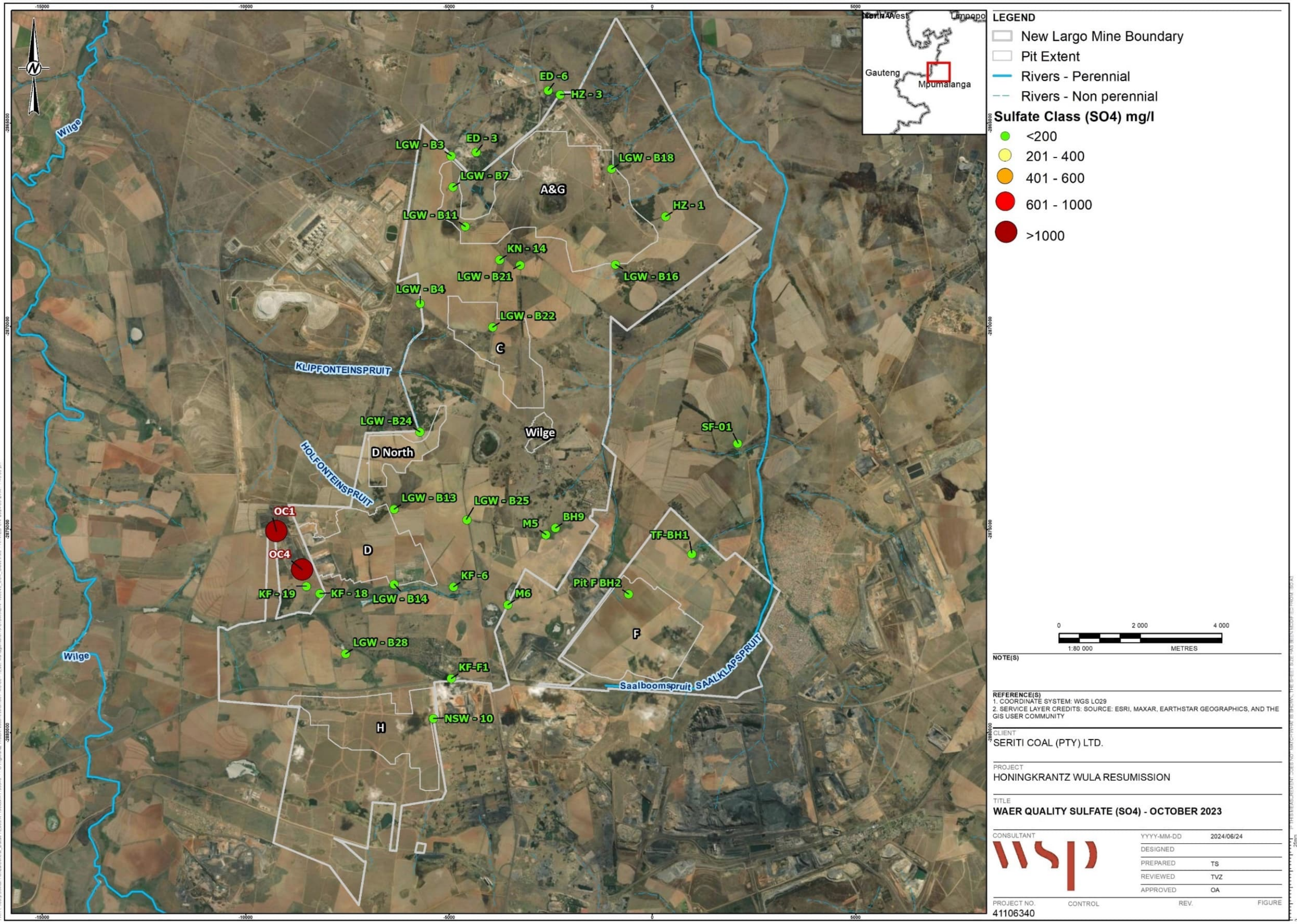


Figure 5-11 - Observed Sulfate concentrations (October 2023)

5.6.1. MU20

The pits that fall within MU22 are the eastern parts of Pit A and Pit C as well as the entire Pit F. A section of Pit F has been mined, but Pits A and C will be mined from 2025 onward.

There are seven (7) boreholes that fall in MU20, three (3) hydrocensus boreholes and four (4) monitoring boreholes. In general, the water quality is acceptable, but the following values should be noted:

- Nitrate (as N) – The values of the monitoring boreholes range from 1.5 mgN/L to 2.4 mgN/L while some of the values of the hydrocensus boreholes were comparatively higher, ranging from below detection to 12.4 mgN/L possibly due to these being located in agricultural areas.
- Mn – A localised maximum of 0.16 mg/L Mn was measured at BH9 which is between Wilge Pit and Pt F and near the underground workings.
- The water quality in the hydrocensus boreholes TF-BH3 (pH of 5.7) and TF-BH1 (pH of 6.1) were slightly acidic in comparison to the other borehole water quality in the area. These boreholes are north-east of Pit F.

5.6.2. MU21

Ten monitoring boreholes fall within MU21. In general, the water quality is acceptable, but the following values should be noted:

- Nitrate (as N) –Values ranged from 0.2 to 172 mgN/L. The highest values measured was at:
  - ED6 where 161 mgN/l was recorded.
  - LGW-B11 where 26.6mgN/L was recorded.
  - HZ-3 where 16.2mgN/L was recorded.
  - Elsewhere within MU21, the nitrate values were below 4 mgN/L.
- Mn – Borehole LGW-B22 had a value of 0.26 mg/L Mn and borehole HZ-1 had a value of 0.41 mg/L Mn.

5.6.3. MU22

Seventeen (17) boreholes are located in MU22, three (3) hydrocensus boreholes and fourteen (14) monitoring boreholes. The following values should be noted:

- The pH at hydrocensus borehole KF-F1 was slightly acidic (pH of 5.9).
- EC values above 200 mS/m and TDS of 1000 mg/l were observed at boreholes OC1 and OC4 associated with comparatively elevated sulfate concentrations of > 1000 mg/L where the other boreholes were generally < xxx
- Total Alkalinity values above 100 mg/L were observed at monitoring boreholes LGW-B13, LGW-B14, and OC4.
- Ca values above 80 mg/L were observed at boreholes OC1 and OC4.
- Mg values above 70 mg/L were observed at boreholes OC1 and OC4.
- Sodium concentrations were locally elevated above 100 mg/L at Pit F BH2.
- Nitrate (as N) values were generally reported as below 6 mg/L except in KF-F1 (6.2 mgN/L), LGW-B24 (26.6 mgN/L), KF-18 (172 mgN/L) and Pit F BH2 (172 mgN/L).
- Fluoride values above 0.7 mg/L were locally observed at monitoring boreholes LGW-B13, LGW-B14, and OC4.

- Iron was locally elevated in OC1 at 108 mg/L Fe. This was for October 2023, however, the only other measurement at OC1 was in July 2023 when 1.6 mg/L Fe was measured. It is possible that the 108 mg/L is a typing error.
- Manganese concentrations above 0.4 mg/L were observed at boreholes KF-6 and OC4.

Boreholes OC1 and OC4 are impacted by mining as they are situated downgradient from Pit D and the Klipfontein open pit.

Table 5-2 – New Largo Groundwater Chemistry data (in mg/L, except for EC which is in mS/m)

Pit	Borehole	Management Unit	pH	EC	TDS	Total Alkalinity	Ca	K mg/l	Mg	Na	Cl	NO_3 (N)	SO_4	F	Fe	Mn	Class
	WQPL's for MU20		6.5-8.4	75	500	120	80		50	70	45	0.5	400	0.75	0.1	0.02	
	WQPL's for MU21		6.5-8.4	75	500	120	80		30	70	20	0.5	400	0.75	0.3	0.18	
	WQPL's for MU22		6.5-8.4	40	260	120	32		20	30	20	0.5	70	0.75	0.1	0.02	
	Class 0 Max. Allowable Limit		7-9.5	<70	<450	-	<80	<25	<70	<100	<100	<6	<200	<0.7	<0.01	<0.1	0
	Class 1 Max. Allowable Limit		9.5-10	70-150	450-1000	-	80-150	25-50	70-100	100-200	100-200	6 to 10	200-400	0.7-1.0	0.01-0.2	0.1-0.4	1
	Class 2 Max. Allowable Limit		10-10.5	150-370	1000-2400	-	150-300	50-100	100-200	200-400	200-600	10 to 20	400-600	1.0-1.5	0.2-2.0	1.0 to 4.0	2
	Class 3 Max. Allowable Limit		10.5-11	370-520	2400-3400	-	>300	100-500	200-400	400-1000	600-1200	20-40	600-1000	1.5-3.5	2 to 10	4.0 to 10.0	3
	Class 4 Max. Allowable Limit		>11	>520	>3400	-		>500	>400	>1000	>1200	>40	>1000	>3.5	>10.0	>10.0	4
East of Wilge,	SF-01	MU20	6.9	24.1	188	41	18	1.2	9.5	10.8	13.8	10.7	<2.5	0.08	0.059	0.056	2 (NO_3)
Pit A	LGW - B16	MU20	5.9	2.5	20	5.3	<0.263	0.4	10.4	7.2	1.3	2.1	1.8	<0.263	<0.004	0.16	1 (Mn)
Pit A	LGW - B18	MU20	6.6	11.3	106	42.9	11.5	4.8	4.2	4.5	3.3	2.4	2.4	<0.263	<0.004	0.1	1 (Mn)
Pit F	TF-BH1	MU20	6.1	17.6	139	8.3	9.6	4	5.3	11.2	12.4	12.1	<2.5	<0.06	0.048	<0.001	2 (NO_3)
Wilge/ UG workings	BH9	MU20	7.9	67.7	404	96.1	<0.263	2.3	1.9	6.1	40.1	1.8	161	<0.263	<0.004	0.01	0
Wilge/ UG workings	M5	MU20	5.5	13.1	84	3.6	<0.263	5.5	3.9	10.3	4.1	1.5	16.2	<0.263	<0.004	<0.001	1 (pH)
Pit A	ED -6	MU21	6.5	7.5	50	32	0.4	1	9.1	3.9	<0.557	161	3.4	0.37	<0.004	0.1	4 (NO_3)
Pit A	HZ - 1	MU21	6.9	7.2	54	29.2	3.3	2.1	3.3	4.3	1.1	0.2	2.1	<0.263	<0.004	0.41	1 (Mn)
Pit A	HZ - 3	MU21	7.6	20.1	110	96.5	0.9	1	16.2	3.5	1.4	16.2	2.8	0.85	<0.004	0.04	2 (NO_3)
Pit A	LGW - B21	MU21	6.5	2.3	16	7.7	0.7	0.6	2.5	1.6	1.2	2	1.8	0.7	<0.004	0.04	1 (F)
Pit A/UG workings	KN - 14	MU21	7.1	9.8	60	46.4	<0.263	2.3	4.3	4.8	2.1	2.8	2.1	<0.263	<0.004	<0.001	0
Pit C	LGW - B22	MU21	6.4	7.7	46	31.6	0.5	1.2	3.3	3.7	2.5	1.8	1.5	0.49	<0.004	0.26	1 (Mn)
Pit G	ED - 3	MU21	7	22.6	186	85.6	0.8	1	2.8	1.4	1.3	3.7	26.6	0.83	<0.004	<0.001	1 (F)
Pit G	LGW - B11	MU21	8.1	11.7	76	44.1	9.8	2.3	5.9	2.8	3.8	26.6	4.2	<0.263	<0.004	<0.001	3 (NO_3)
Pit G	LGW - B3	MU21	6.5	9.9	82	17.8	5.4	1.7	4.6	5	2.3	2	2	0.36	<0.004	<0.001	1 (pH)
Pit G	LGW - B7	MU21	6.5	3.8	30	<1.99	0.8	1	0.4	1.1	1.5	1.8	3.8	<0.263	<0.004	<0.001	1 (pH)
Pit C	LGW - B4	MU22	6.6	3.5	22	9.6	0.5	0.6	1	1.5	0.9	3.9	2	0.47	<0.004	0.11	1 (Mn)
Pit C	KF-F1	MU22	5.9	9.9	77	3.8	12.4	2	5.5	12.2	3.6	6.2	3.8	<0.06	0.01	0.012	1 (NO_3)
Pit D & D North	KF - 18	MU22	7	8.1	54	24.7	4.5	5.2	2.2	3.6	3.1	172	1.8	0.64	<0.004	0.12	4 (NO_3)
Pit D & D North	KF - 19	MU22	8.1	24.6	128	49.7	13	4.2	17.3	4.9	5.6	1.8	61.7	<0.263	<0.004	0.11	1 (Mn)
Pit D & D North	KF -6	MU22	5.8	45.1	380	3.2	0.6	9.4	1.2	1.3	3.4	2.2	172	0.62	<0.004	0.61	1 (Mn)
Pit D & D North	LGW - B13	MU22	8	32.8	188	180	23.6	4.6	13.9	28	4.6	3.4	2	2.59	<0.004	<0.001	3 (F)
Pit D & D North	LGW - B14	MU22	9	28	160	147	5.7	3.6	2.1	58.1	5	2.8	1.9	4.91	<0.004	<0.001	4 (F)
Pit D & D North	LGW -B24	MU22	8.1	7.8	56	30	<0.263	2.3	4.7	8.2	2.9	26.6	1.4	<0.263	<0.004	<0.001	3 (NO_3)
Pit D & D North	M6	MU22	7.2	18.4	134	74.2	<0.263	2.8	1	1.5	5.6	1.4	2.2	<0.263	<0.004	<0.001	0
Pit D & D North	OC1	MU22	6.5	209	1900	49.4	233	14.9	107	23	4.5	0.3	1192	<0.263	108	12.5	4 (SO_4)
Pit D & D North	OC4	MU22	6.9	219	1952	357	404	20.3	133	13.6	3.1	0.3	1116	0.8	0.3	1.52	4 (SO_4)
Pit F	Pit F BH2	MU22	7.4	15.4	98	61	0.5	2.1	4.9	118	2.5	172	3.7	0.45	<0.004	0.07	4 (NO_3)
Pit H	LGW - B28	MU22	8.4	18.3	110	99.4	31.4	1.1	3.2	3	3	1.5	3.9	<0.263	<0.004	<0.001	0
Pit H	NSW - 10 (monitoring)	MU22	7.1	8.2	52	22.2	4.5	4.4	0.9	3.9	2.6	1.4	4.2	<0.263	<0.004	<0.001	0
Pit H	NSW-10 (hydrocensus)	MU22	6.3	5.9	44	12.1	2.3	5.3	1.2	4.7	<2.5	<0.25	5.2	<0.06	<0.004	0.011	0
Wilge/ UG workings	LGW-B25	MU22	7.2	17.3	110	62	17.2	3.5	4.7	8.7	<2.5	2.3	<2.5	0.09	0.04	0.021	0

5.7. PIPER DIAGRAM

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

5.7.1. HYDROCENSUS BOREHOLES

The hydrocensus boreholes chemistry are plot on a Piper Diagram (Figure 5-12). Three of the borehole's groundwater quality (SF-01, NSW-10 and LGW-B25) plots as ambient groundwater that is of a bi-carbonate type (recently recharged). Borehole NSW-10 has a slightly higher sodium and potassium type of enrichment typical of underground coal workings. Fountain KF-F1 and borehole TF-BH3 have no dominate anions and cations in the water and represent a mix type of water quality. Borehole TF-BH1 represent a chloride type of water quality and no dominant cation quality.

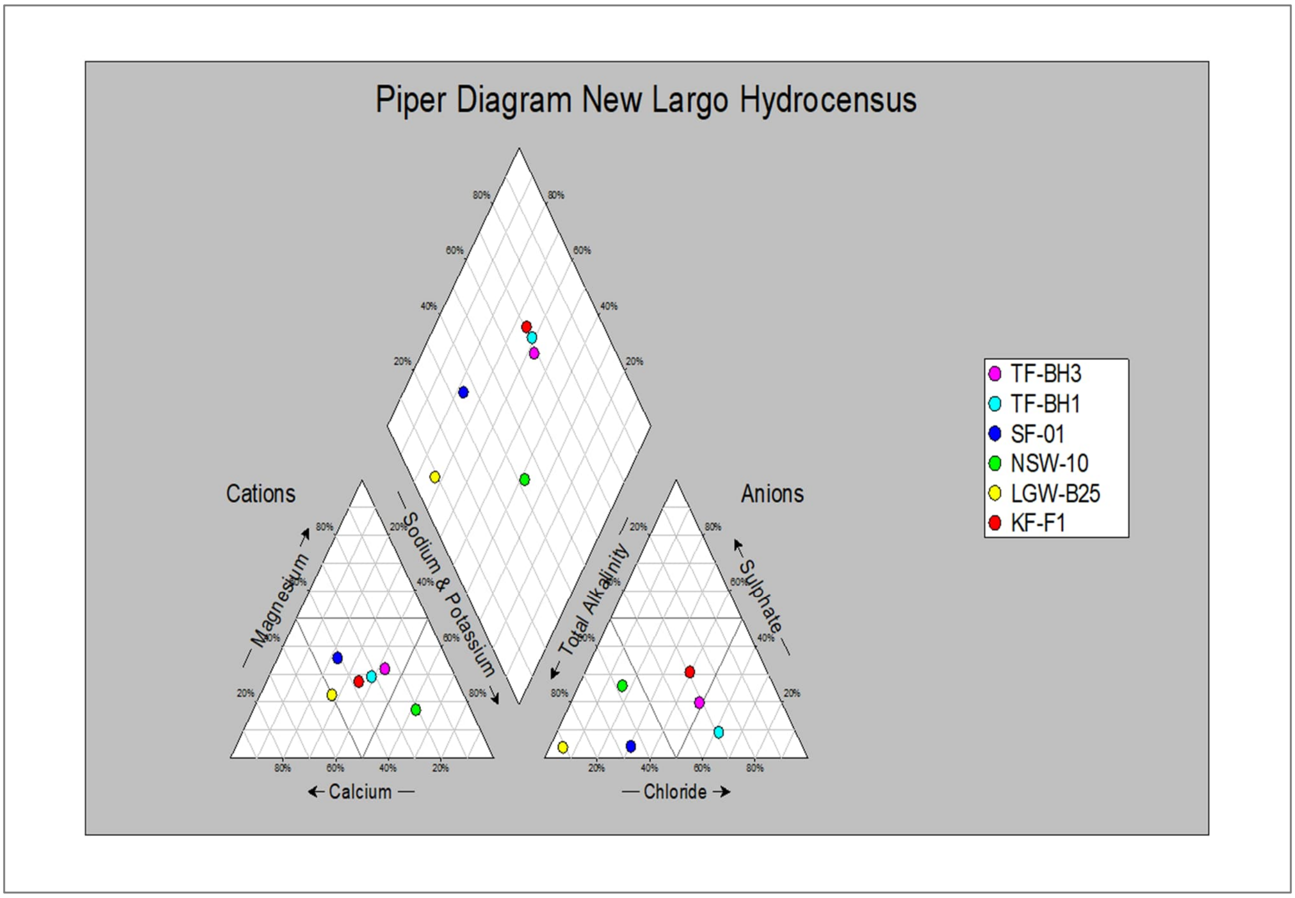


Figure 5-12 - Piper Diagram - Hydrocensus Boreholes

5.7.2. NEW LARGO LGW-BOREHOLES OCTOBER 2023

The LGW boreholes chemistry data are plotted on a Piper Diagram (Figure 5-13). Borehole LGW-B7 is predominantly n Calcium/Sodium Sulfate water type with no dominant type of anion or cation. The rest of the LGW monitoring boreholes mostly represent a Magnesium/Bicarbonate type of water quality except for borehole LGW-B13 that has a sodium bicarbonate type of water quality.

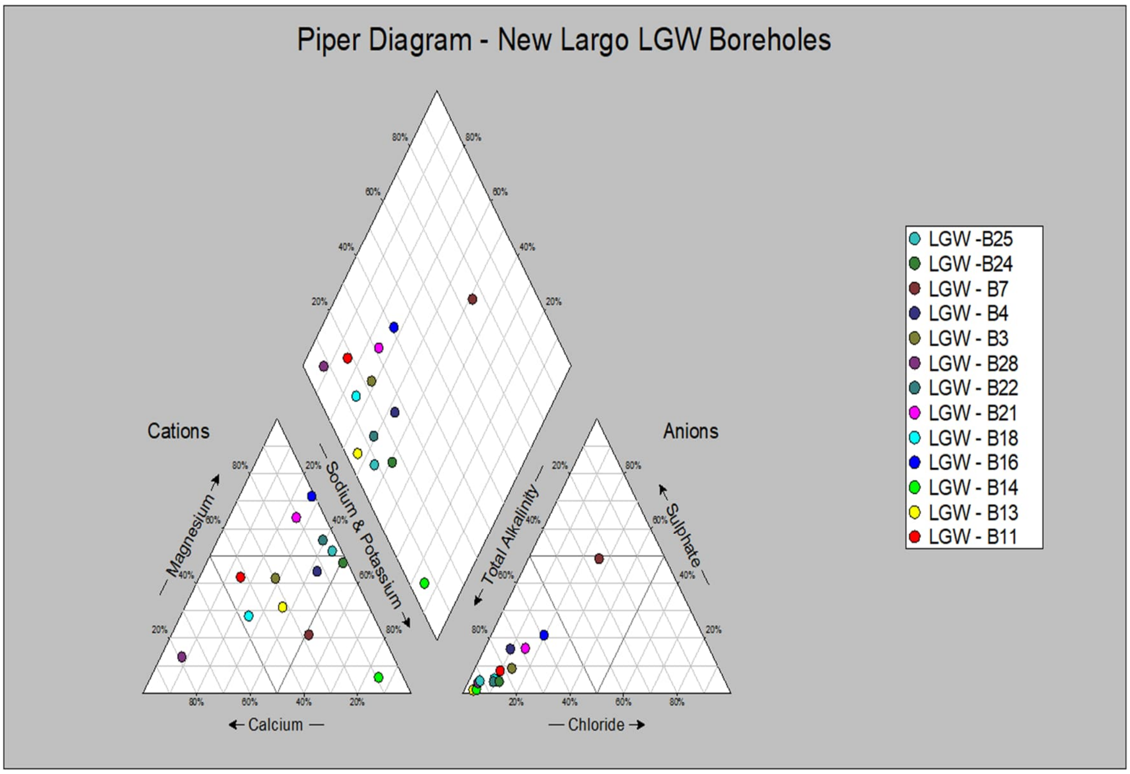


Figure 5-13 - Piper Diagram - New Largo LGW Boreholes

5.7.3. NEW LARGO MONITORING BOREHOLES

The New Largo monitoring boreholes chemistry are plot on a Piper Diagram (Figure 5-14). Boreholes OC1, OC4, KF-6, BH-9, M5 and KF-19 represent a dominant Sulfate type of water that is an indication of mine pollution. Borehole OC1 OC4 and KF-19 have an enrichment of calcium chloride and boreholes BH9, M5 and KF-6 have an enrichment of sodium chloride.

Boreholes ED-3, ED-6, KF-18, HZ-1, KF-19, KN-14 and M6 have a magnesium/bicarbonate type of water quality.

Borehole Pit F BH2 has a sodium bicarbonate type of water quality.

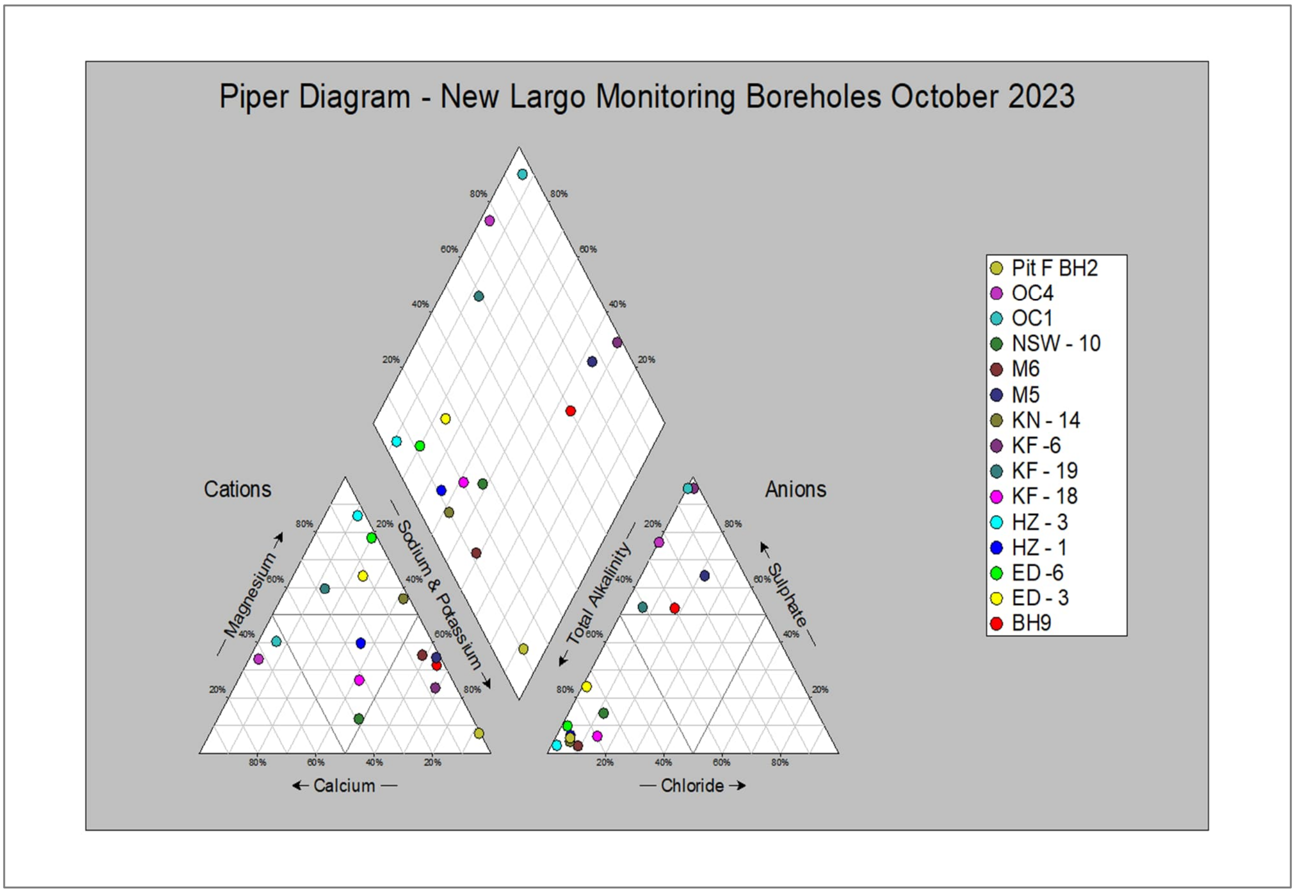


Figure 5-14 - Piper Diagram - New Largo Monitoring Boreholes

5.8. EXPANDED DUROV DIAGRAM

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

5.8.1. NEW LARGO LGW BOREHOLES

The LGW boreholes chemistry are plotted on an Expanded Durov Diagram Borehole (Figure 5-15). LGW-B7 is indicative of power station and vanadium extraction type of water quality with high sulphite values.

Boreholes LGW-B13 and LGW-B24 have a water quality type indicative of wastewater discharge/high extraction underground coal mines and has higher sodium, potassium and carbonate (total alkalinity) values.

Boreholes LGW-B11, LGW-B13, LGW-B18, LGW-B3, LGW-B21, LGW-B16, LGW-B4, LGW-B22 and LGW-B25 is typical of unpolluted groundwater and have a high magnesium and T-alkalinity type of water quality.

Borehole LGW-B28 is typical of unpolluted groundwater and have a higher calcium type of water quality.

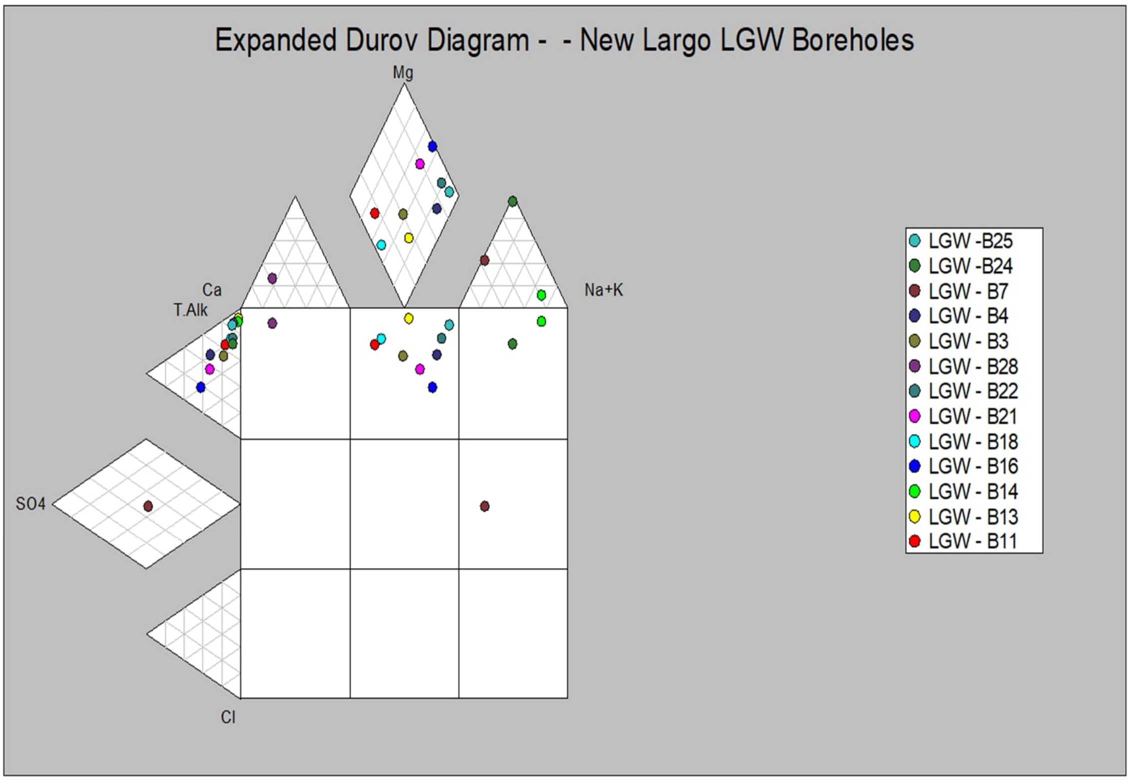


Figure 5-15 - Expanded Durov Diagram - New Largo LGW Boreholes

5.8.2. NEW LARGO MONITORING BOREHOLES OCTOBER 2023

The New Largo monitoring boreholes chemistry are plot on an Expanded Durov Diagram (Figure 5-16). Boreholes BH9, KF-6 and M5 is indicative of power station and vanadium extraction type of water quality with high Sulfate values.

Boreholes OC4 and OC1 is indicative of acid water or lime treatment water and has exceptionally high Sulfate values.

Borehole KF-19 is typical of opencast coal mine water with high Sulfate values.

Boreholes M6 and Pit F BH2 have a water quality type indicative of wastewater discharge/high extraction underground coal mines and has higher sodium, potassium and carbonate (total alkalinity) values.

Boreholes HZ-1, HZ-3, ED-6 ED-3, KF-18, NSW-10 and KN 14 is typical of unpolluted groundwater with a higher magnesium and T-Alk type of water quality.

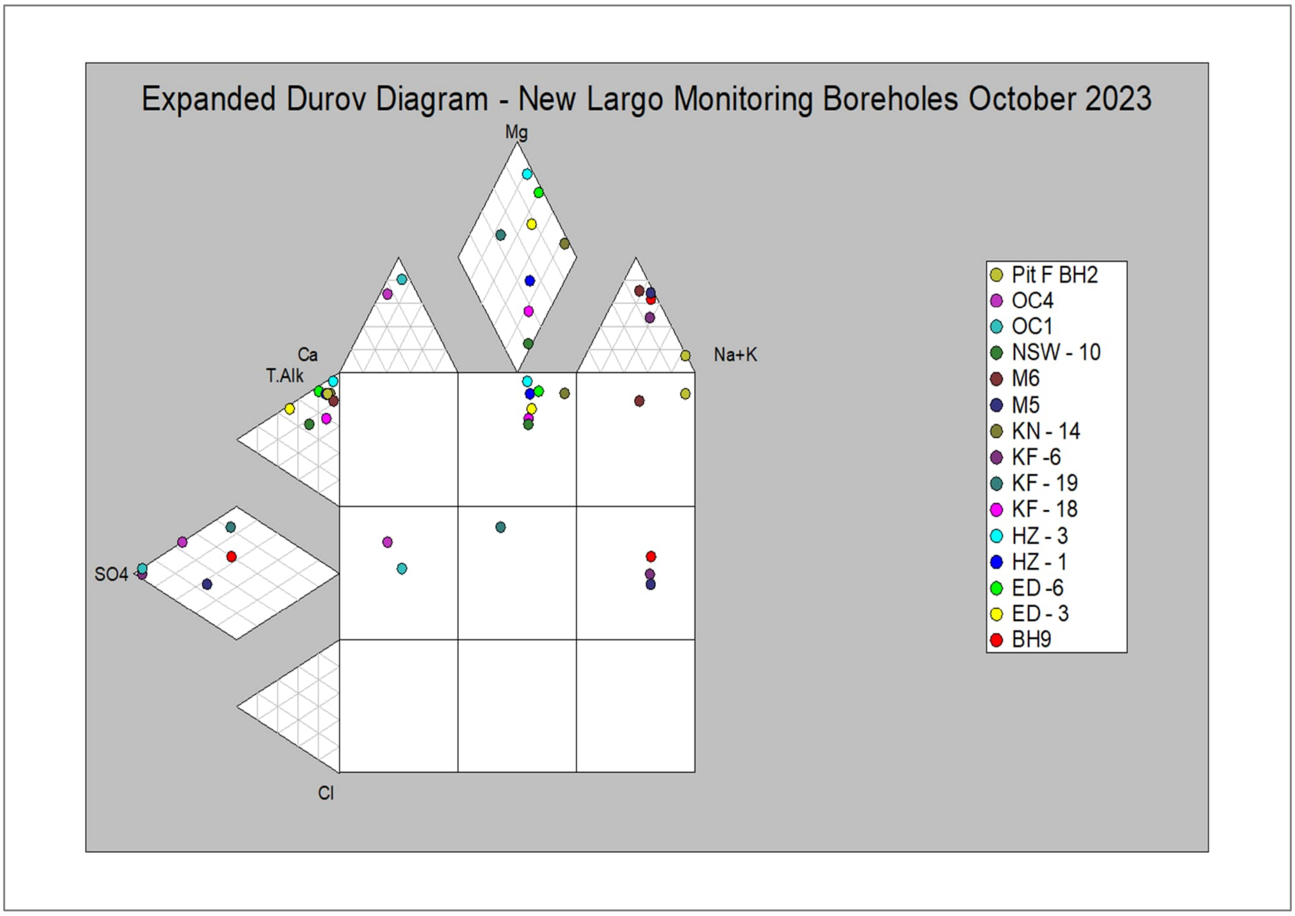


Figure 5-16 - Expanded Durov Diagram - New Largo Monitoring Boreholes

6. AQUIFER CHARACTERISATION

6.1. GROUNDWATER VULNERABILITY

A groundwater vulnerability map for the area is presented in Figure 6-1. The groundwater vulnerability is defined as the tendency or likelihood for contamination to reach a specific position within the aquifer the groundwater system after being introduction at an upgradient location. Most of the New Largo area has aquifers of **medium vulnerability**, which is vulnerable to some pollutants with continuous discharge or leaching.

The area in the north of New Largo has aquifers of **low vulnerability**, and a small area in the north-east of New Largo has aquifers of high and medium high vulnerability.

6.2. AQUIFER CLASSIFICATION

The aquifer classification map for the area is presented in Figure 6-2. The aquifer underlying the site were classified in accordance with the “South African Aquifer System Management Classification, December 1995” presented in Table 6-1. The aquifer classification in the area is indicated as a minor aquifer for the entire area surrounding New Largo.

Table 6-1 - Aquifer system management classes

Type of aquifer system	Description of system
Sole Aquifer System	An aquifer which is used to supply 50 per cent or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
Major Aquifer System	Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (electrical conductivity of less than 150 mS/m).
Minor Aquifer System	**These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying baseflow for rivers.**
Non-Aquifer System	These are formations with negligible permeability that are regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks, although imperceptible, does take place and needs to be considered when assessing the risk associated with persistent pollutants.

Figure 6-2 also indicates the hydrogeological yield:

- Most of the area is classified as: Intergranular and Fractured with yields between 0.1 and 0.5 l/s.
- The north-eastern section of New Largo is classified as: Intergranular and Fractured with yields between 0.5 and 2 l/s.

6.3. AQUIFER PROTECTION CLASSIFICATION

Aquifer susceptibility is a qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities, and which includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification. Parsons and Conrad (1998) provided the basis for assigning aquifer contamination susceptibility classes (Table 6-2).

Table 6-2 – Basis for assigning aquifer contamination susceptibility classes

Aquifer system management class	Low Vulnerability (1)	Medium Vulnerability (2)	High Vulnerability (3)
Poor Groundwater Region (1)	Low Susceptibility (1)	Low Susceptibility (2)	Medium Susceptibility (3)
Minor Groundwater Region (2)	Low Susceptibility (2)	Medium Susceptibility (4)	High Susceptibility (6)
Major Groundwater Region (3)	Medium Susceptibility (3)	High Susceptibility (6)	High Susceptibility (9)

For most of New Largo, the susceptibility rating is low (4), indicating that medium level groundwater protection may be required. The northern area of New Largo has a low susceptibility (2) while a small area in the north-east of New Largo has a high susceptibility (6).

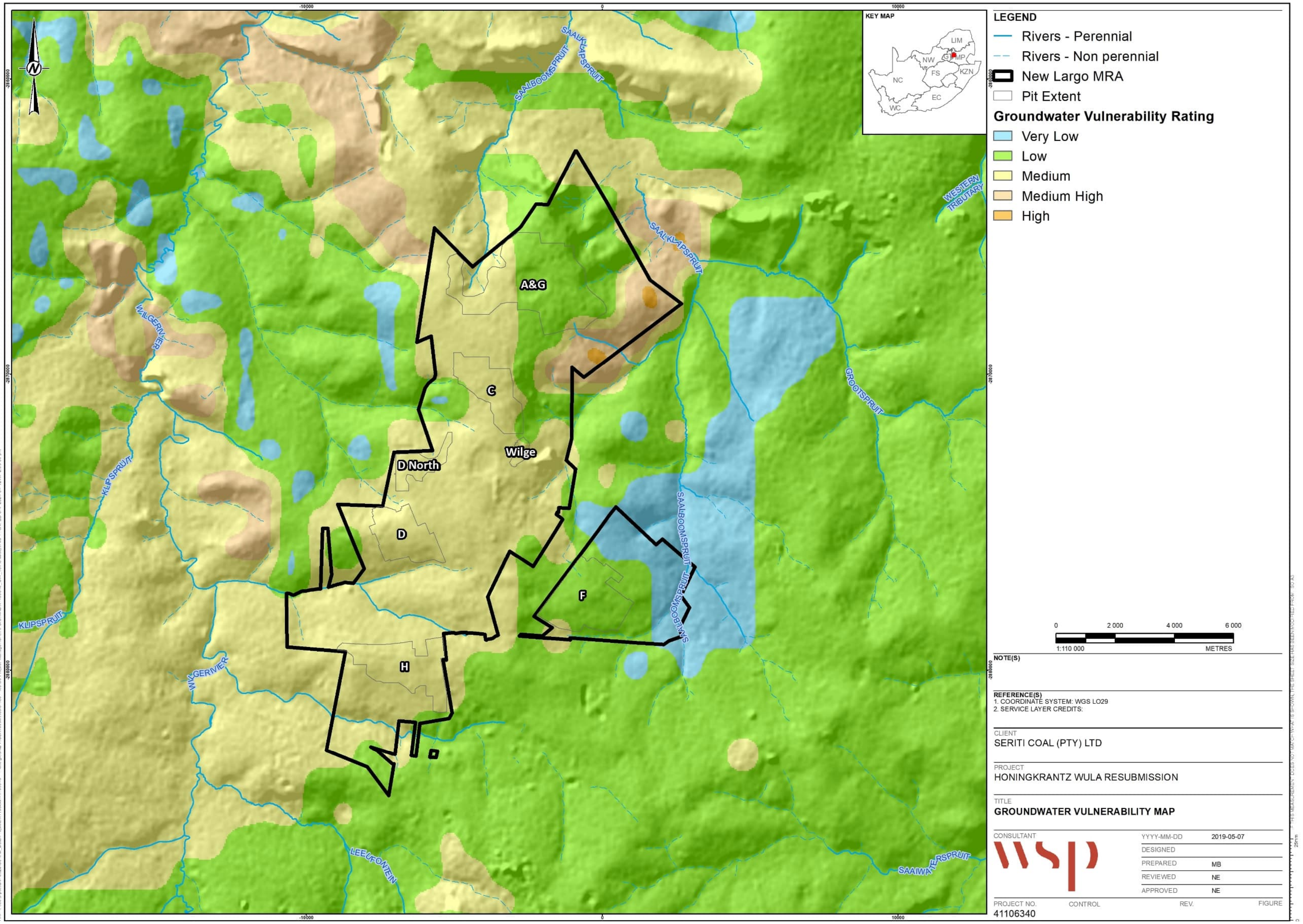


Figure 6-1 - Groundwater Vulnerability Map

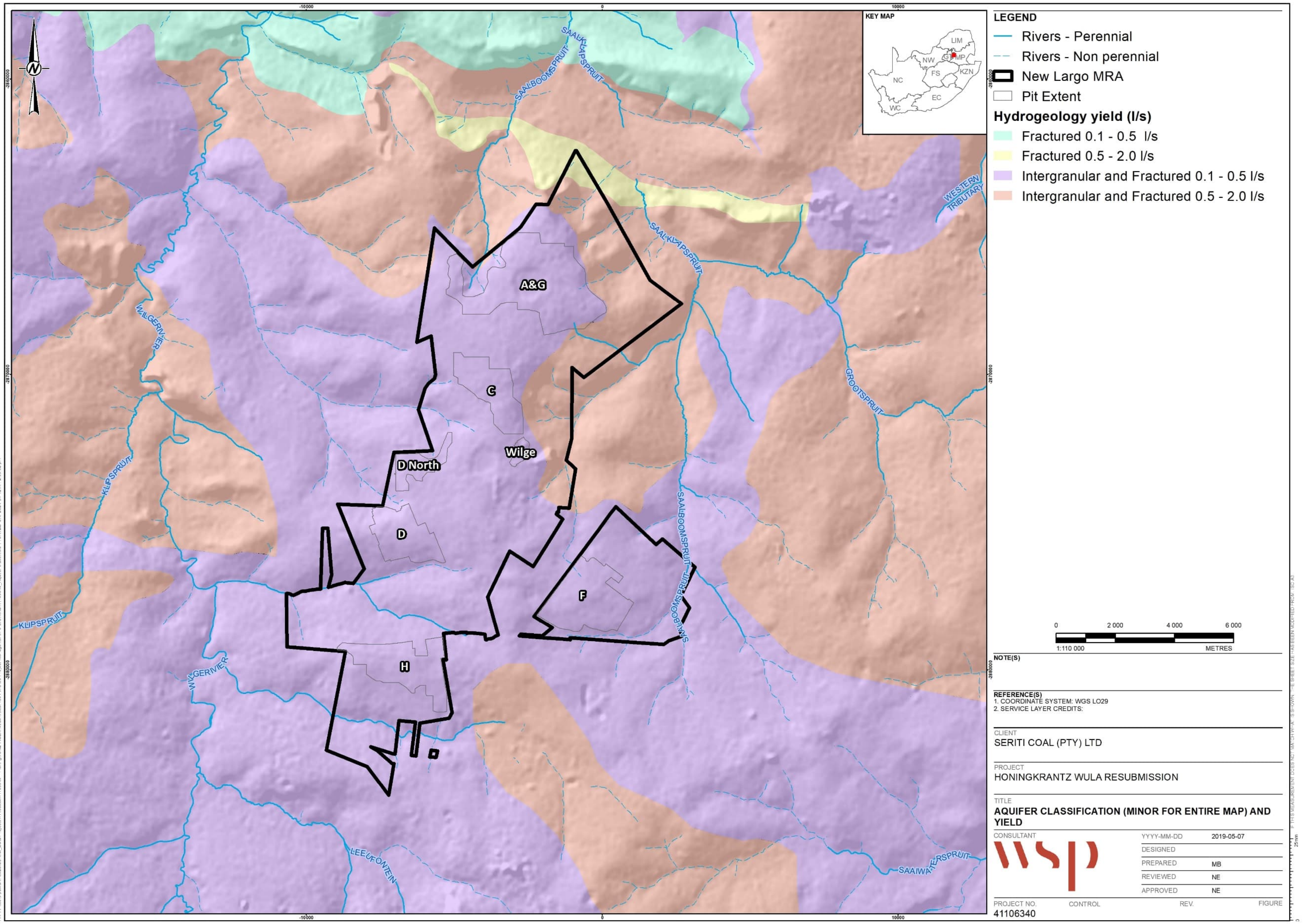


Figure 6-2 - Aquifer Classification Map

7. GROUNDWATER MODELLING

7.1. SOFTWARE MODEL CHOICE

The code selected for conducting the groundwater model for New Largo is **FEFLOW**, developed by the WASY Institute for Water Resources Planning and Systems Research Ltd Berlin, Germany. **FEFLOW** is an interactive groundwater modelling system for three and two-dimensional, aireal and cross-sectional, fluid density-coupled, thermohaline or uncoupled, variably saturated, transient or steady state flow, mass and heat transport in subsurface water resources with or without one or multiple free surfaces.

FEFLOW can be efficiently used to describe the spatial and temporal distribution of groundwater, to model geothermal processes, to estimate the duration and travel times of pollutants in aquifers, to plan and design remediation strategies and interception techniques, and to assist in designing alternatives and effective monitoring schemes.

7.2. MODEL SET-UP AND BOUNDARIES

The model domain covers a surface area of about 1 045 km^2. The modelling area was selected based on a combination of both topographical (surface catchment boundaries) and hydrogeological controls (rivers). The model was delineated to coincide with rivers and assumed groundwater divides. This is a reasonable approach since a correlation exists between groundwater level elevation and surface topography. The model area was conceptualized large enough to cover the location of the key stresses on the groundwater system and to make sure that boundary effects do not affect the modelling in the area of interest.

The groundwater model boundary was selected to coincide with the Wilge River in the west, the Saaiwater Spruit in the south-east, and with sub-catchment boundaries in the other areas (Figure 7-1).

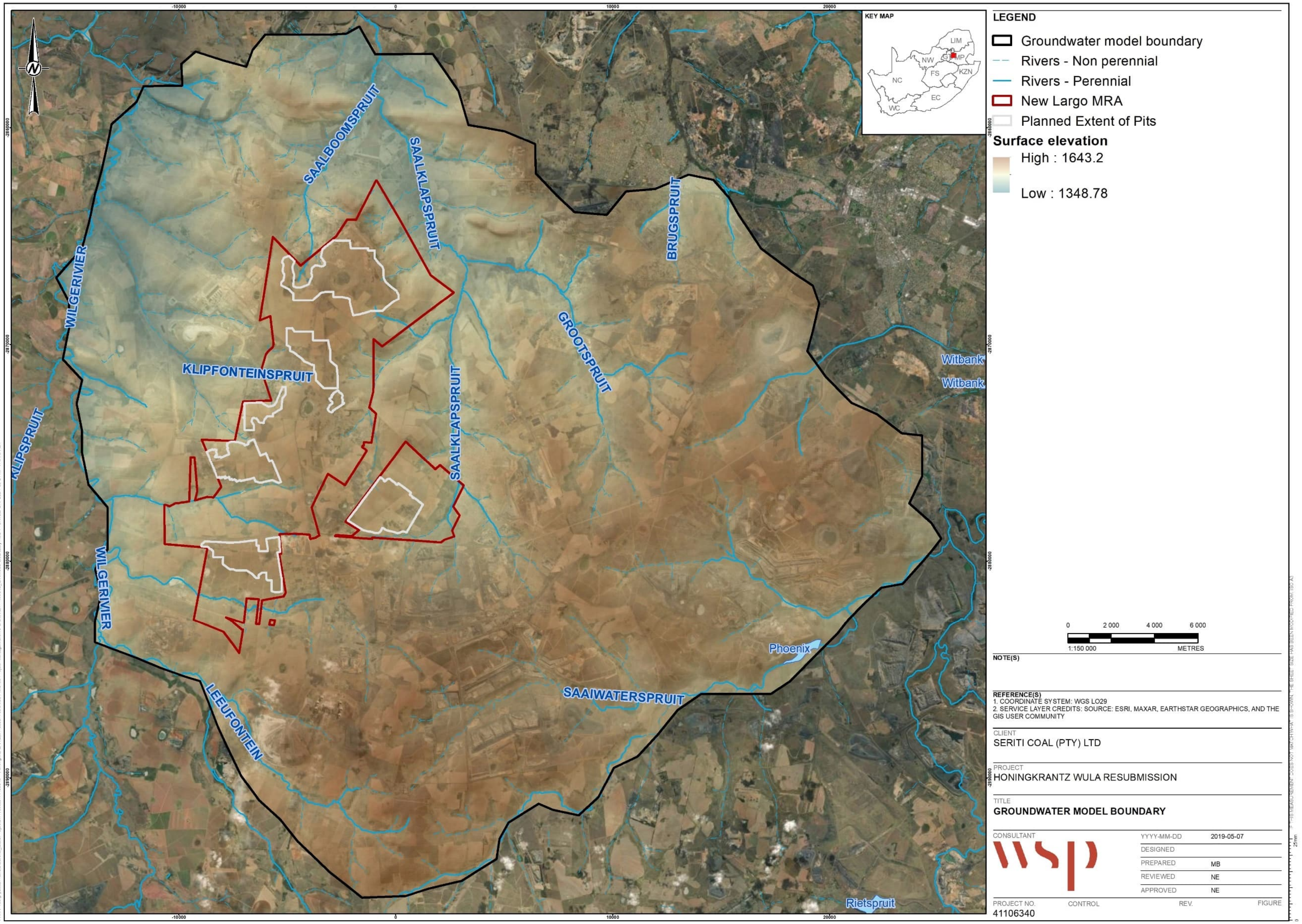


Figure 7-1 - Groundwater model boundary

7.2.1. BOUNDARY CONDITIONS

Boundary conditions express the way the considered domain interacts with its environment. In other words, they express the conditions of known water flux, or known variables, such as piezometric head. Different boundary conditions result in different solutions hence the importance of stating the correct boundary conditions. Boundary conditions in a groundwater flow model can be specified either as:

- Dirichlet Type I (or constant or specified head) boundary conditions.
- Neuman Type II (or specified flux) boundary conditions.
- Cauchy Type III - a mixture of the above.

7.2.1.1. Model Perimeter Boundaries

It was assumed that groundwater flow directions largely follow topography, and thus the groundwater basin geometry can be approximated by the surface water drainage geometry. The boundaries of the numerical model are shown in Figure 7-1. Two boundary conditions were used at the model perimeter:

- The model perimeter coincides with the Wilge River in the west and the Saaiwater Spruit in the south-east. River boundaries are represented numerically by what is referred to as a seepage face boundary condition (Dirichlet Type I boundary condition). A seepage face boundary can remove water from the system but cannot add water to the system.
- Where the model perimeter is not bounded by a river, the surface catchment boundaries were used. In these areas no boundary conditions need to be specified as the model assumes a Neuman Type II zero flux boundary condition.

7.2.1.2. Internal Model Boundaries

The groundwater system within the study area is largely recharged via infiltration from precipitation. It is thought that most of the groundwater recharge occurring within the study area discharges internally to the surface drainage systems via discharge to the base of river drainage systems (base flow). Dirichlet Type I boundary conditions (seepage faces) were specified along the major surface drainages, pans, dams, and wetlands.

Seepage faces were also assigned to active mining areas to represent dewatering.

7.3. GROUNDWATER ELEVATION AND GRADIENT

The groundwater elevation was discussed under section 5.4. Groundwater elevations vary from 1508 mamsl near the Saalboomspruit to 1573 mamsl on the catchment boundaries. The highest gradient is 0.325.

7.4. GEOMETRIC STRUCTURE OF THE MODEL

The model was set up as a three-dimensional groundwater flow model. The model was constructed with eight layers (nine slices) corresponding with the conceptual model. The mesh was designed to incorporate the New Largo operations (historical underground workings and future opencast areas) with a refined mesh in the areas of interest. The finite element mesh generated by FEFLOW using a triangular prism mesh is made up of 75437 elements and 37804 nodes per slice. Figure 7-2 illustrates the model domain for the study area.

The mesh quality is regarded suitable based on the following criterion:

- Interior holes: 0
- Obtuse angled triangles: 0.1% > 120°, 4.4% > 90º
- Delaunay-violating triangles: 0.5%

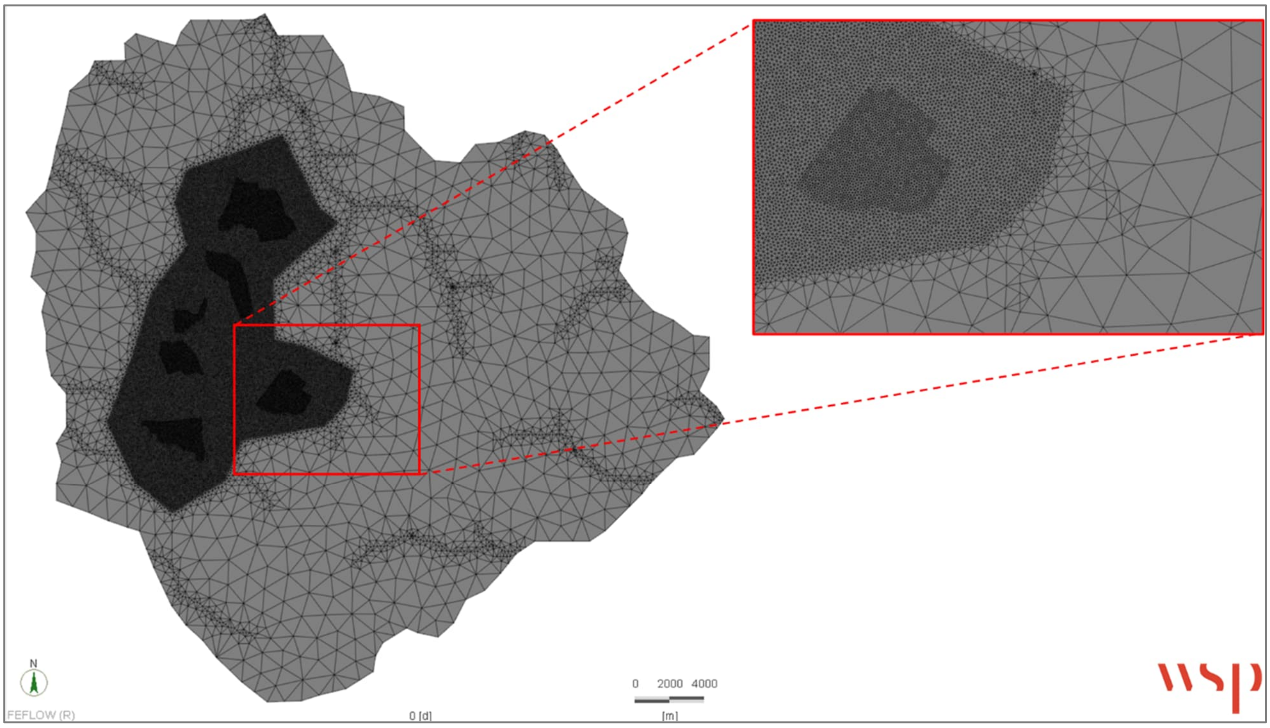


Figure 7-2 - Model Mesh

7.5. GROUNDWATER SOURCES AND SINKS

The source of water is recharge, while the rivers act as sinks. The underground mining void is mainly connected to the regional aquifer, but there seems to be areas with a disconnect, forming localised sinks as in the area of borehole KN-14.

7.5.1. SOURCE TERMS

During the operational period, the pits are dewatered for mining and cones of depression are formed in the groundwater level. This directs the surrounding groundwater flow and contaminant movement towards the pits. For this reason, the contaminant plume migration was only modelled for the post-closure scenarios.

It was assumed that all surface sources will be rehabilitated before or at closure and therefore no surface sources were considered. (WSP, 2024c) provided preliminary geochemical source terms for the backfilled pits for the two post-closure scenarios as presented in Table 7-1.

Two post-closure scenarios were modelled:

- Post-closure scenario 1: Backfilling with overburden and DMS discard/rejects from destoning plant (refer to Table 1-1).
- Post-closure scenario 2: Backfilling with overburden only.

Table 7-1 – Source terms

PIT	Sulfate (mg/L) scenario 1	Sulfate (mg/L) scenario 2	TDS (mg/L) scenario 1	TDS (mg/L) scenario 2
Pit A&G	868	646	2160	1946
Pit C	878	654	2281	2097
Pit D	851	650	2077	1918
Pit D-North	1102	923	3043	2068
Pit F	873	613	1504	1292
Pit H	718	650	1945	1918
Wilge Pit	654	654	2097	2097

7.6. CONCEPTUAL MODEL

The conceptual model for New Largo was developed based on the information described in the sections above. The following considerations relating to the geometry of the topography and the coal seams are:

- There are two dominant hydrogeological units at New Largo, namely:
  - A laterally extensive shallow weathered zone aquifer. The average vertical thickness of this aquifer zone is approximately 21 meters.
    More localised deeper fractured aquifer systems restricted to contact zones between intrusive diabase bodies and the host rock. These semi-confined aquifers may have high yields in places but have limited storage (JMA, 2012).
  - Although not considered a natural aquifer, significant volumes of water are stored in the mined-out (4 Seam and 2 Seam) underground workings.
- Transmissivities are expected to range from 0.04 m^2/d to 2 m^2/d. Transmissivities higher than 2 m^2/d are associated with fracture zones.
- Recharge is expected to range between 0.5% and 5% of MAP, or between 3.5 mm/a and 35 mm/a.

Three cross sections were made to illustrate the topography, water levels and setting of the pits. The locations of the cross sections are shown in Figure 7-3 and the cross sections are shown as follow:

- The north to south (NS) cross section is shown in Figure 7-4.
- The north-north-east to south-south-west (NNE-SSW) cross section is shown in Figure 7-5.
- The west to east (WE) cross section through pits D and F is shown in Figure 7-6.
- The west to east (WE) cross section through pits D north and Wilge is shown in Figure 7-7.

Data indicates that the water levels in the underground mining area have mostly recovered. The groundwater flow is mainly towards the rivers, except where the recent pit mining causes local sinks. (GPT, 2022) mentioned two decant points:

- Decant 1 into the Klipfonteinspruit with had an estimated flow rate of 125 L/s. This is indicated in Figure 7-5.
- Decant 2 into the Holfonteinspruit was observed, but the flow rate was too low to measure. From the NNE-SSW cross section this seems to be hillslope seepage rather than decant (Figure 7-5 at LGW-B13). The water quality at this decant point was of a better quality further supporting that the seepage does not originate from decant.
- The location of these two decant points are indicated in Figure 7-3**.**

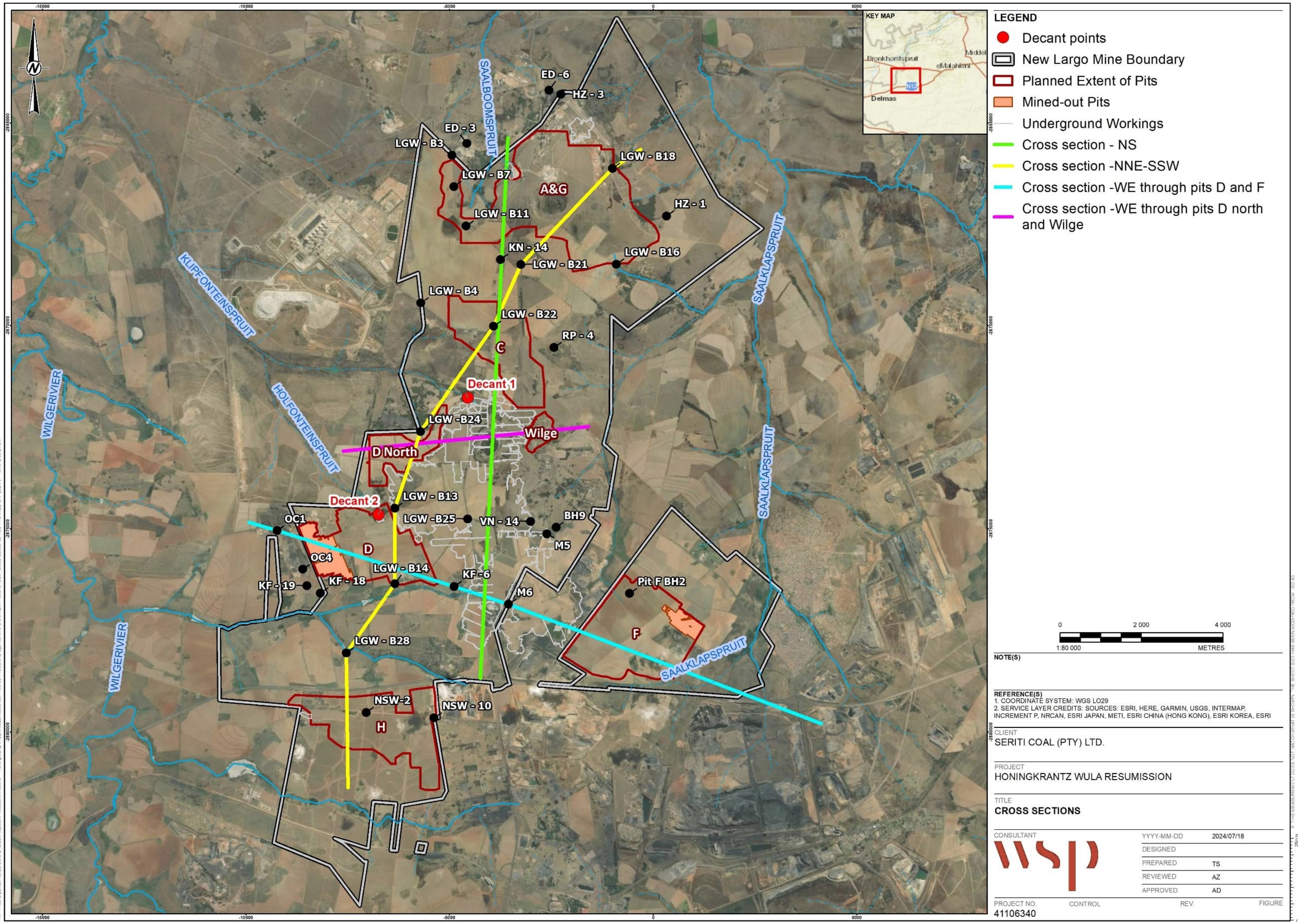
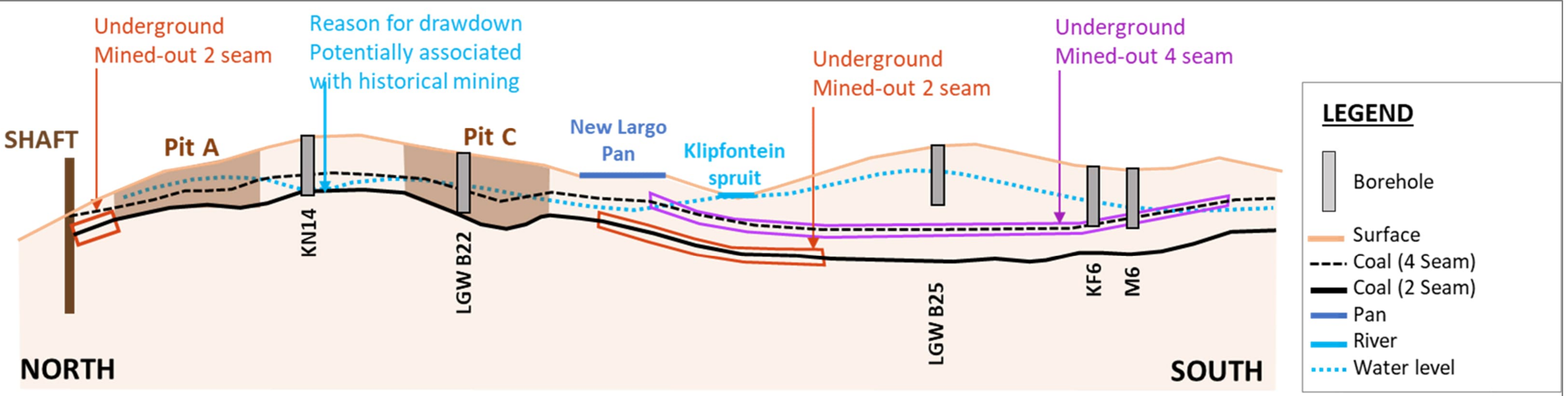


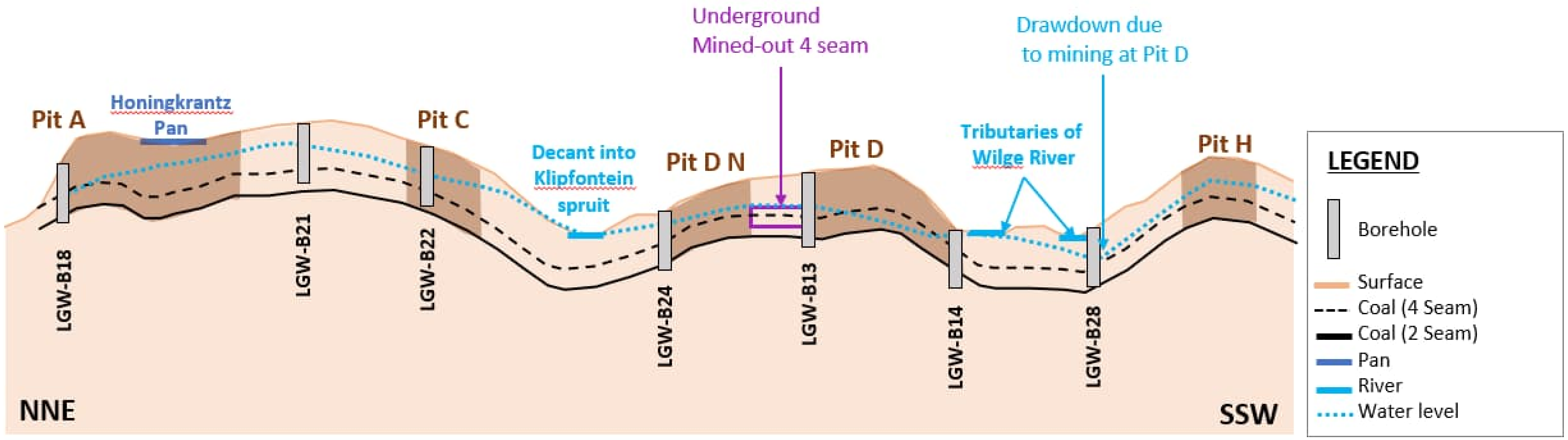
Figure 7-3 - Locations of cross sections



	KN-14	LGW B22	LGW B25	KF6	M6
TDS	60	46	110	380	134
SO_4	2.1	1.5	<2.5	172	2.2
NO_3	2.8	1.8	2.3	2.2	1.4

Figure 7-4 - North to south cross section

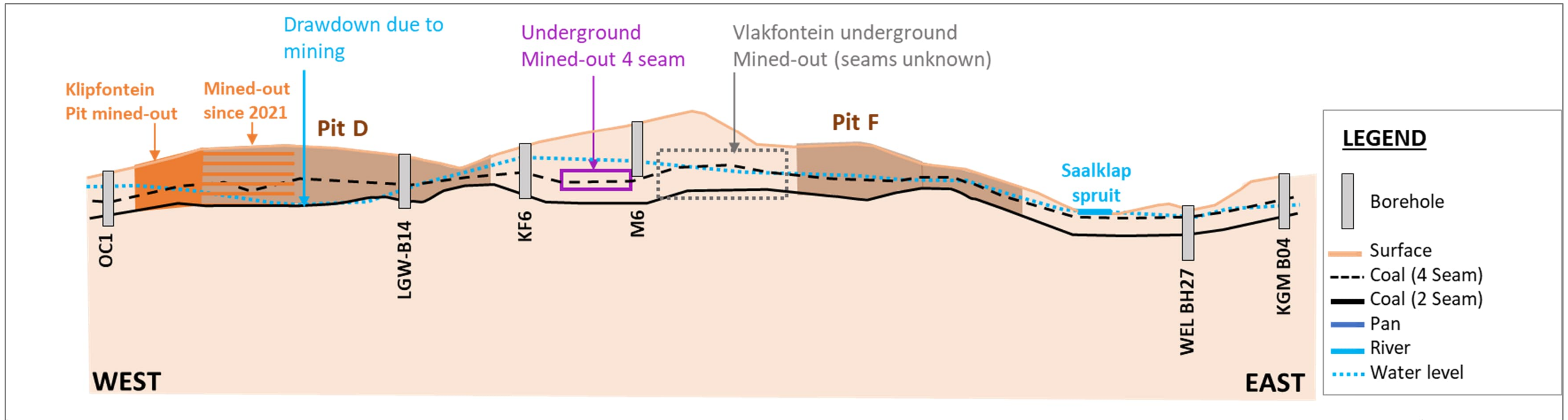
The water quality is generally good, with the highest Sulfate concentrations associated with underground mining.



	LGW B18	LGW B21	LGW B22	LGW B24	LGW B13	LGW B14	LGW B28
TDS	106	16	46	56	188	160	110
SO_4	2.4	1.8	1.5	1.4	2.0	1.9	3.9
NO_3	2.4	2.0	1.8	26.6	3.4	2.8	1.5

Figure 7-5 - North-north-east to south-south-west cross section

The water quality is generally good, with high Nitrates at LGW-B24 (potentially linked to agricultural runoff) and slightly elevated TDS concentrations at LGW-B13 and LGW-B14.



	OC1	LGW B14	KF6	M6	WEL BH27	KGM B04
TDS	1900	160	380	134		
SO_4	1192	1.9	172	2.2		
NO_3	0.3	2.8	2.2	1.4		

Figure 7-6 - West to east cross section through pits D and F

The water quality is generally good, except for high TDS and Sulfate at OC1. This is associated with opencast mining.

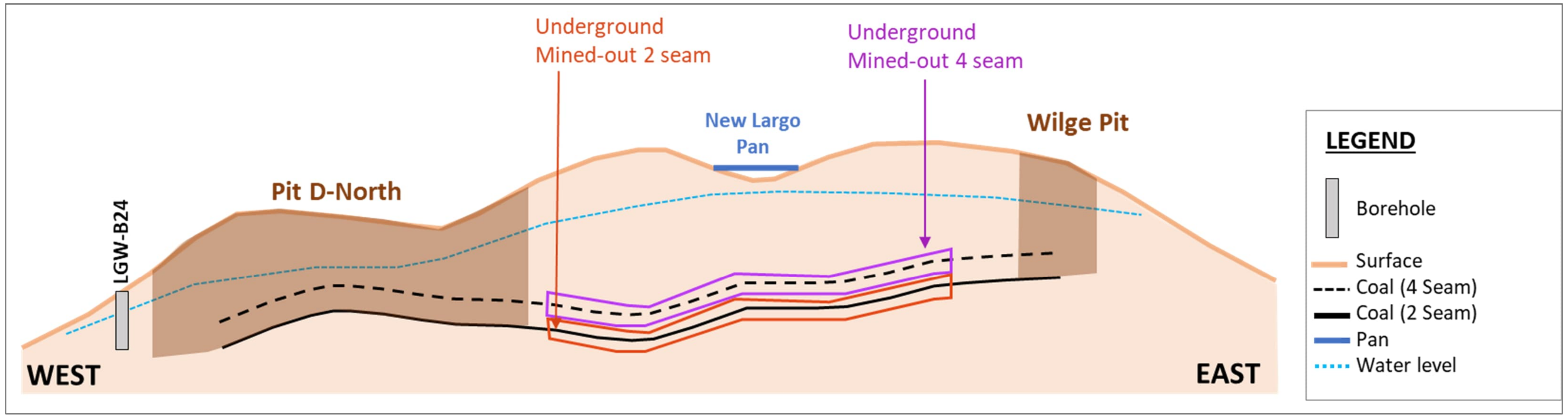


Figure 7-7 - West to east cross section through Pit D-North and Wilge Pit

7.7. NUMERICAL MODEL

7.7.1. MODEL CAPABILITIES AND LIMITATIONS

The general capabilities and limitations of the model can be summarized as follows:

- A groundwater model is a predictive tool that aims to assess the influence of various activities to the groundwater environment. The relevant activities are imposed onto the local aquifer i.e., abstraction, dewatering, sources, sinks and boundary conditions and the resultant influence are quantified according to the specified hydraulic parameters.
- The construction of a model is based on representative data obtained from investigations conducted within sample locations. Therefore, a model is a simplification of reality and produces simplified results.
- Although all models are subject to a level of error, model accuracy increases as more information associated with high accuracy becomes available as model input.
- Predictions associated with groundwater - surface water interactions from a groundwater model are associated with low certainty i.e., responses by surface water bodies to elements beyond the groundwater environment i.e., seasonal fluctuation of surface water levels and run-off. Further investigations such as hydropedological assessments and unsaturated flow modelling are recommended for more detailed groundwater/surface water interaction.

7.7.2. LIMITS TO ACCURACY

Groundwater models are simplified mathematical representations of complex natural systems. Because of this, there are limits to the accuracy with which groundwater systems can be simulated. Generally model uncertainty is based on assumptions of homogeneity and temporal averaging.

The data has been assessed regarding the inputs required with assumptions and limitations based on the information available as shown in Table 7-2.

Table 7-2 - Inputs required with assumptions and limitations

Goup	Input parameter	Description	Data source	Data confidence
General	Topography	Digital Elevation Model (DEM) from 5 m contours	National Geospatial Information (NGI)	Medium to High
	Rivers, streams, drainages	Rivers and drainages captured within the Investigation area	DWAF rivers digitised from topographical maps	Medium to High
	Geology & hydrostratigraphic sequence	Surface geology from SA Geological maps (1:250 000)	Council for Geoscience (CGS)	Medium
	Geological structures	Interconnectivity between underground mining and surface	No data available	Low
	Mine plans	Mined out and future mining	Seriti, New largo	High
	Rainfall	All accumulated rainfall data	Rainfall collected on site and from South	High

Goup	Input parameter	Description	Data source	Data confidence
			African Weather Stations data	
	Water levels (shallow aquifer)	Water levels measured at boreholes	Hydrocensus and Seriti, New largo	Medium to High
Steady State Modelling Parameters	Boundary conditions	Model boundaries were setup to be more than 5 km from the mining area	Selected from topography to correspond with watersheds or rivers	High
	Recharge	Recharge was adjusted as part of calibration within the limits of expectations based on literature	Calibrated	Medium (within expected range based on literature)
	Hydraulic conductivity (K)	K was adjusted in the model as part of calibration.	Calibrated	Medium (within expected range based on literature and site information)
	Ingress used as calibration target	Pumping measured at existing pits	Calibrated	Low (available pumping data includes direct rainfall which is not in the model)
Transient Modelling Parameters	Aquifer Storativity	Amount of water that can be stored in the matrix rock and faults	Limited measurement and Literature on storage in the coal fields of Mpumalanga	Medium (within expected range based on literature)

7.7.3. MODEL CONFIDENCE LEVEL CLASSIFICATION

The Australian Groundwater Modelling Guidelines Barnett *et al*. (2012) provide a model confidence level classification, the current model has been classified according to it.

The classification consists of three tiers: Class 1, Class 2, and Class 3, in order of increasing confidence. Factors that typically determine the confidence level are:

- Available data and the accuracy of the data.
- Model calibration: the type and quality of the input data, the ability to adequately represent site observations and the time frame of the calibration period. What is meant by 'calibration period' is whether transient calibration was conducted and how long the transient calibration period was conducted versus the predictive period, the longer the transient calibration period the higher the confidence levels.
- The level of stresses applied to the model i.e., when more stresses are applied to the predictive period compared against the stress applied to the calibration period the model will be of low confidence.

7.7.4. THE CLASSIFICATION

The classification table from Barnett *et al*. (2012) is presented in Table 7-3. The relevant characteristics and indicators were considered and used to classify the model. The current groundwater model predominantly falls in Class 2, based on the following assessment of the data, calibration, prediction, key indicators and uses.

- Data: The available data quality is above Class 1. The borehole log distribution, together with knowledge from nearby mines was sufficient to delineate the local stratigraphy. There is adequate elevation coverage throughout the site. The water levels are monitored throughout the site. However, the lack of long-term water level data to compare with rainfall keeps this model at Class 2.
- Calibration: The model calibration is above Class 1 because it was calibrated showing acceptable steady state calibration in the shallow aquifer. However, there are no water level (pressure heads) available in the underground mining area. Therefore, according to calibration the model falls in Class 2.

Table 7-3 - Model Confidence Level Classification — Characteristics and Indicators (Barnett et al., 2012)

Confidence level classification	*Data*	*Calibration*	*Prediction*	*Key indicator*	*Examples of specific uses*
Class 3	• Spatial and temporal distribution of groundwater head observations adequately define groundwater behaviour, especially in areas of greatest interest and where outcomes are to be reported. • Spatial distribution of bore logs and associated stratigraphic interpretations clearly define aquifer geometry. • Reliable metered groundwater extraction and injection data is available. • Rainfall and evaporation data is available. • Aquifer-testing data to define key parameters. • Streamflow and stage measurements are available with reliable baseflow estimates at a number of points. • Reliable land-use and soil-mapping data available. • Reliable irrigation application data (where relevant) is available. • Good quality and adequate spatial coverage of digital elevation model to define ground surface elevation.	• Adequate validation* is demonstrated. • Scaled RMS error (refer Chapter 5) or other calibration statistics are acceptable. • Long-term trends are adequately replicated where these are important. • Seasonal fluctuations are adequately replicated where these are important. • Transient calibration is current, i.e. uses recent data. • Model is calibrated to heads and fluxes. • Observations of the key modelling outcomes dataset is used in calibration.	• Length of predictive model is not excessive compared to length of calibration period. • Temporal discretisation used in the predictive model is consistent with the transient calibration. • Level and type of stresses included in the predictive model are within the range of those used in the transient calibration. • Model validation* suggests calibration is appropriate for locations and/or times outside the calibration model. • Steady-state predictions used when the model is calibrated in steady-state only.	• Key calibration statistics are acceptable and meet agreed targets. • Model predictive time frame is less than 3 times the duration of transient calibration. • Stresses are not more than 2 times greater than those included in calibration. • Temporal discretisation in predictive model is the same as that used in calibration. • Mass balance closure error is less than 0.5% of total. • Model parameters consistent with conceptualisation. • Appropriate computational methods used with appropriate spatial discretisation to model the problem. • The model has been reviewed and deemed fit for purpose by an experienced, independent hydrogeologist with modelling experience.	• Suitable for predicting groundwater responses to arbitrary changes in applied stress or hydrological conditions anywhere within the model domain. • Provide information for sustainable yield assessments for high-value regional aquifer systems. • Evaluation and management of potentially high-risk impacts. • Can be used to design complex mine-dewatering schemes, salt-interception schemes or water-allocation plans. • Simulating the interaction between groundwater and surface water bodies to a level of reliability required for dynamic linkage to surface water models. • Assessment of complex, large-scale solute transport processes.
Class 2 *Cont'd overleaf*	• Groundwater head observations and bore logs are available but may not provide adequate coverage throughout the model domain.	• Validation* is either not undertaken or is not demonstrated for the full model domain. • Calibration statistics are generally reasonable but may suggest significant errors in parts of the	• Transient calibration over a short time frame compared to that of prediction. • Temporal discretisation used in the predictive model is different from that used in transient	• Key calibration statistics suggest poor calibration in parts of the model domain. • Model predictive time frame is between 3 and 10 times the duration of transient calibration. • Stresses are between 2 and 5 times greater than those	• Prediction of impacts of proposed developments in medium value aquifers. • Evaluation and management of medium risk impacts.

Confidence level classification	*Data*	*Calibration*	*Prediction*	*Key indicator*	*Examples of specific uses*
Class 2 *Cont'd*	• Metered groundwater-extraction data may be available but spatial and temporal coverage may not be extensive. • Streamflow data and baseflow estimates available at a few points. • Reliable irrigation-application data available in part of the area or for part of the model duration.	model domain(s). • Long-term trends not replicated in all parts of the model domain. • Transient calibration to historic data but not extending to the present day. • Seasonal fluctuations not adequately replicated in all parts of the model domain. • Observations of the key modelling outcome data set are not used in calibration.	calibration. • Level and type of stresses included in the predictive model are outside the range of those used in the transient calibration. • Validation* suggests relatively poor match to observations when calibration data is extended in time and/or space.	included in calibration. • Temporal discretisation in predictive model is not the same as that used in calibration. • Mass balance closure error is less than 1% of total. • Not all model parameters consistent with conceptualisation. • Spatial refinement too coarse in key parts of the model domain. • The model has been reviewed and deemed fit for purpose by an independent hydrogeologist.	• Providing estimates of dewatering requirements for mines and excavations and the associated impacts. • Designing groundwater management schemes such as managed aquifer recharge, salinity management schemes and infiltration basins. • Estimating distance of travel of contamination through particle-tracking methods. Defining water source protection zones.
Class 1	• Few or poorly distributed existing wells from which to obtain reliable groundwater and geological information. • Observations and measurements unavailable or sparsely distributed in areas of greatest interest. • No available records of metered groundwater extraction or injection. • Climate data only available from relatively remote locations. • Little or no useful data on land-use, soils or river flows and stage elevations.	• No calibration is possible. • Calibration illustrates unacceptable levels of error especially in key areas. • Calibration is based on an inadequate distribution of data. • Calibration only to datasets other than that required for prediction.	• Predictive model time frame far exceeds that of calibration. • Temporal discretisation is different to that of calibration. • Transient predictions are made when calibration is in steady state only. • Model validation* suggests unacceptable errors when calibration dataset is extended in time and/or space.	• Model is uncalibrated or key calibration statistics do not meet agreed targets. • Model predictive time frame is more than 10 times longer than transient calibration period. • Stresses in predictions are more than 5 times higher than those in calibration. • Stress period or calculation interval is different from that used in calibration. • Transient predictions made but calibration in steady state only. • Cumulative mass-balance closure error exceeds 1% or exceeds 5% at any given calculation time. • Model parameters outside the range expected by the conceptualisation with no further justification. • Unsuitable spatial or temporal discretisation. • The model has not been reviewed.	• Design observation bore array for pumping tests. • Predicting long-term impacts of proposed developments in low-value aquifers. • Estimating impacts of low-risk developments. • Understanding groundwater flow processes under various hypothetical conditions. • Provide first-pass estimates of extraction volumes and rates required for mine dewatering. • Developing coarse relationships between groundwater extraction locations and rates and associated impacts. • As a starting point on which to develop higher class models as more data is collected and used.

7.7.5. MODEL CALIBRATION

Calibration is the process of finding a set of parameters, boundary conditions, and stresses that best reproduce the observed water levels and/or fluxes (Anderson and Woessner, 1992). A standard trial-and-error approach to calibrate the model was used.

A steady state groundwater flow model was constructed encompassing the mined-out areas (underground mining) as at the end of 2023. The measured water levels for December 2023 were used as calibration targets for the steady state calibration.

The calibration data shown in Table 7-4, shows an acceptable error with a root mean square error (RMSE) of 8.4 m and a normalised RMSE of 12.5%.

The simulated vs observed water levels are plotted in Figure 7-7 as a scatter plot and in Figure 7-8 as a bar graph. The simulated steady state water levels are depicted in Table 7-4.

Table 7-4 - Steady state calibration

Name	Observed GWL (mamsl)	Simulated GWL (mamsl)	Mean Error	Mean Absolute Error	Root Mean Square
BH9	1546.0	1546.0	0.0	0.0	0.0
ED -6	1538.3	1534.6	3.7	3.7	13.6
HZ - 1	1512.5	1530.2	-17.7	17.7	313.0
HZ - 3	1556.3	1540.0	16.2	16.2	263.6
KF - 18	1506.2	1510.3	-4.2	4.2	17.4
KF - 19	1513.8	1516.8	-3.0	3.0	9.0
KF -6	1546.8	1551.0	-4.2	4.2	17.5
KN - 14	1555.5	1567.4	-12.0	12.0	143.3
LGW - B11	1556.8	1562.4	-5.6	5.6	31.1
LGW - B13	1535.4	1536.2	-0.8	0.8	0.6
LGW - B14	1518.6	1523.4	-4.8	4.8	23.3
LGW - B16	1543.9	1544.9	-0.9	0.9	0.8
LGW - B18	1555.6	1553.4	2.2	2.2	4.9
LGW - B21	1573.4	1567.3	6.1	6.1	37.5
LGW - B22	1556.7	1556.9	-0.2	0.2	0.0
LGW - B28	1514.4	1515.0	-0.6	0.6	0.4
LGW - B3	1539.7	1540.9	-1.2	1.2	1.4

LGW - B4	1536.4	1543.8	-7.4	7.4	54.9
LGW - B7	1543.5	1552.1	-8.6	8.6	74.1
LGW -B24	1527.8	1530.9	-3.1	3.1	9.9
LGW -B25	1571.3	1551.5	19.8	19.8	391.7
M5	1537.6	1549.6	-12.0	12.0	144.6
M6	1542.2	1559.0	-16.8	16.8	283.8
NSW - 10	1554.5	1564.9	-10.5	10.5	109.5
NSW-2	1560.0	1561.5	-1.6	1.6	2.5
OC1	1529.4	1534.4	-5.0	5.0	25.4
OC4	1526.5	1526.4	0.1	0.1	0.0
Pit F BH2	1534.1	1542.8	-8.8	8.8	76.9
RP - 4	1544.5	1544.2	0.3	0.3	0.1
Average			**-2.8**	**6.1**	**70.7**
Root Mean Square Error (m)					**8.4**
Normalised Root Mean Square Error (%)					**12.5**

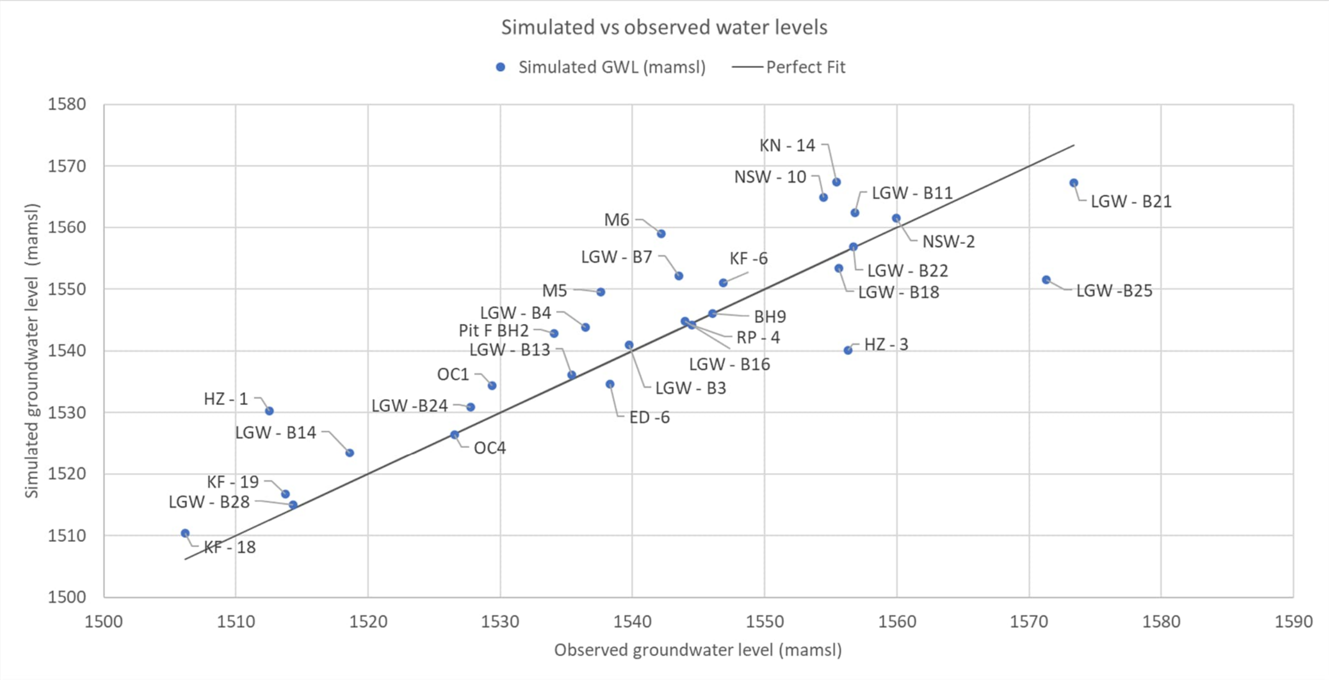


Figure 7-8 - Simulated vs Observed water levels - scatter plot

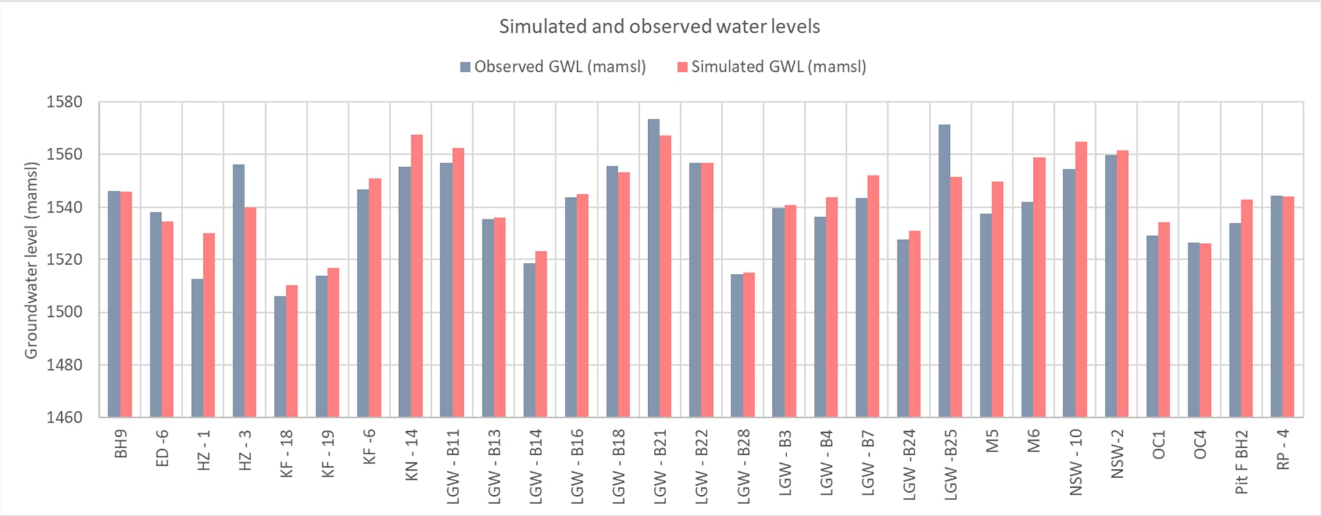


Figure 7-9 - Simulated vs Observed water levels - bar graph

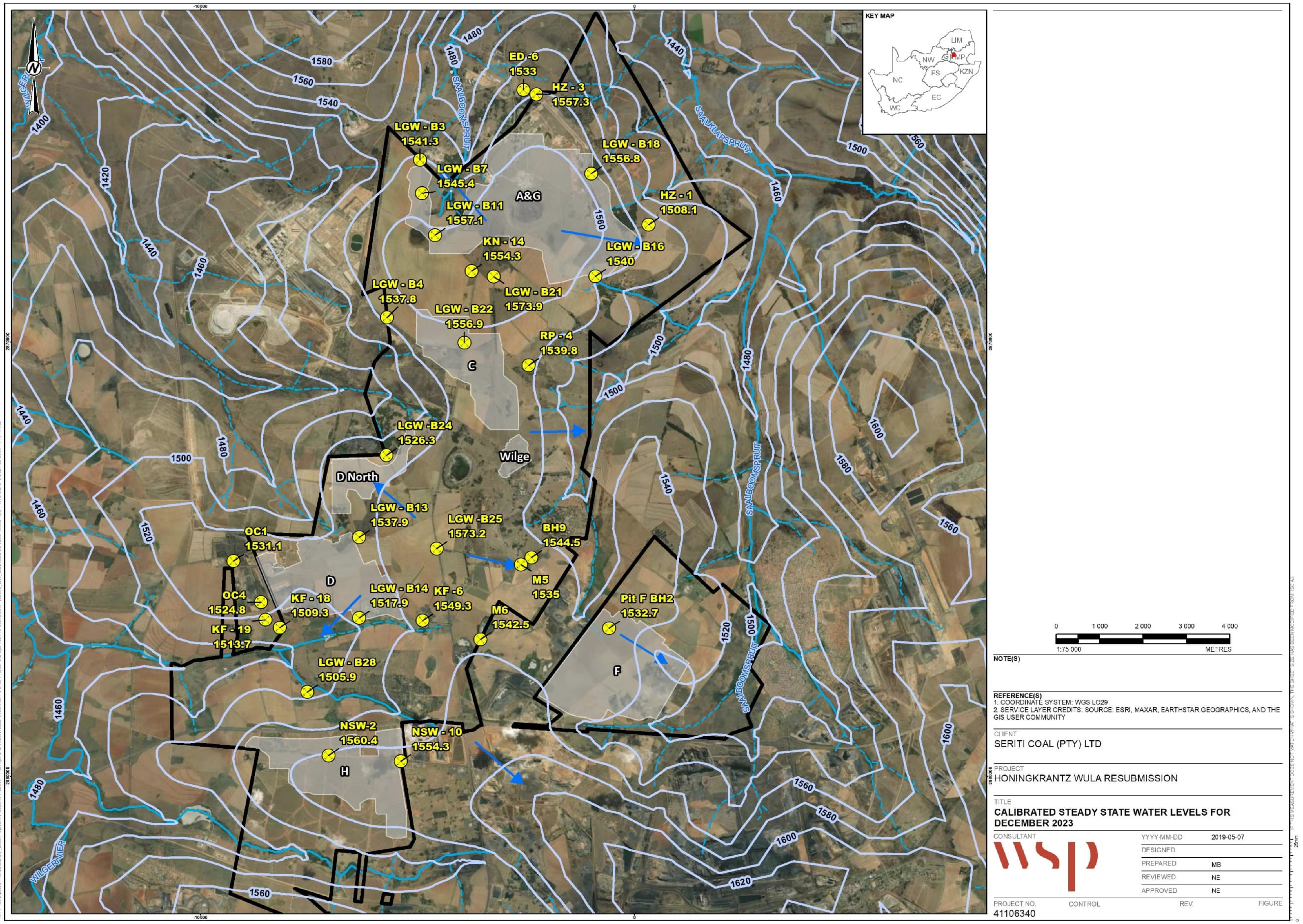


Figure 7-10 - Simulated steady state water levels

7.7.6. GROUNDWATER BALANCE

The groundwater balance for current (2023) mined-out conditions which were assumed to act as steady state, is summarised in Table 7-5.

Table 7-5 - Groundwater balance for the entire model area

	In (m^3/d)	Out (m^3/d)	Out (%)
Recharge	40 071		
Streams		19 220	48.0%
Wetlands		20586	51.4%
Pit D		125	0.3%
Pit F		140	0.3%
TOTAL	40 071	40 071	100%

7.7.7. CALIBRATED MODEL PARAMETERS

The calibrated model parameters of recharge and transmissivity is presented in Table 7-6.

Table 7-6 – Calibrated model parameters

Model Layer	Layer	Recharge OR Hydraulic conductivity
Recharge (mm/a)	1	14 mm/a
Topsoil	1	0.26 m/d
Weathered zone/sandstone	2	0.0039 m/d in areas where clay and silt / siltstone were present (from borehole logs) 0.26 m/d in areas where no clay or silt was present
Sandstone/Mudstone	3	
Coal seam 4	4	0.0390 m/d 0.65 m/d for mined-out sections
Sandstone/Mudstone/Shale	5	0.0039 m/d
Coal seam 2	6	0.0390 m/d 0.65 m/d for mined-out sections
Sandstone/Mudstone/Shale	7	0.0039 m/d
Dwyka Tillite	8	0.00039 m/d

7.7.8. MODEL ASSUMPTIONS

The following assumptions were made for modelling:

- The groundwater balance for current (2023) mined-out conditions which were assumed to act as steady state.
- It was assumed that the recharge through the backfilled overburden is 18% of MAP (126 mm/a).
- Since the DMS discard or destoning rejects added into the pits is a small amount compared to the overburden, it was assumed that the added material will make no difference to the recharge.
- Assuming pits are covered at closure, recharge through the backfilled overburden and discard/rejects is 14% of MAP (98 mm/a).
- Farmers' abstraction and irrigation was not included in the model.

7.7.9. MODEL SCENARIOS

The life of mine (LOM) schedules were applied into the model from 2025 to 2055. The simulated ingress excludes rainfall and runoff and therefore accounts only for lateral groundwater ingress into the pits.

Figure 7-10 illustrates how mining was applied in the model. Mining is represented by dewatering down to seam 2 (seepage faces) for one year, the year after mining, the mining block is left open and the second year after mining, backfilling is simulated by adding additional recharge. It was assumed that the recharge through the backfilled overburden is 18% of MAP (126 mm/a).

It was assumed that the dry discard material added to the pits will make no difference to the recharge. Nevertheless, it will have an impact on the water quality in the pit. During mining the water flow is towards the mining face where water is pumped out and no plume will develop. Therefore, the contaminant transport was only modelled after closure.

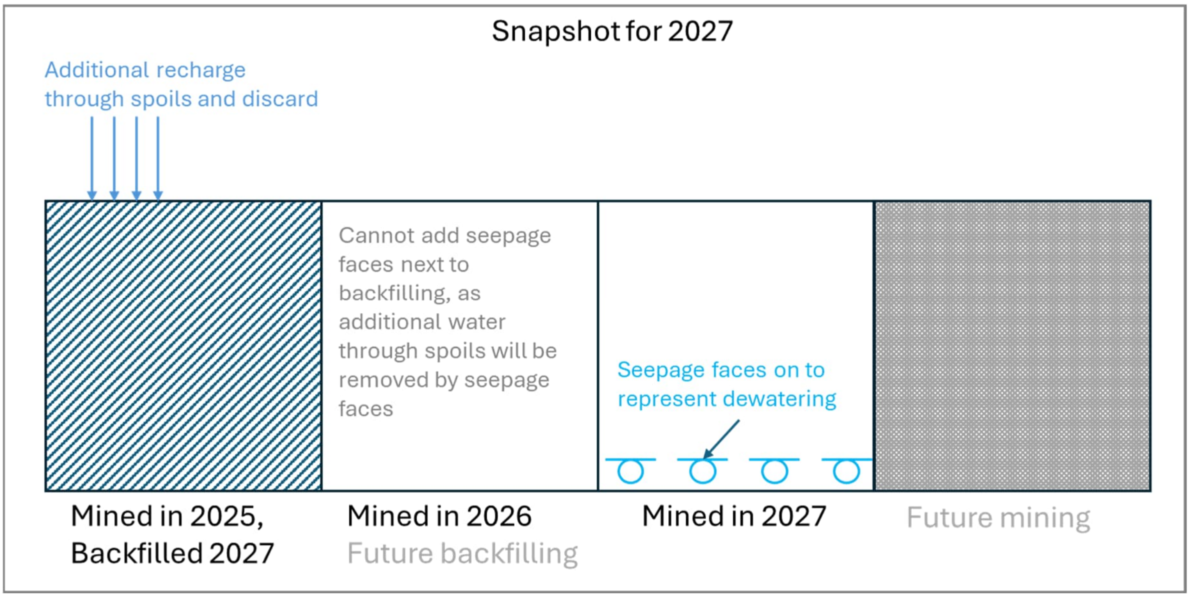


Figure 7-11 - Illustration of mining in model

The model scenarios are as follows:

- Operational model: Flow only, no quality modelling. Recharge through the backfilled overburden and discard is 18% of MAP (126 mm/a).
- Post-closure: Flow and quality modelling. Assuming pits are covered after closure, recharge through the backfilled overburden and discard is 14% of MAP (98 mm/a).
  - Post-closure scenario 1: Backfilling with overburden and DMS discard/rejects from destoning plant (refer to Table 1-1).
  - Post-closure scenario 2: Backfilling with overburden only.

7.8. RESULTS OF THE MODEL

7.8.1. PRE-FACILITY (PRE-MINING)

The area has been mined out underground and water levels have mostly filled the voids (with some exceptions where the underground void seems to be disconnected to the shallow aquifer). The current situation (end 2023) was used as the steady state calibration. Since this is at the beginning of mining, the calibrated "steady state" model can be used for pre-mining results. These results are indicated in the calibration section of this report.

7.8.2. DURING FACILITY (OPERATIONAL MODEL)

Groundwater Ingress

Please note:

- The simulated ingress is groundwater ingress only and does not account for rainfall directly on the pit nor for surface runoff that enters the pit. That is why the simulated ingress values are lower than the amount of water pumped out of the pits.
- Since the mining schedule provided is an annual schedule, the model results are presented as annual inflows.

The average and maximum ingress per pit is given in Table 7-7 and the ingress over time is depicted in Figure 7-11. Please note that rainfall on the pit as well as runoff into the pit should be added to these numbers to make provision of pumping from the pits.

Table 7-7 – Average and maximum groundwater ingress per pit (m^3/d)

	Pit A	Pit C	Pit D	Pit D North	Wilge Pit	Pit F	Pit H
Average	528.2	118.0	105.4	95.5	14.9	322.3	201.3
Maximum	935.5	352.1	486.1	562.5	253.2	1101.4	958.4

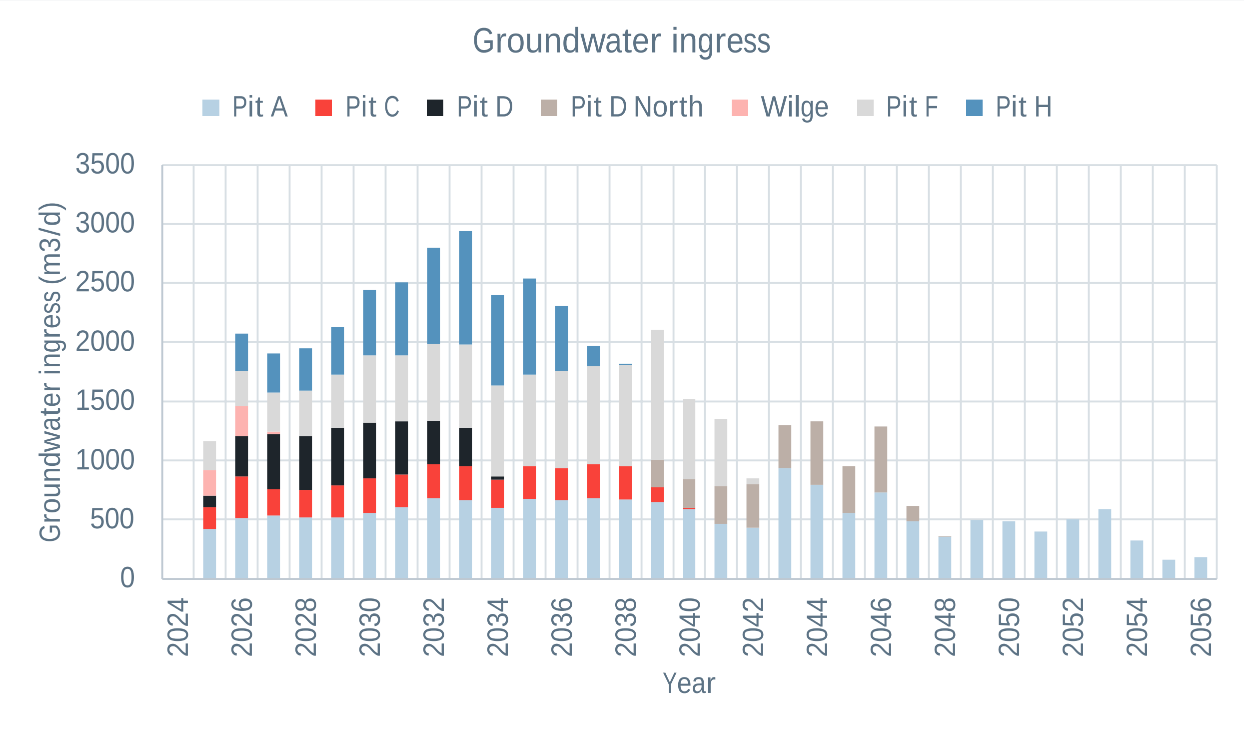


Figure 7-12 - Simulated groundwater ingress

Figure 7-11 shows the total ingress for all the pits reaches a maximum in 2033. Pit ingress in directly related to the area that will be mined in a year. Therefore, Pit A shows highest ingress in 2043, Pit F shows highest ingress in 2039, and Pit H shows highest ingress in 2033.

Groundwater Drawdown

Figure 7-12 shows how the borehole water levels are pulled down by mining and subsequent recovery.

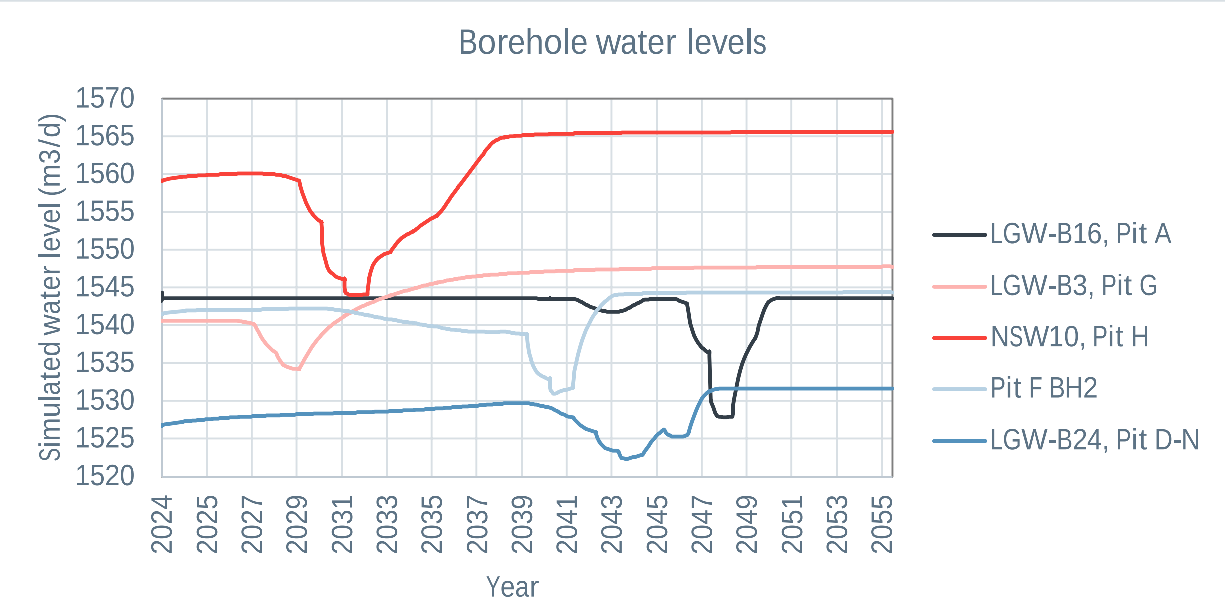


Figure 7-13 - Simulated water levels at boreholes

Figure 7-13 shows how the simulated drawdown over time is associated with the pits. For 2030 the drawdown is limited to Pit D, Pit F, Wilge Pit and starting to develop in Pit C and Pit G. As time progresses, the extent of drawdown grows larger and finally reaches the eastern part of Pit A that will be mined last.

7.8.3. POST-FACILITY (POST-CLOSURE MODEL)

For post-closure it was assumed that all the pits will be covered at closure. For modelling purposes this was applied from 2056 by applying a reduced recharge of 98 mm/a to the pits. Two scenarios were modelled:

- Post-closure scenario 1: Backfilling with overburden and DMS discard/rejects from destoning plant (refer to Table 1-1).
- Post-closure scenario 2: Backfilling with overburden only.

There was no difference in the flow regime between the two scenarios. The recovery rates and decant was the same for both scenarios. However, the source concentrations for scenario 2 was lower than for scenario 1.

Water Level Recovery

Water level recovery starts at the end of mining. Two cross sections are shown in Figure 7-14. The water levels for 2055 will not change after closure (specifically for these cross sections), as the decant will prevent the water levels to rise further. The final water levels are indicated in Figure 7-15 showing where the water levels are higher and lower than the current (2024) water levels.

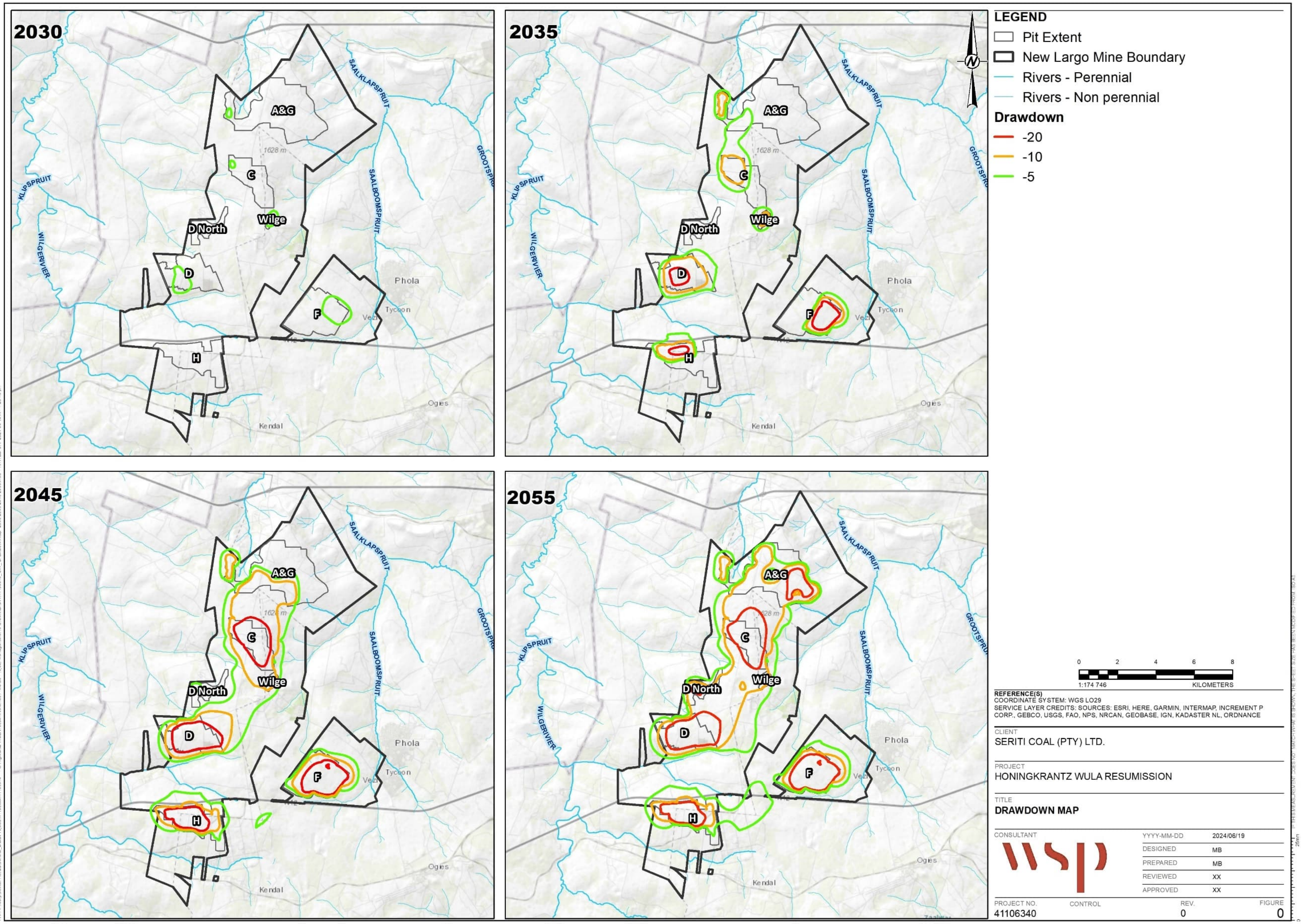


Figure 7-14 - Simulated drawdown over time

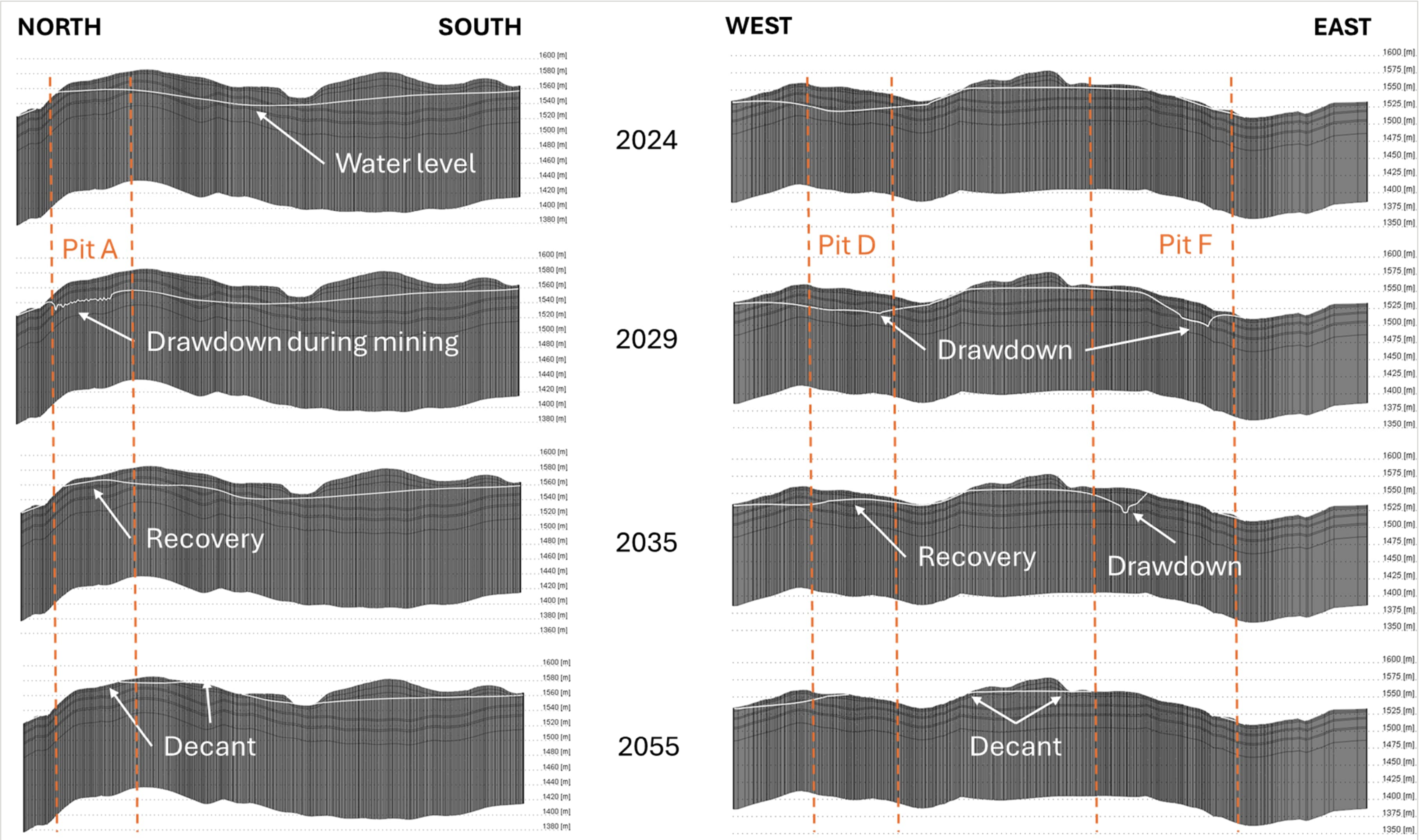


Figure 7-15 - Cross sections NS and EW indicating drawdown and recovery

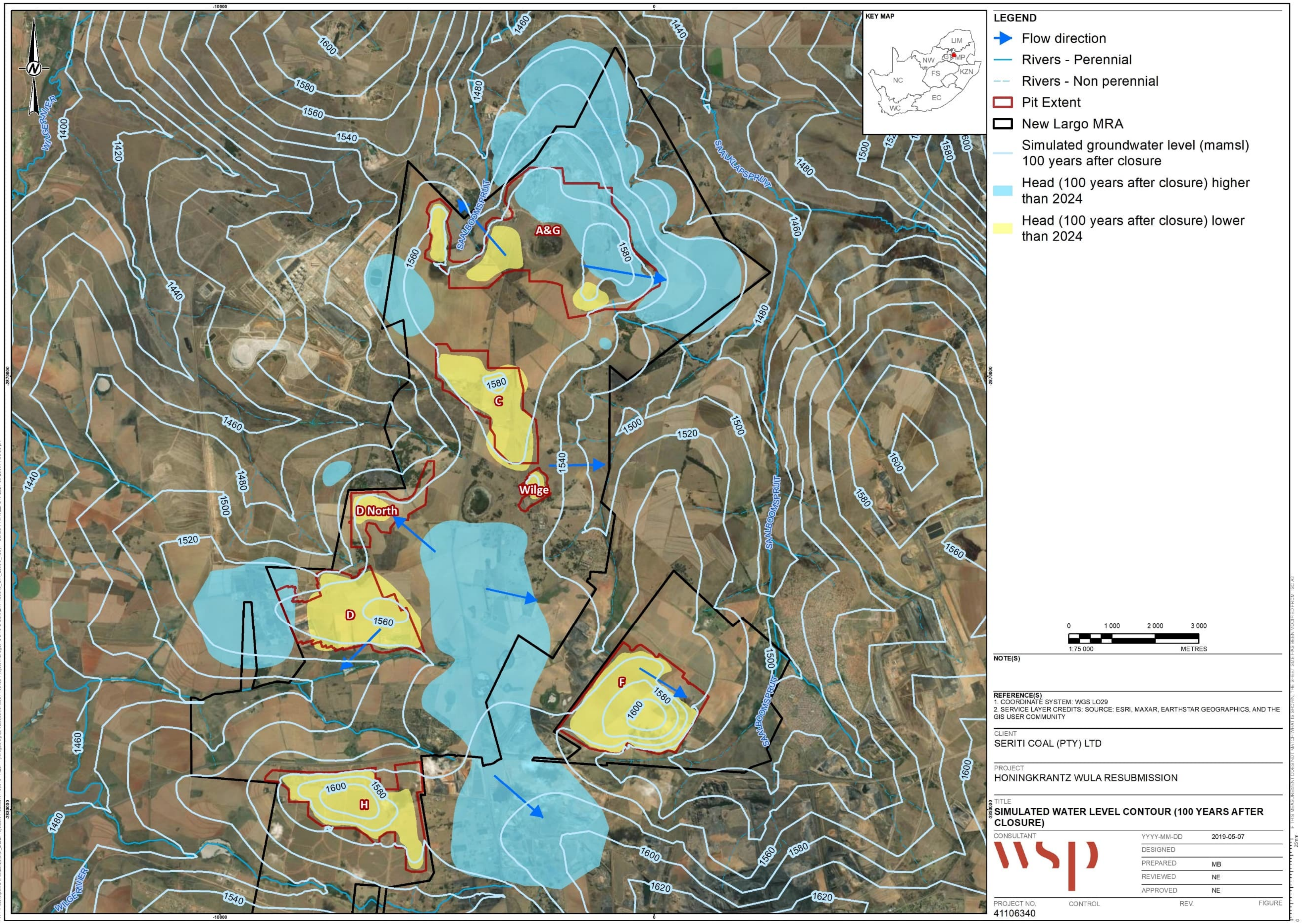


Figure 7-16 - Final water levels 100 years after closure

Contaminant Transport

The contaminant plumes for post-closure scenario 1 are shown in Figure 7-16. The map shows how the 400 mg/L Sulfate and the 500mg/L TDS plumes grows over time for 10, 20, 50, and 100 years after closure.

There is very little difference in the contaminant plumes for the two scenarios. Hundred years after closure, the TDS plumes for the two scenarios are the same. The Sulfate plume for scenario 1 (that includes discard/rejects) extends up to 400 m further than the Sulfate plume for scenario 2 as indicated in Figure 7-17.

7.8.4. DECANT

There is uncertainty about the observed decant points. Figure 7-18 indicates two decant points observed by GPT (2022):

- Decant 1 into the Klipfonteinspruit with an estimated flow rate of 125 L/s. In earlier studies this point was indicated as a spring.
- Decant 2 into the Holfonteinspruit was observed, but the flow rate was too low to measure. Based on most recent water level maps, the water level is below this “decant” point. Since there is a wetland associated with Decant 2, it is a possibility that this point is hillslope seepage. However, it could be decant associated with the old underground mine.

The simulated decant at Decant 1 is 207.4 m^3/d (2.4 L/s) which is much lower than the measured 125 L/s. This could be due higher interconnectivity between the underground mine and the decant point. No preferential flow paths or geological structures were included in the model as there is no information indicating such connections.

Since the flow regime of the two scenarios are the same, the simulated decant for the two scenarios are the same.

Please note that the simulated decant points differ from the potential decant location based on the lowest surface elevation for each pit. This can be due to model simplifications and calibration errors. Where the calibrated water level was higher than measured, it will mean that the decant volumes will be overestimated (conservative approach). This was the case for Pit G, Pit C, Pit D, Pit F and Pit H.

Figure 7-19 indicates the simulated decant points. Please note that these are the initial decant points. The decant should be managed by pumping from the pits. Failure to manage the decant will result in the extent of decant will spread all around the pits. This is because the pits are situated in the upper catchment areas.

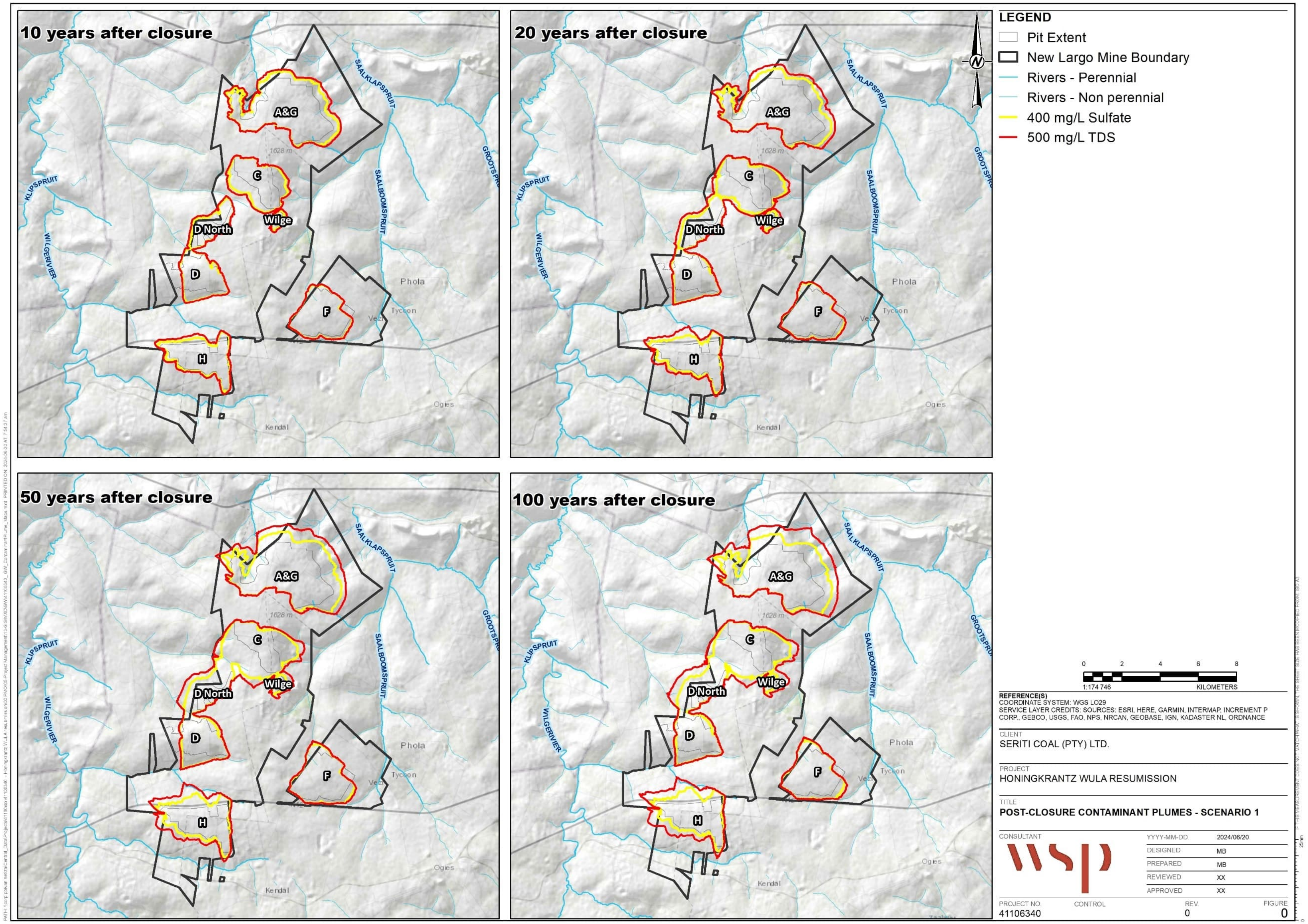


Figure 7-17 - Contaminant plumes for scenario 1

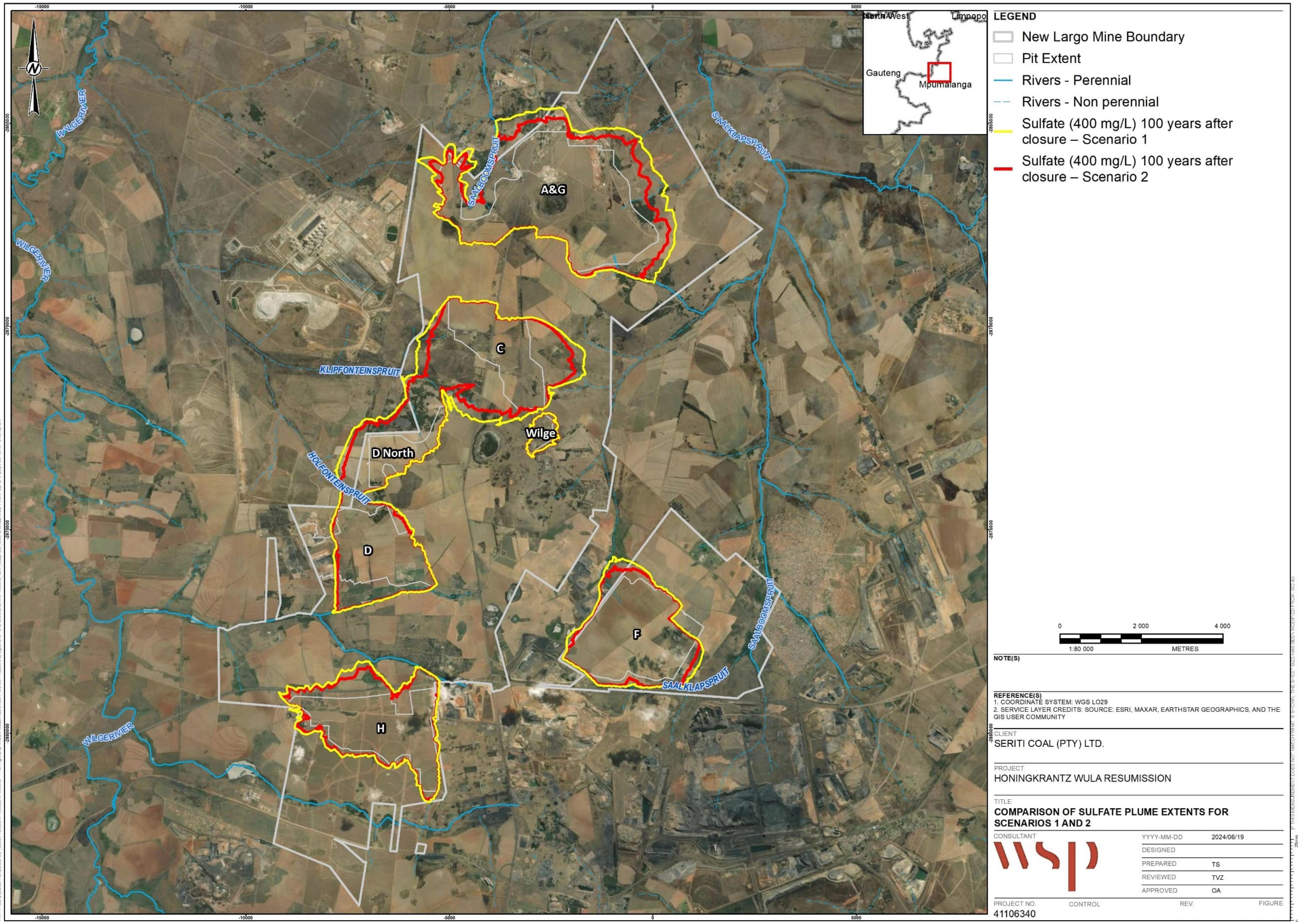


Figure 7-18 - Comparison of Sulfate plume for two scenarios

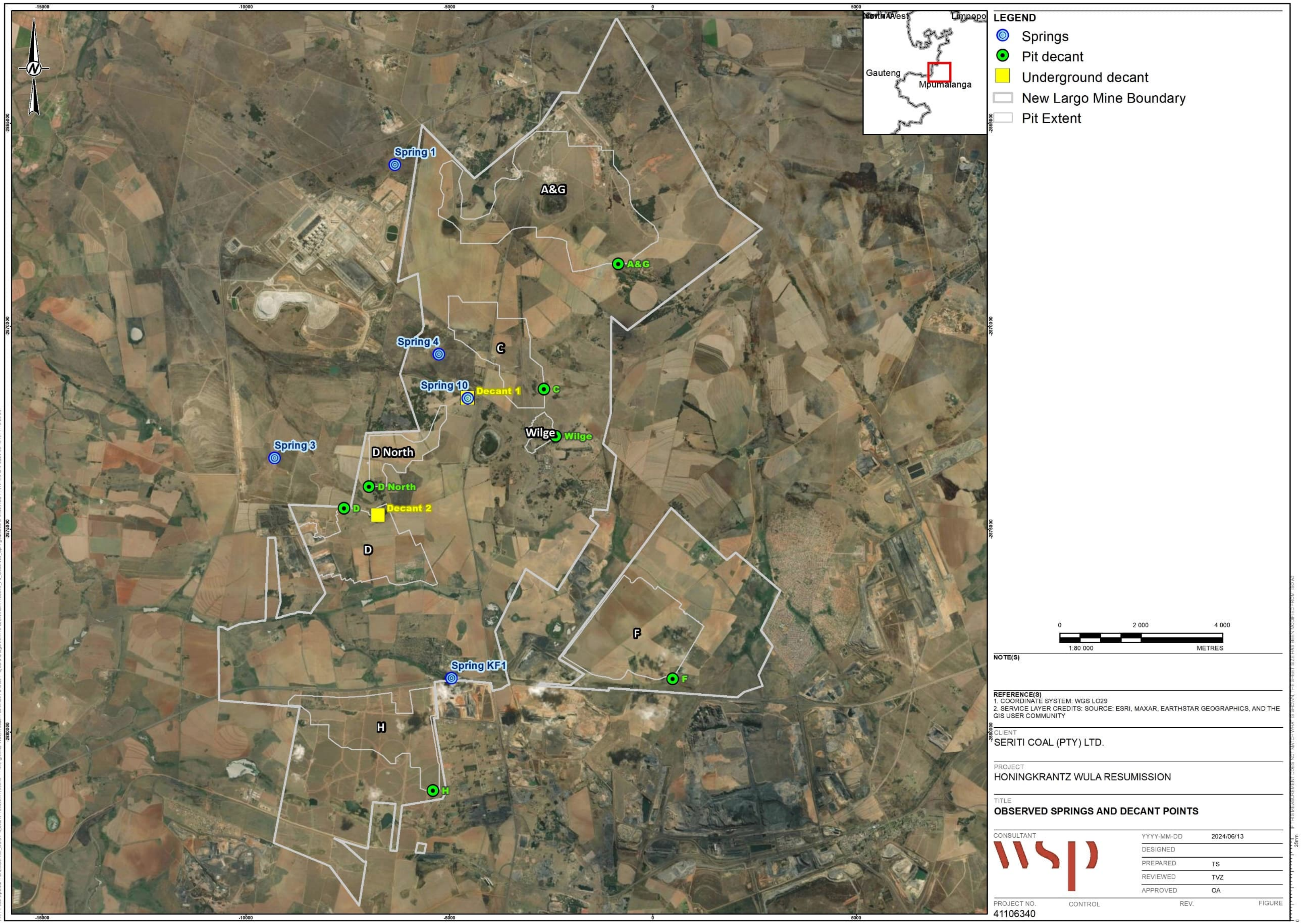


Figure 7-19 - Natural springs and decant points

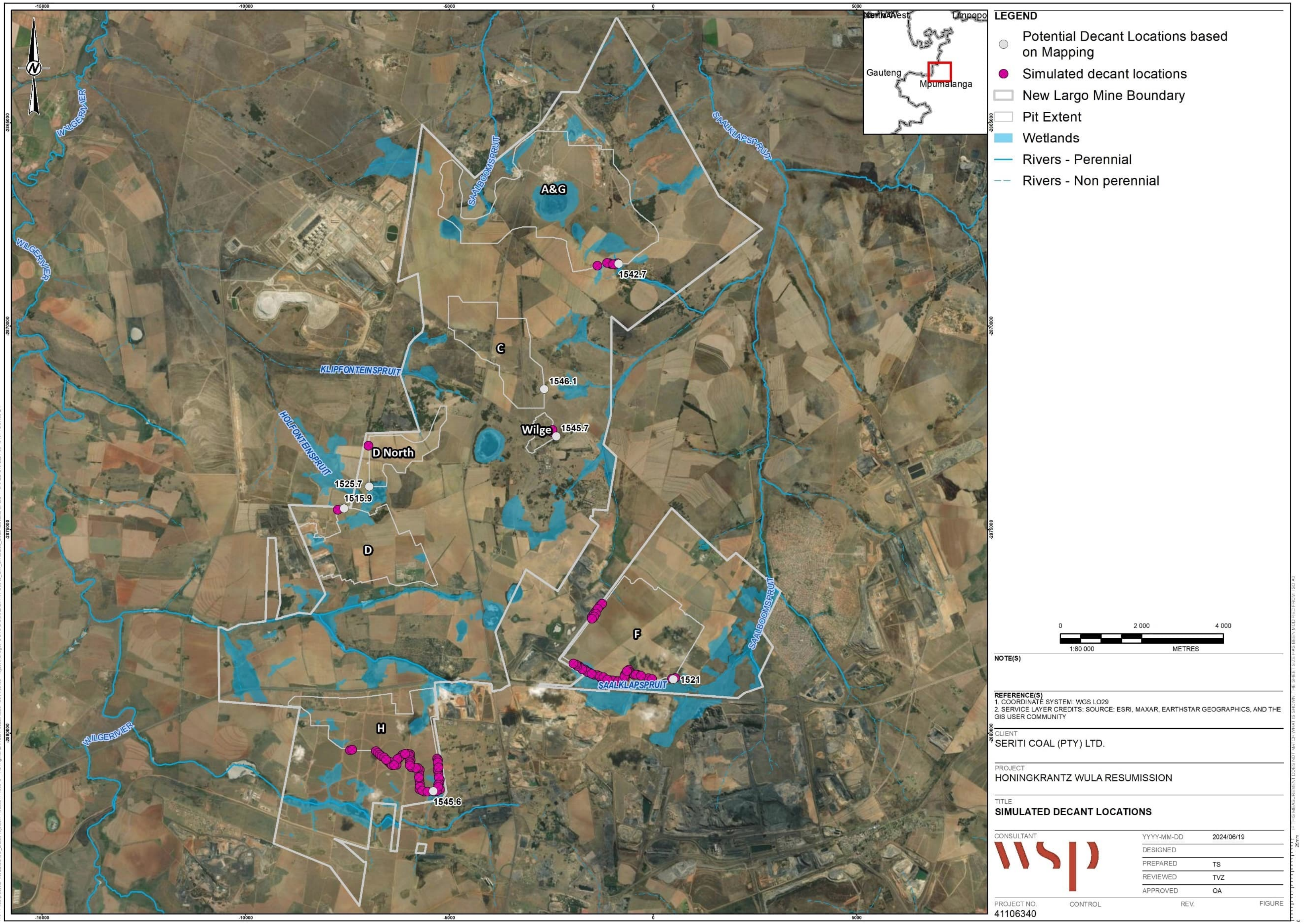


Figure 7-20 - Simulated decant locations

The decant from the various pit are shown in Figure 7-20. It was assumed that all the pits will be covered at closure. This will reduce the recharge through the backfill and hence, the decant will be reduced.

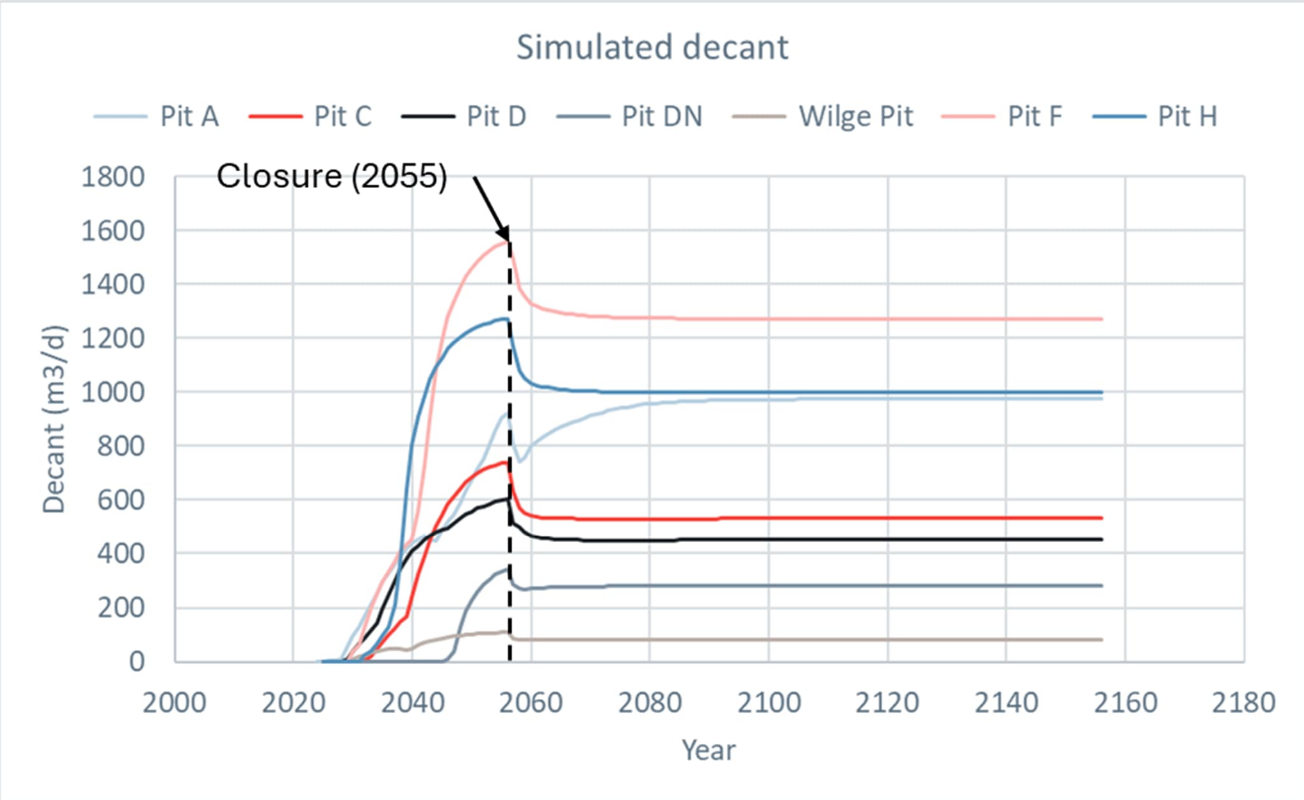


Figure 7-21 - Simulated Decant

The simulated decant start time and volumes are presented in Table 7-8.

Table 7-8 – Simulated decant start time and volumes

Pit	Start of decant	Decant at end of operations (m^3/d)	Long-term decant (m^3/d)
Pit A	2026	924	976
Pit C	2032	738	531
Pit D	2029	603	452
Pit D North	2044	342	282
Wilge Pit	2029	109	81
Pit F	2030	1560	1273
Pit H	2032	1273	1001

8. GEOHYDROLOGICAL IMPACTS

The impact assessment is aimed at identifying any additional impacts not listed in the original EIA (Synergistics Environmental Services, 2012).

The latest mine plan has a footprint area that is considerably smaller than for the original impact assessment and it is therefore expected that the impact will be lower than before, as indicated in the sections below. The construction phase was not considered as mining has already commenced.

8.1. CONSTRUCTION PHASE

Not applicable as New Largo mining is authorised.

8.2. OPERATIONAL PHASE

8.2.1. IMPACTS ON GROUNDWATER QUANTITY

Continuous dewatering of mined-out opencast pits will result in a loss in groundwater yield. This will impact surrounding groundwater users and result in a loss in stream base flow.

- The mitigation stays the same as listed in the approved EMPr: *Handle all excess water as part of the operational phase water balance. No surface decant will take place due to pro-active pump and treat. Identify all ground water users that can be affected by the cone of dewatering (500 m around all mining activities). Include these boreholes in the active monitoring system. Proven decrease in ground water quantities will be supplemented by an external source. Calculate loss in catchment reserve and release water in all sub-catchments to make up for the loss in individual stream base flow*.
- With this mitigation, the impact will be reduced from High to Moderate.

8.2.2. IMPACTS ON GROUNDWATER QUALITY

- During the operational phase the flow will be towards the pits, therefore the impact will be limited to the pits. There will be deterioration of in-pit water quality.
  - The mitigation listed before is: *A complete pump and treat system will be put in place. All dirty water will be captured and treated at both the portable WTP and the permanent WTP (when such facilities become available). The Environmental reserve will determine how much water will be released.*
  - The reduction in area mined will reduce the impact from High to Moderate.
- Deposition of discard deposition into the pit will further reduce the pit water quality.
  - The mitigation will be to: *Spread the discard out to a maximum of 2.5 m in the pit and it will be covered with overburden*.
  - The impact on groundwater quality is High with and without mitigation.

8.2.3. IMPACTS ON SURFACE WATER

This was addressed under the heading “Impacts on groundwater quantity.”

8.2.4. GROUNDWATER MANAGEMENT

The recommended mitigation actions can be summarised as follows:

- *A complete pump and treat system will be put in place. All dirty water will be captured and treated at both the portable WTP and the permanent WTP (when such facilities become available). The Environmental reserve will determine how much water will be released.*
- *Spread the discard out to a maximum of 2.5 m in the pit and it will be covered with overburden*.

8.3. DECOMMISSIONING PHASE

Golder (2022) listed the following activities for closure:

- Removal of infrastructure and concrete foundations.
- Material handling activities and transport of recovered material offsite.
- Backfilling, capping, closure and rehabilitation activities for disturbed areas.

The last bullet has reference on the groundwater regime.

8.4. POST-MINING PHASE

Golder (2022) listed the following activities for closure:

- Removal of infrastructure and concrete foundations.
- Material handling activities and transport of recovered material offsite.
- Backfilling, capping, closure and rehabilitation activities for disturbed areas.

The last bullet has reference on the groundwater regime.

8.4.1. GROUNDWATER QUANTITY

Mining of the pits will result in water level recovery during the post-closure phase.

- This is a positive impact.

8.4.2. GROUNDWATER QUALITY

- Potential decant:
  - The *mitigation* will be to: *Manage water levels to prevent decant. Keep water level at least one meter below the decant water level by pumping.*
  - With this mitigation the impact will be reduced from High to Low.
- Plume migration towards wetlands and rivers:
  - The *mitigation* will be to: *Monitor water quality within the plume, and when quality deteriorates, pumping should be implemented to contain the plume. Capping of the pits will reduce the magnitude of the impact.*
  - With this mitigation the impact will be reduced from High to Low.
- Deterioration of in-pit groundwater qualities and plume development, which will impact the water quality for surrounding groundwater users.
  - The *mitigation* will be: *Capping of the pits will reduce the magnitude of the impact. All contaminated water to be pumped to the WTP. The treated water will be released according to a Reserve Determination update at the time of closure. Continue to supplement users where necessary. Capping of the pits will reduce the magnitude of the impact*.

- With this mitigation the impact will be reduced from High to Moderate.

8.4.3. CUMULATIVE IMPACTS

All the impacts have been evaluated as the total (cumulative) impact in the sections above.

8.4.4. GROUNDWATER MANAGEMENT

The mitigation actions can be summarised as:

- *Manage water levels to prevent decant. Keep water level at least one meter below the decant water level by pumping.*
- *Monitor water quality within the plume, and when quality deteriorates, pumping should be implemented to contain the plume. Capping of the pits will reduce the magnitude of the impact.*
- *Capping of the pits will reduce the magnitude of the impact. All contaminated water to be pumped to the WTP. The treated water will be released according to a Reserve Determination update at the time of closure. Continue to supplement users where necessary. Capping of the pits will reduce the magnitude of the impact.*
- *A decant management plan should inform the management post closure. If this includes management of the water levels to prevent decant, the water levels will need to be maintained at least one meter below the decant water level by pumping and the abstracted water will require treatment before discharging back to the surface environment or for re-use. If managed on surface, the decant management plan must include an assessment of the subsurface baseflow as well as the flow to the surface environment.*

9. GROUNDWATER MONITORING SYSTEM

9.1. GROUNDWATER MONITORING NETWORK

The groundwater monitoring system at New Largo is extensive and covers most of the New Largo mining area. However, the monitoring data was supplied in separate spreadsheets. Some of the sheets contains the quality for one measurement of one borehole. This gives the impression that that the data is not stored in a database. It is strongly recommended that the data should be combined into a database for easy reference and extraction. Long term graphs that are automatically updated when new data is entered will help to identify anomalies so that action can be taken without delay when necessary.

Most of the monitoring boreholes are sampled bi-annually for water quality analysis, but not consistently. Water level data measurements are more regular. Since October 2023, monthly water levels were recorded at 29 boreholes.

9.1.1. SOURCE, PLUME, IMPACT AND BACKGROUND MONITORING

There are thirty (30) current monitoring boreholes:

- Eight (8) of them are located within the planned pits and will be destroyed by mining.
- Another three (3) of the current monitoring boreholes are very close to the planned pits and may potentially be destroyed by mining.
- Two (2) of the boreholes are within the Klipfontein Pit area.

- One (1) borehole is drilled into the underground workings[4].
- The remaining 16 boreholes are well placed for future monitoring and 9 of them (orange dots in Figure 9-1) can be used to monitor potential plumes after mining.

Figure 9-1 shows the classification of the boreholes for future monitoring and indicates locations of another 9 boreholes for future plume monitoring. It is understood that the mine is currently installing more boreholes that will go into the underground workings.

9.1.2. SYSTEM RESPONSE MONITORING NETWORK

The current groundwater monitoring boreholes are distributed across the site, however, some of them will be destroyed by mining. It is therefore important to drill new replacement boreholes strategically placed to effectively monitor potential contamination (potential locations indicated in Figure 9-1. The monitoring program must be used to guide environmental management decision making, including taking remedial measures when water quality guidelines are exceeded.

9.1.3. MONITORING FREQUENCY

The Water Use Licence (WUL 04/B20G/ACFGIJ/2538) recommends quarterly water quality monitoring for 62 boreholes. Currently it seems that only 30 boreholes are monitored and not all of them are done every quarter. Water level data measurements are more regular. Since October 2023, monthly water levels were recorded at 29 boreholes.

It is important to measure both water levels and quality at a regular interval and for all the monitoring boreholes. Monthly water levels are useful to get a seasonal trend and to see the effect of mine dewatering. Water quality samples should be taken quarterly at the boreholes and proposed boreholes indicated in Figure 9-1.

[4] Boreholes M5 and LGW-13 were drilled into the underground workings, however, LGW-13 is on the edge of Pit D and may potentially be destroyed by mining.

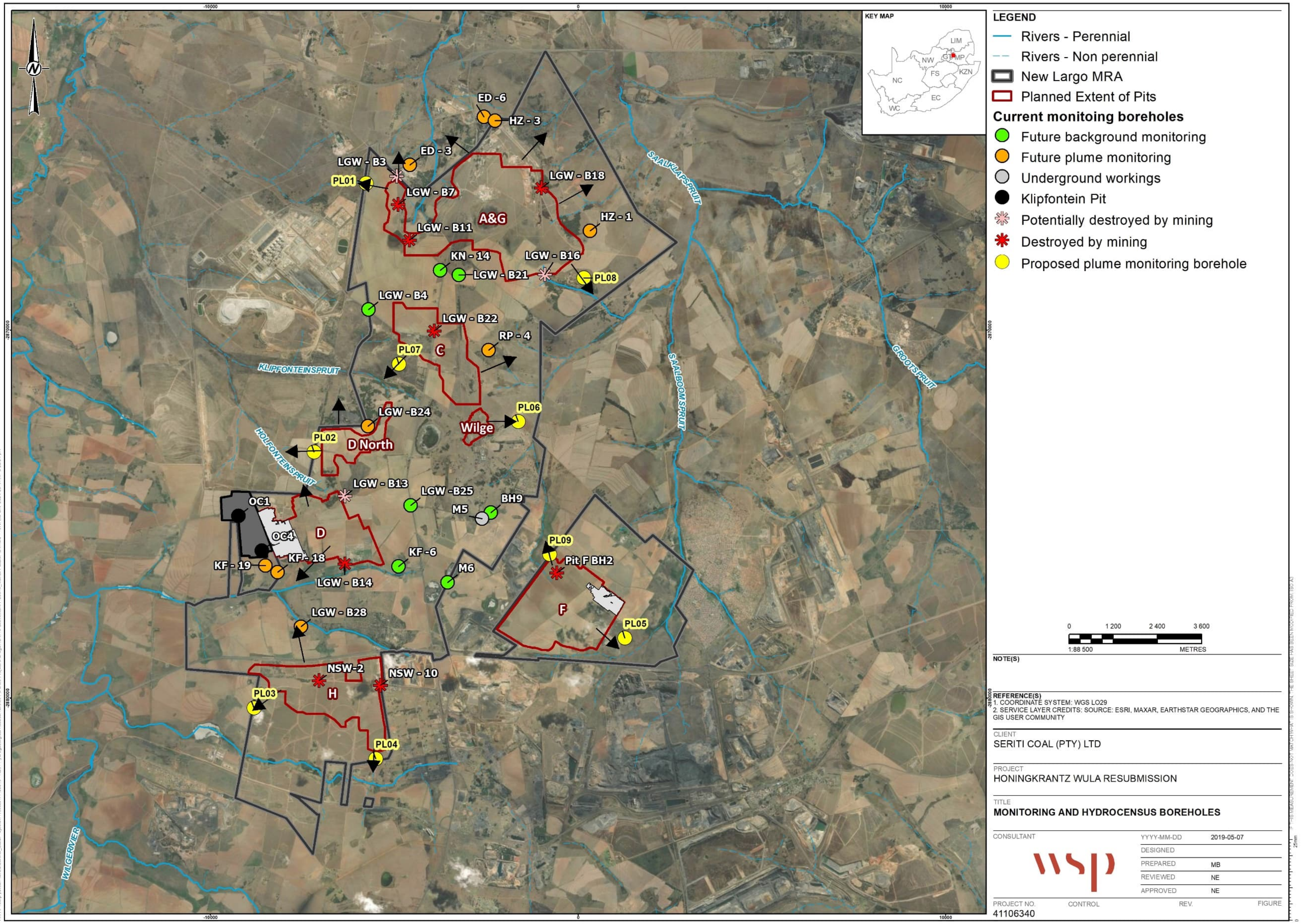


Figure 9-1 - Future monitoring programme

9.2. MONITORING PARAMETERS

The Water Use Licence (WUL 04/B20G/ACFGIJ/2538) stipulates that the following parameters shall be included in the groundwater monitoring programme:

- pH
- Electrical Conductivity (EC)
- Total Dissolved Solids (TDS)
- Total Alkalinity
- Ammonium (NH_4 as N)
- Nitrate (NO_3 as N)
- Chloride (as Cl)
- Sulfate (as SO_4)
- Sodium (as Na)
- Porassiom (as K)
- Calcium (as Ca)
- Magnesium (as Mg)
- Aluminium (as Al)
- Iron (as Fe)
- Manganese (as Mn)
- Fluoride (as F).

It is our recommendation to continue monitoring all these parameters.

9.3. MONITORING BOREHOLES

The list of boreholes to be monitored are presented in Table 9-1

Table 9-1 – Proposed monitoring boreholes

No	Locality	Latitude	Longitude	Reason
1	BH9	-25.983	28.97625	Background monitoring
2	KF -6	-25.9962	28.95118	Background monitoring
3	KN - 14	-25.9235	28.96256	Background monitoring
4	LGW - B21	-25.9247	28.9676	Background monitoring
5	LGW - B4	-25.9332	28.94305	Background monitoring
6	LGW -B25	-25.9812	28.95449	Background monitoring
7	M6	-26.0001	28.96453	Background monitoring
8	OC1	-25.9838	28.90772	Plume monitoring
9	OC4	-25.9923	28.91405	Plume monitoring
10	ED - 3	-25.8977	28.95434	Plume monitoring

No	Locality	Latitude	Longitude	Reason
11	ED -6	-25.8859	28.97445	Plume monitoring
12	HZ - 1	-25.9139	29.00326	Plume monitoring
13	HZ - 3	-25.8868	28.97742	Plume monitoring
14	KF - 18	-25.9976	28.91837	Plume monitoring
15	KF - 19	-25.996	28.91506	Plume monitoring
16	LGW - B28	-26.011	28.92471	Plume monitoring
17	LGW -B24	-25.9618	28.94293	Plume monitoring
18	RP - 4	-25.9431	28.97566	Plume monitoring
19	M5	-25.9845	28.97389	Underground workings
20	PL03	-26.0309	28.91185	Proposed new borehole
21	PL04	-26.0433	28.94495	Proposed new borehole
22	PL05	-26.0138	29.01267	Proposed new borehole
23	PL02	-25.968	28.92826	Proposed new borehole
24	PL01	-25.9022	28.94242	Proposed new borehole
25	PL08	-25.9254	29.00151	Proposed new borehole
26	PL07	-25.9465	28.95132	Proposed new borehole
27	PL06	-25.9607	28.98366	Proposed new borehole
28	PL09	-25.9933	28.99221	Proposed new borehole

These boreholes include the following (as shown in Figure 9-1):

- Currently monitored boreholes excluding the eleven (11) boreholes that might be destroyed by mining.
- Nine (9) proposed boreholes to be drilled within the expected contaminant plumes after closure.
- One (1) borehole drilled into the underground mining area.

The boreholes that are currently drilled into the underground mining area should be added to this list.

10. GROUNDWATER ENVIRONMENTAL MANGEMENT PROGRAMME

10.1. CURRENT GROUNDWATER CONDITIONS

Recent data indicates the groundwater quality is generally good with locally elevated nitrate, possibly due to farming practices. The two boreholes that are located in the Klipfontein pit area (OC1 and OC4) shows the impact of mining with high levels of Sulfate, TDS, EC and metals (Fe and Mn) (refer to Figure 5-9,Figure 5-10, Figure 5-11 and Table 5-2).

10.2. PREDICTED IMPACTS OF FACILITY (MINING)

The identified groundwater impacts associated with the proposed opencast mining were described in section 8:

- Operational:
  - Dewatering will result in a loss in groundwater yield. This will impact surrounding groundwater users and result in a loss in stream base flow.
  - There will be deterioration of in-pit water quality and deposition of discard deposition into the pit will further reduce the pit water quality.
  - There is a risk of additional inflows into the pits, if the pits are mined into the underground workings particularly where these are flooded.
- After closure:
  - The pits will fill up with continuous groundwater ingress and decant will occur.
  - Plume migration towards wetlands and rivers.
  - Deterioration of in-pit groundwater qualities and plume development, which will impact the water quality for surrounding groundwater users.
  - Discard deposited into the pits will have a limited further impact on the in-pit groundwater qualities and plume migration.

10.3. MITIGATION MEASURES

10.3.1. LOWERING OF GROUNDWATER LEVELS DURING OPERATION (MINING)

Due to mining, the cone of dewatering is extending laterally outward from the pits. This may impact water users near the pits. These users should be identified, and their boreholes should be included in the active monitoring system. Proven decrease in ground water quantities should be supplemented by an external source.

The loss in catchment reserve should be calculated. It is anticipated that these losses will be temporary but should be made up for where necessary by releasing treated pit water to streams.

10.3.2. BARRIER BETWEEN PITS AND UNDERGROUND WORKINGS DURING OPERATION (MINING)

The proposed mine plans for the pits seems to be in close proximity to the mined out underground workings. This creates a risk for inflows into the pits which should be avoided. Areas that need particular attention include:

- Mapped underground mining to the north of Pit A.
- Red zones in Pit A & G areas.
- Potential unidentified red zones south of Pit A.
- Mapped underground mining to the south of Pit C.
- Red zone to the west of Pit C.
- Mapped underground mining to the west of Wilge Pit.
- Mapped underground mining to the east of Pit D-North.
- Mapped underground mining to the east of Pit D.
- Vlakfontein underground mining to the west of Pit F.
- Mapped underground mining to the west of Pit H.

There are also red zones under Pit D for which there may not be a mitigation, however, these areas are small and not connected to the larger underground mining voids.

Mitigation will be to keep the barrier pillar intact between the opencast mining and the old workings.

10.3.3. RISE OF GROUNDWATER LEVELS POST FACILITY OPERATION (MINING)

A water level recovery post mining is a positive impact. However, the model predicts decant, preventing water level rise in the pits to the original level. In areas between the pits the water level may rise to a higher level than before mining. The groundwater numerical model simulated the following maximum decant rates (refer to Table 7-8):

- Pit A: 976 m^3/d.
- Pit C: 738 m^3/d.
- Pit D: 452 m^3/d.
- Pit D North: 342 m^3/d.
- Wilge Pit: 109 m^3/d.
- Pit F: 1560 m^3/d.
- Pit H: 1273 m^3/d.

A decant management plan should inform the management post closure. If this includes management of the water levels to prevent decant, the water levels will need to be maintained at least one meter below the decant water level by pumping and the abstracted water will require treatment before discharging back to the surface environment or for re-use. If managed on surface, the decant management plan must include an assessment of the subsurface baseflow as well as the flow to the surface environment.

10.3.4. SPREAD OF GROUNDWATER POLLUTION POST FACILITY OPERATION (MINING)

To prevent decant, the water level should be kept at least one meter below the decant water level by pumping. All dirty water will be captured and treated at both the portable WTP and the permanent WTP (when such facilities become available). The Environmental reserve will determine how much water will be released.

A network of shallow capture wells can be installed in the pits or immediately downgradient of the site, to drain contaminated water for treatment before disposal, until such time when the groundwater quality has improved and meets the relevant discharge limits.

Groundwater quality should be measured within the plume, and when quality deteriorates, pumping should be implemented to contain the plume. Table 9-1 indicates which boreholes should be used for plume monitoring.

Capping of the pits are essential to reduce the amount of rainwater that will infiltrate into the pits. Establishing vegetation on the cover, will further reduce infiltration into the pits.

11. POST CLOSURE MANAGEMENT PLAN

11.1. REMEDIATION OF PHYSICAL ACTIVITY

Golder (2022) listed the following activities for closure:

- Removal of infrastructure and concrete foundations.
- Material handling activities and transport of recovered material offsite.
- Backfilling, capping, closure and rehabilitation activities for disturbed areas.

The last bullet has reference on the groundwater regime.

Golder (2022) estimated closure costs for several cost components for decommissioning and rehabilitation, equating to an outside (third party) contractor establishing on-site and conducting the outstanding rehabilitation-related work:

- Dedicated contractors would be commissioned to conduct the demolition and rehabilitation work on the site. This would inter alia require establishment costs for the contractors and hence, the allowance for preliminary and general (P&Gs) in the cost estimate.
- It was assumed that all metal and steel waste will be salvaged, although it is expected to be minimal. No allowance was made to offset the salvage value of the scrap metal against the demolition costs.
- Allowance has been made for third party contractors and consultants to conduct care and maintenance work, as well as compliance monitoring, following the rehabilitation of outstanding items.

11.2. REMEDIATION OF STORAGE FACILITIES

The storage facilities form a small part of the infrastructure and is included in the activities for closure listed by Golder (2022):

- Removal of infrastructure and concrete foundations.
- Material handling activities and transport of recovered material offsite.

11.3. REMEDIATION OF ENVIRONMENTAL IMPACTS

- A complete pump and treat system will be put in place. All dirty water will be captured and treated at the permanent WTP (when such facilities become available). This will continue post closure.
- The treated water will be released according to a Reserve Determination update at the time of closure.
- Capping of the pits. Capping will consist of a soil cover and vegetation.
- A decant management plan should inform the management post closure. If this includes management of the water levels to prevent decant, the water levels will need to be maintained at least one meter below the decant water level by pumping and the abstracted water will require treatment before discharging back to the surface environment or for re-use. If managed on

surface, the decant management plan must include an assessment of the subsurface baseflow as well as the flow to the surface environment.

- Monitor groundwater levels in all pits and surrounding external user's boreholes.
- Monitor water quality within the plume, and when quality deteriorates, pumping should be implemented to contain the plume.

11.4. REMEDIATION OF WATER RESOURCES IMPACTS

- Treated water will be released according to a Reserve Determination update at the time of closure.
- The Environmental reserve will determine how much water will be released.

11.5. BACKFILLING OF THE PITS

The pits will be backfilled with overburden material, discard from the DMS plant and/or rejects from the destoning plant and after closure. The backfill will be conducted during the operational period and the pits will be capped at closure.

12. CONCLUSIONS

The New Largo coal resource lies between the N4 and N12 national freeway, some 30 kilometres west of eMalahleni and 100 kilometres east of Johannesburg in the Mpumalanga Province

Historically, underground mining of both 2 seam and 4 seam was competed before 2012. Water level data indicates that the water level has recovered after the underground mining. Currently, New Largo started opencast mining at two pits and plans to mine another five pits. Mining started in 2021 at Pit D and in 2024 at Pit F. Other pits that will be mined between 2025 and 2055 includes Pit A&G (mostly referred to as Pit A), Pit C, Pit D North, Wilge Pit, and Pit H.

The hydrocensus found that the monitoring boreholes visited as well as the six additional samples from the hydrocensus boreholes around Pit F and Pit H, provided sufficient coverage of the mining area to inform the groundwater water quality baseline required for the R267 geohydrology framework.

A regional groundwater model was developed and calibrated for current (2024) conditions with open voids representing the mined-out underground workings.

During mining there will be dewatering to remove water from groundwater ingress as well rainfall and runoff into the pits. The simulated total groundwater ingress does not make provision for direct rainfall and runoff into the pits, which should be added to the groundwater ingress. The ingress rates are directly related to the area mined in a year. The numerical groundwater model predicts the following rates:

- Pit A: Maximum 935 m^3/d, Average 528 m^3/d.
- Pit C: Maximum 352 m^3/d, Average 118 m^3/d.
- Pit D: Maximum 486 m^3/d, Average 105 m^3/d.
- Pit D North: Maximum 562 m^3/d, Average 95 m^3/d.
- Wilge Pit: Maximum 253 m^3/d, Average 15 m^3/d.
- Pit F: Maximum 1101 m^3/d, Average 322 m^3/d.
- Pit H: Maximum 958 m^3/d, Average 201 m^3/d.

After mining the water levels will rise and recover until decant occurs. Water levels in the pits cannot rise higher than the decant levels. The groundwater numerical model simulated the following maximum decant rates after mining:

- Pit A: 976 m^3/d.
- Pit C: 738 m^3/d.
- Pit D: 452 m^3/d.
- Pit D North: 342 m^3/d.
- Wilge Pit: 109 m^3/d.
- Pit F: 1560 m^3/d.
- Pit H: 1273 m^3/d.

When dewatering stops the plume of contamination will develop, extending laterally outward from the pits. As committed to in the original EMPr (Synergistics, 2012), the pits should be capped after closure, which will limit the extent of the plumes. It is recommended that groundwater quality should be measured within the plumes, and when quality deteriorates, pumping should be implemented to contain the plumes.

The pits will be backfilled with overburden material, discard from the DMS plant and/or rejects from the destoning plant and after closure, these pits will be covered with a soil layer and vegetation will be established.

The groundwater monitoring system at New Largo is extensive and covers most of the New Largo mining area. However, some of the monitoring boreholes are in the areas earmarked for mining and will be destroyed. Therefore, we recommend that these boreholes should be replaced, preferably new boreholes should be drilled in locations to monitor plume migration.

An impact assessment was undertaken specifically to identify any additional impacts not listed in the EIA (Synergistics, 2012).

The latest mine plan has a footprint area that are considerably smaller than for the previous impact assessment and it is therefore expected that the impact will be lower than before. Impacts previously assessed in terms of operational in-pit water quality deterioration remain High. The additional areas where discard will be deposited into the pits will have a limited further impact on the in-pit groundwater qualities and plume migration at closure. The mitigation actions listed as part of the impact assessment, are discussed below under recommendations.

13. RECOMMENDATIONS

It is recommended to follow the monitoring stipulations of the WUL in terms of boreholes to be monitored and the frequency of monitoring.

Since some of the monitoring boreholes will be destroyed during mining it is recommended that these boreholes should be replaced, preferably new boreholes should be drilled in locations to monitor plume migration. Figure 9-1 shows the locations of nine (9) proposed boreholes to be drilled within the expected contaminant plumes after closure.

The mitigation measures identified in the original EIA (Synergistics, 2012) and revisited in the Impact Assessment section should be implimented and followed. These mitigation measures are:

- Operational:

- Due to mining, the cone of dewatering may impact water users near the pits. These users should be identified, and their boreholes should be included in the active monitoring system. Proven decrease in ground water quantities should be supplemented by an external source.
- The loss in catchment reserve should be calculated. It is anticipated that these losses will be temporary but should be made up for where necessary by releasing treated pit water to streams.
- Keep the barrier pillars intact between the opencast mining and the old workings.
- Handle all excess water as part of the operational phase water balance. No surface decant will take place due to pro-active pump and treat. Identify all ground water users that can be affected by the cone of dewatering (500 m around all mining activities). Include these boreholes in the active monitoring system. Proven decrease in ground water quantities will be supplemented by an external source. Calculate loss in catchment reserve and release water in all sub-catchments to make up for the loss in individual stream base flow.
- A complete pump and treat system will be put in place. All dirty water will be captured and treated at both the portable WTP and the permanent WTP (when such facilities become available). The Environmental reserve will determine how much water will be released.
- Spread the discard out to a maximum of 2.5 m in the pit and it will be covered with overburden.

▪ Post Closure

- Manage water levels to prevent decant. Keep water level at least one meter below the decant water level by pumping. A network of shallow capture wells can be installed in the pits or immediately downgradient of the site, to drain contaminated water for treatment before disposal, until such time when the groundwater quality has improved and meets the relevant discharge limits.
- Monitor water quality within the plume, and when quality deteriorates, pumping should be implemented to contain the plume. Capping of the pits will reduce the magnitude of the impact.
- Capping of the pits will reduce the magnitude of the impact. All contaminated water to be pumped to the WTP. The treated water will be released according to a Reserve Determination update at the time of closure. Continue to supplement users where necessary. Capping of the pits will reduce the magnitude of the impact.

The newly drilled boreholes (into underground workings) will provide additional information for future modelling and should be included in future model calibrations.

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Appendix A

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DOCUMENT LIMITATIONS

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WSP GROUP AFRICA (PTY) LTD

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

wsp.com