Appendix 5
Hebden Seam Recovery
Noise Impact Assessment

7 February 2011

Ref: 07373/3853

Mr Alan Wells
Wells Environmental Services
PO Box 205
East Maitland NSW 2323

NOISE IMPACT ASSESSMENT – ASHTON HEBDEN SEAM RECOVERY

Dear Sir,

Ashton Coal Operations Pty Ltd (ACOL) proposes to utilise existing machinery at the North East Open Cut (NEOC) to mine vertically down through the south east corner of the existing Barrett Pit to access 100,000 T of coal from the Hebden Seam. The haulage of coal will be consistent with existing operations with overburden material emplaced within the existing open cut at levels below the rim of the NEOC.

Spectrum Acoustics has conducted annual ENM noise modelling of Ashton's open cut operation for several years and we note that all mining noise sources would be at lower RL than for previously modelled scenarios for mining in the Barrett Pit and overburden dumping on the out-of-pit emplacement at RL 80-95.

Noise levels were found to comply with the criteria at all receivers for previous "low-level dumping" scenarios under adverse conditions and noise levels for the proposed Hebden seam recovery will be lower still. Accordingly, we advise that a full noise impact assessment of the Proposal is not necessary and this letter should be included with the submission to demonstrate compliance with existing noise criteria.

Yours faithfully,

SPECTRUM ACOUSTICS PTY LIMITED

Neil Pennington
Principal/Director

Appendix 6
Hebden Seam Recovery
Air Quality Impact Assessment

22 February 2011

Alan Wells
Wells Environmental Services
PO Box 205
East Maitland, NSW 2298

Ashton NEOC - Review of the air quality impacts from coal extraction in the proposed Hebden Seam.

Dear Alan

1 INTRODUCTION

PAEHolmes have investigated the potential air quality impacts from further coal extraction from the recovery of the Hebden Seam, below the floor of the existing Ashton North East Open Cut (hereafter referred to as NEOC).

Recovery of the Hebden Seam is proposed to occur over a period of approximately 3 months and would include open cut mining, ROM coal processing, waste and product handling.

PAEHolmes previously conducted an air quality impact assessment for the approval of the Ashton NEOC ("Air Quality Impact Assessment – Proposed Ashton Mine Near Camberwell" (**PAEHolmes, 2001**)). The continued NEOC project will be operated as part of the Ashton Coal Project and will utilise the coal handling, preparation and loading facilities, and other office and surface facilities approved by the Ashton development consent (DA) 309-11-2001-i in 2002.

Wells Environmental Services on behalf of Ashton Coal Operations Limited (ACOL) have requested an air quality assessment of the proposed recovery of the Hebden Seam, as part of a modification to the existing Ashton coal mine development approval.

The objectives of this report are to determine the likely air quality impacts associated with the recovery of the additional coal from the Hebden Seam

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2 EXISTING AND PROPOSED OPERATIONS

The NEOC project was approved in 2002 and continues to mine open cut and underground coal as a part of the Ashton Coal project. Recent operations include open cut mining in the western side of the NEOC site, in proximity to the Coal Handing and Preparation Plant (CHPP). Underground mining has also continued to the west of the site with ROM coal being transported to the CHPP. Open cut mining includes excavation of overburden and ROM coal material, loading and unloading of material, hauling and crushing/screening and other processing operations at the CHPP. The mine currently operates for 15 hours per day, 7 days a week.

Proposed operations include continuing coal extraction through recovery of the Hebden Seam (see **Figure 2.1**). Approximately 100,000 tonnes of ROM coal will be extracted over three months with approximately 656,400 tonnes of overburden material to be hauled and dumped at the Arties Pit less, than 400 m to the northwest, and within the Hebden Seam excavation area. As per the existing approval, ROM coal would be transported to the CHPP for processing. The Hebden Seam would be accessed through the current floor of the NEOC in the southern corner of the existing Barrett pit.

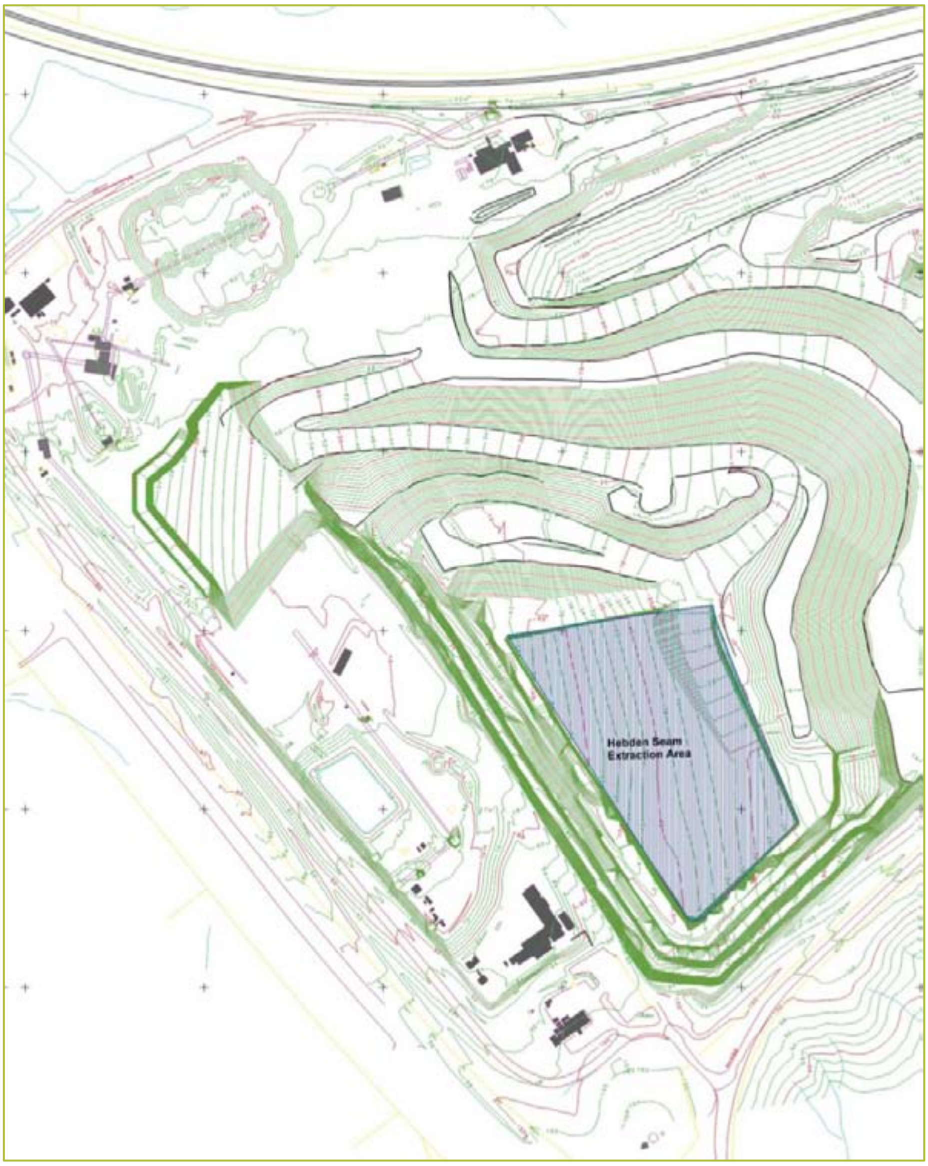

Figure 2.1: Proposed Hebden Seam Extraction Area

3 ASSESSMENT OF PROPOSED MINING OPERATIONS AND POTENTIAL AIR QUALITY IMPACTS

As the NEOC is approaching finalisation, the amount of overburden and ROM coal has decreased towards the end of 2010. The continuation of coal extraction through recovery of the Hebden Seam would not increase this production rate. Monthly production rates of 320,000 bcm overburden and 35,000 t ROM in the Hebden Seam represent a significant decrease in monthly production rate from NEOC operations.

Table 3.1 provides a summary of the overburden and ROM coal amounts handled for NEOC operations for the period January 2008 to December 2010.

Table 3.1: Total annual and average monthly overburden and ROM coal amounts for the NEOC 2008 - 2010

Date	Overburden (bcm)	ROM coal (t)
2008 Monthly Average	885,493	158,629
Total 2008	10,625,914	1,903,546
2009 Monthly Average	774,446	138,925
Total 2009	9,293,351	1,667,103
2010 Monthly Average	600,082	139,816
Total 2010	7,200,986	1,677,789

3.1 Annual Average PM_{10} Concentrations

Table 3.2 presents the annual average PM_{10} concentrations measured at the Ashton TEOM's between 2008 and 2010. All sites show annual averages below the DECCW criterion of 30 µg/m^3 for the three year period and indicated material handling amounts (**Table 3.1**).

Therefore, with the proposed mining extraction rate of 100,000 tonnes of ROM coal over three months, using the same mining method but deeper in the pit, it is clear that PM_{10} concentrations would also be below the assessment criteria and would not cause adverse impacts on sensitive receptors in and around Camberwell Village (represented by TEOM Site 1, Site 2 and Site 8).

Table 3.2: Annual average PM_{10} concentrations at each Ashton TEOM monitoring site (µg/m^3)

TEOM Site	2008	2009	2010
1	25.9	29.5	22.1
2	18.2	19.8	14.8
3	22.5	27.3	20.0
4	23.1	28.7	22.4
7	21.5	24.3	19.5
8	25.1	28.0	22.2

3.2 24-Hour Average PM_{10} Concentration

The production rate at Ashton has been dropping in 2010 as the mine approaches finalisation. This trend is shown in **Figure 3.1** for both overburden and ROM. The recovery of the Hebden Seam would continue this downward trend, also shown in **Figure 3.1**.

As the dust generation at a mine is broadly commensurate with the level of activity, the likely contribution to 24-hour PM_{10} concentrations from the continuation of mining in the NEOC will be significantly less than during 2010, where air quality concentrations below criteria are already being demonstrated based on data collected to date. Towards the end of 2010, there are no exceedances in 24-hour PM_{10} concentrations at the sites within Camberwell village, which also corresponds to a sharp drop off in production at the site.

It therefore follows that short-term air quality impacts from the proposed recovery of the Hebden Seam should not result 24-hour PM_{10} concentrations above current levels. Notwithstanding this, short term dust impacts during the continuation of mining in the Hebden Seam would be controlled under the existing air quality management plan for the NEOC.

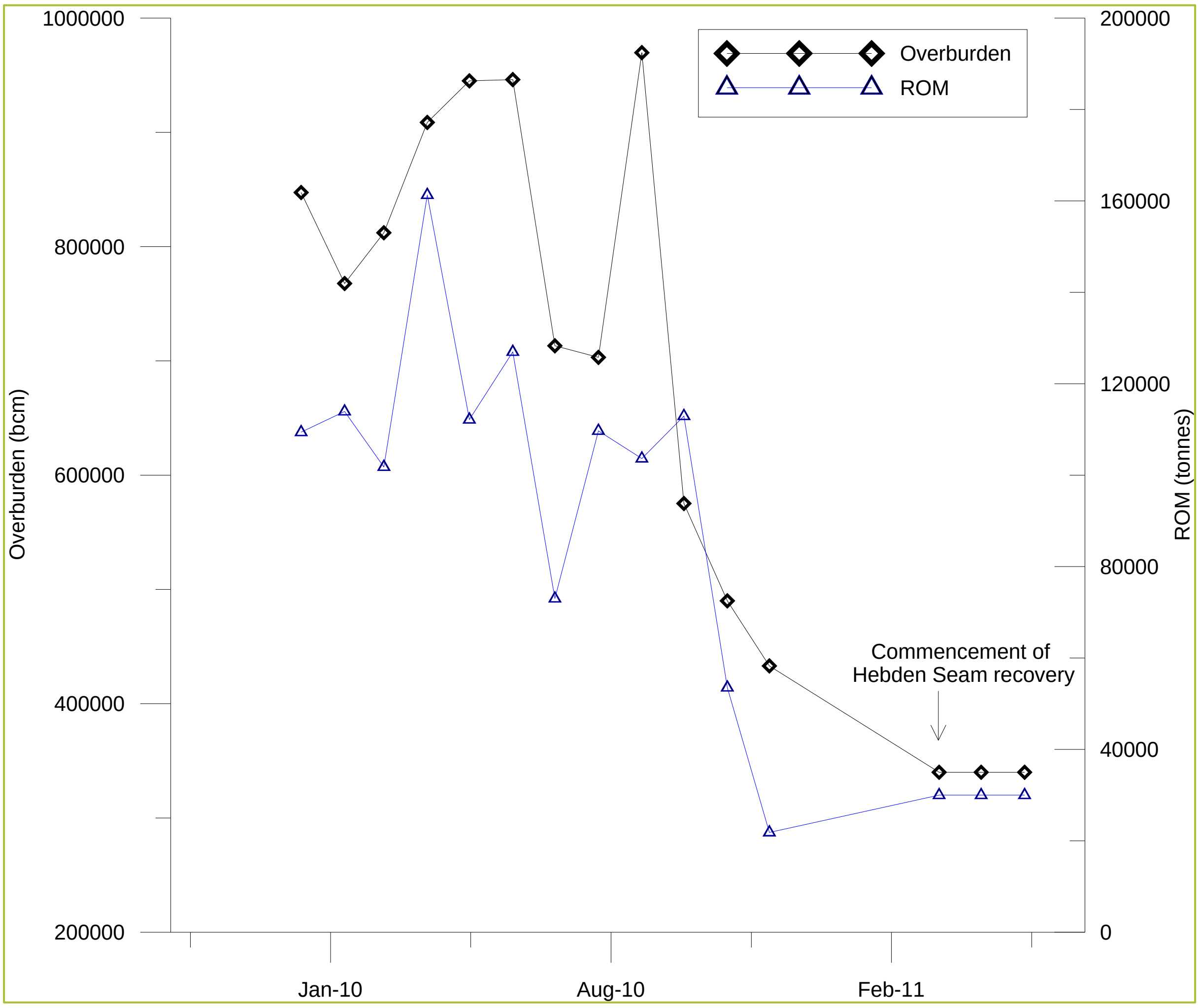

Figure 3.1: Ashton Production Data – 2010 and Hebden Seam Production Rates

4 CONCLUSIONS

This report has assessed the likely effects on air quality as a result of proposed recovery of the Hebden Seam at Ashton's North East Open Cut Mine. Mining is intended to occur over three months with approximately 100,000 tonnes of ROM coal to be extracted.

A review of mining rates and historical monitoring has indicated it is unlikely that PM_{10} concentrations and dust deposition levels would be above the criteria at monitoring locations. Previous years of monitoring have indicated that at monthly extraction rates of up to three times of what is proposed for the Hebden Seam, annual PM_{10} concentrations are below the assessment criteria. Short term impacts from 24-hour average PM_{10} concentrations are expected to continue the downward trend already evident during 2010 as production at the NEOC has decreased.

5 REFERENCES

Holmes Air Sciences (2001)

"Air Quality Assessment – Proposed Ashton Mine Near Camberwell, NSW" Prepared for White Mining Pty Ltd by Holmes Air Sciences, Suite 2B, 14 Glen Street, Eastwood, NSW 2122. October 2001.

Appendix 7
Hebden Seam Recovery
Eastern Highwall Geotechnical Stability Assessment

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GS844-001/3
16 February 2011

Ashton Coal Operations Pty Ltd
PO Box 699
SINGLETON NSW 2330

Attention: Mike Woodard

STABILITY ASSESSMENT - PROPOSED MINING TO HEBDEN SEAM

---

1 INTRODUCTION

This report presents a stability assessment for future mining within the North East Open Cut to recover remnant resources below the existing pit floor level.

It is proposed to mine below the existing pit floor (Lower Barrett floor) to access the Hebden Seam on the western side of the spoil buttress that is currently supporting the eastern wall movement. Movement of this wall has previously occurred resulting in the observed cracking across Glennies Creek Road and into the Camberwell Common.

A report was completed by RCA Australia addressing the stability of the eastern wall for mining to the Lower Barrett Seam (Reference 7188-305rev1 dated 29 March 2010). This report should be read in conjunction with the previous report.

The purpose of this report is to assess the potential for mining from the Lower Barrett floor to the Hebden Seam to affect the stability of the mine wall.

2 MINING TO HEBDEN SEAM

The stability of the eastern mine wall due to sliding on various coal seams above (and including) the Lower Barrett Seam has been considered in the previous RCA report. The current pit floor is at the Lower Barrett floor level and the eastern wall has been buttressed with spoil in accordance with the recommendations in the previous report. Survey monitoring data has showed a slowing of the eastern wall movement in response to placement of the spoil buttress.

The mine plan includes removal of approximately 12m to 13m of Hebden parting and coal, down dip of the spoil buttress. Hebden seam contours indicate the seam dips at 6.5° down towards the southwest within the proposed mine footprint and beneath the existing spoil buttress. A minimum 10m wide bench will be left between the spoil buttress toe and crest of the Hebden pit.

Ramp access into the Hebden pit will be on the north-western side of the pit, and will abut in-pit spoil dumps placed over the Lower Barrett floor.

2.1 HEBDEN PARTING AND COAL

Reference to borehole WMLC125 provided by Ashton Coal shows the Hebden parting to be about 12.75m thick and comprise fine grained sandstone/siltstone rocktypes of high strength. The Hebden Seam is 1.33m thick and contains some thin tuff and clay bands.

2.2 GROUNDWATER

The previous report referenced several boreholes drilled behind the eastern wall down to the Lower Barrett floor, none of which encountered groundwater. The boreholes, however, did not extend to the Hebden Seam.

The previous report modeled two groundwater cases, one a drained slope and the other with a phreatic surface rising to a maximum RL50m, slightly below the level of Glennies Creek which is located about 300m to the southeast of the mine wall.

A phreatic surface has been included in the slope models in this report at the level of the Lower Barrett floor (maximum assumed water level based on boreholes to Lower Barrett floor being dry) rising to a maximum RL50m and with drawdown to the toe of the slope (Hebden pit floor).

Two (2) boreholes were drilled on 31 January 2011 from the current pit floor, in front of the existing spoil buttress, to intersect the Hebden Seam. The boreholes were drilled for the purpose of assessing groundwater pressures within the Hebden Seam. The holes were drilled to about 1m below the Hebden floor and were open holes, drilled using a percussion rig.

Results are summarized below:

Table 1 *Water Level Depths*

Borehole	Hole Depth (m)	Depth to Water (Measured 1 February 2011)	Depth to Water (Measured 3 February 2011)	Depth to Water (Measured 4 February 2011)
North	17.4	16.7	16.0	15.2
South	16.5	15.2	12.7	12.2

As shown above, water levels in the boreholes have risen over a 4 day period of monitoring. Water inflows into the boreholes are possible along the Hebden Seam and also along bedding or joint planes intersected by the borehole, above the Hebden seam.

Although at the time of writing, water levels in the boreholes had not stabilized, it is considered likely that the groundwater assumption made in the models by adoption of a phreatic surface running along the Lower Barrett floor with drawdown to the toe of the Hebden pit, is a worst case condition. It is likely groundwater pressures within the slope are less than that assumed.

2.3 Stability Analysis Results

2.3.1 Stability Modeling Assumptions

The following assumptions have been made:

1. The potential critical failure mode is due to sliding along the Hebden seam.

2. An assumed friction angle of 12° along the slide plane at zero cohesion, based on back-analysis of the initial east wall slide movement on the LLLD Seam (discussed in RCA report dated 29 October 2009) and the cored borehole data from WMLC125 that showed the existence of low strength (tuff/clay) bands within the Hebden seam.

3. Groundwater conditions as described above. It is noted that the assumption of a phreatic surface at the level of the Lower Barrett floor may be a conservative assumption, based on the borehole information.

4. Analysed section based on that provided by Ashton Coal.

The modeling results are shown below and have assumed 2 failure modes. One model assuming failure extending back to near Glennies Creek road beyond the crest of the wall, the other assuming failure of the front portion of the slope incorporating the spoil buttress and underlying Hebden parting and coal.

2.3.2 *MODEL ASSESSING FAILURE TO GLENNIES CREEK ROAD*

The failure model included a tension crack extending from ground surface to a basal slide plane running along the Hebden Seam. The required tension crack depth to intersect with the Hebden Seam is about 65m, and is therefore a conservative assumption.

A Factor of Safety (FOS) of 1.43 is indicated assuming a drained slope and 1.35 assuming groundwater conditions described above. Both cases indicate FOS greater than 1.2 and are therefore considered acceptable. Given the conservative assumptions and analysis results, this mode of failure is considered very unlikely.

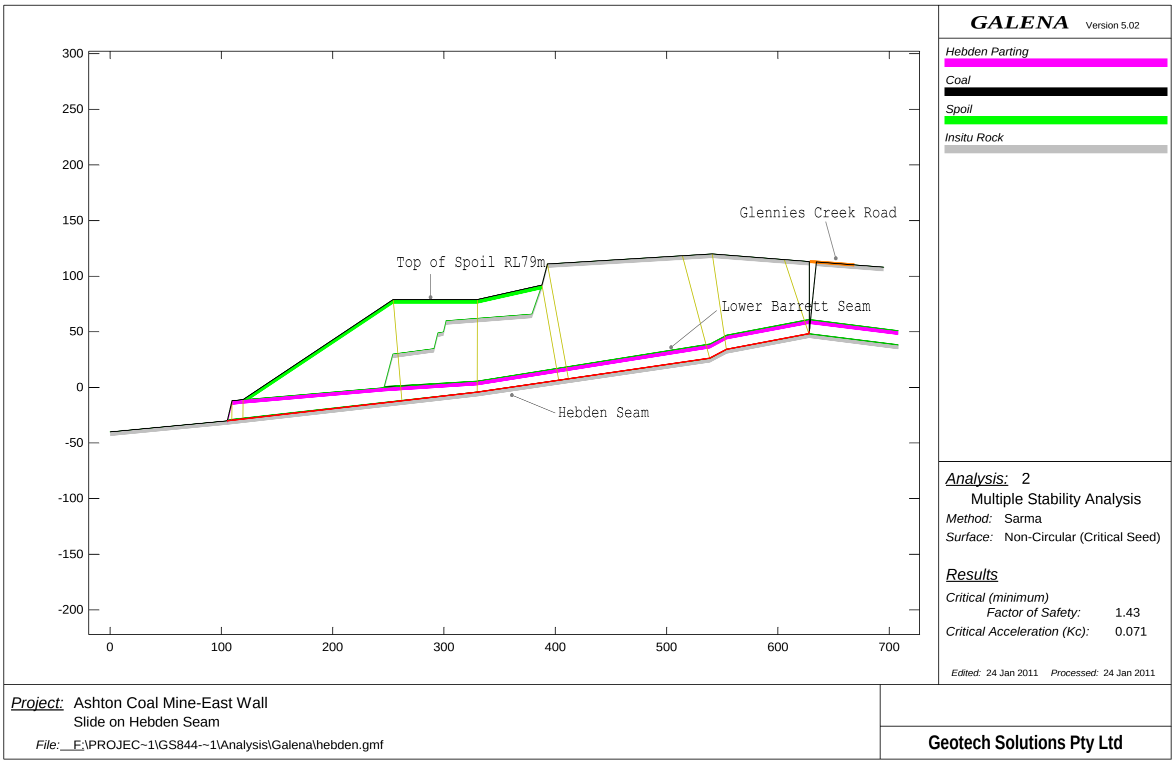

Figure 1 *Drained Slope, Factor of Safety=1.43*

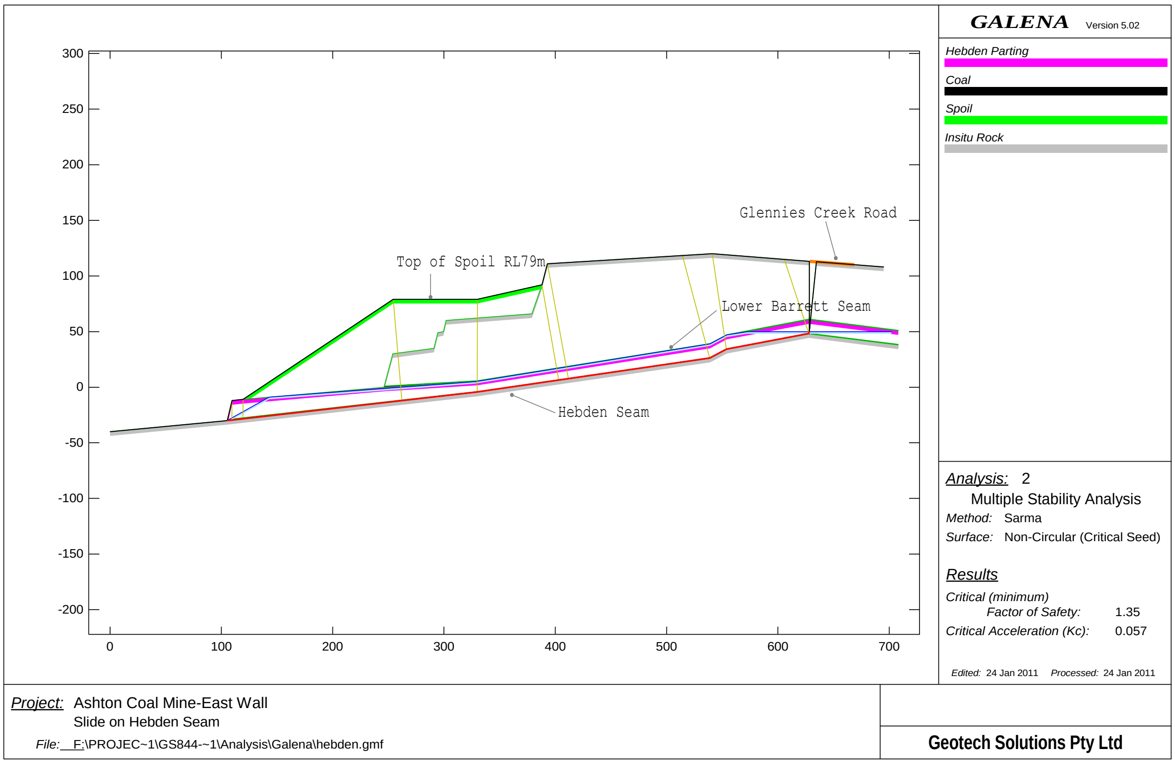

Figure 2 *With Phreatic Surface, Factor of Safety=1.35*

2.3.3 MODEL ASSESSING FAILURE OF FRONT PORTION OF SLOPE

The following models assume sliding of the front part of the slope through the spoil buttress and underlying Hebden parting. The shear strength of the Hebden parting has been assumed as c'=420kPa, phi=45° (based on correlation using the Hoek Brown criteria and assuming GSI=60, UCS=30MPa, mi=13, D=0.7, unit weight=24kN/m^3). Spoil shear strength has been assumed as c'=10kPa, phi=35°, based on experience.

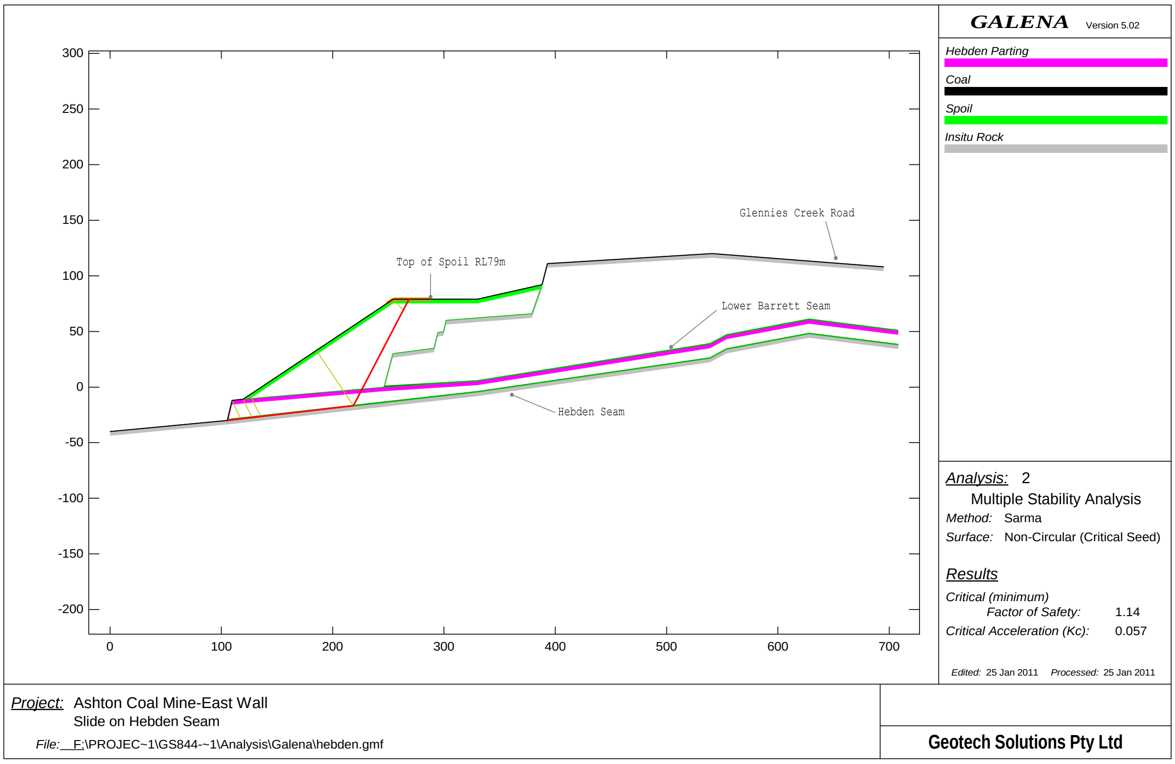

Figure 3 *Dry Slope, Factor of Safety=1.14*

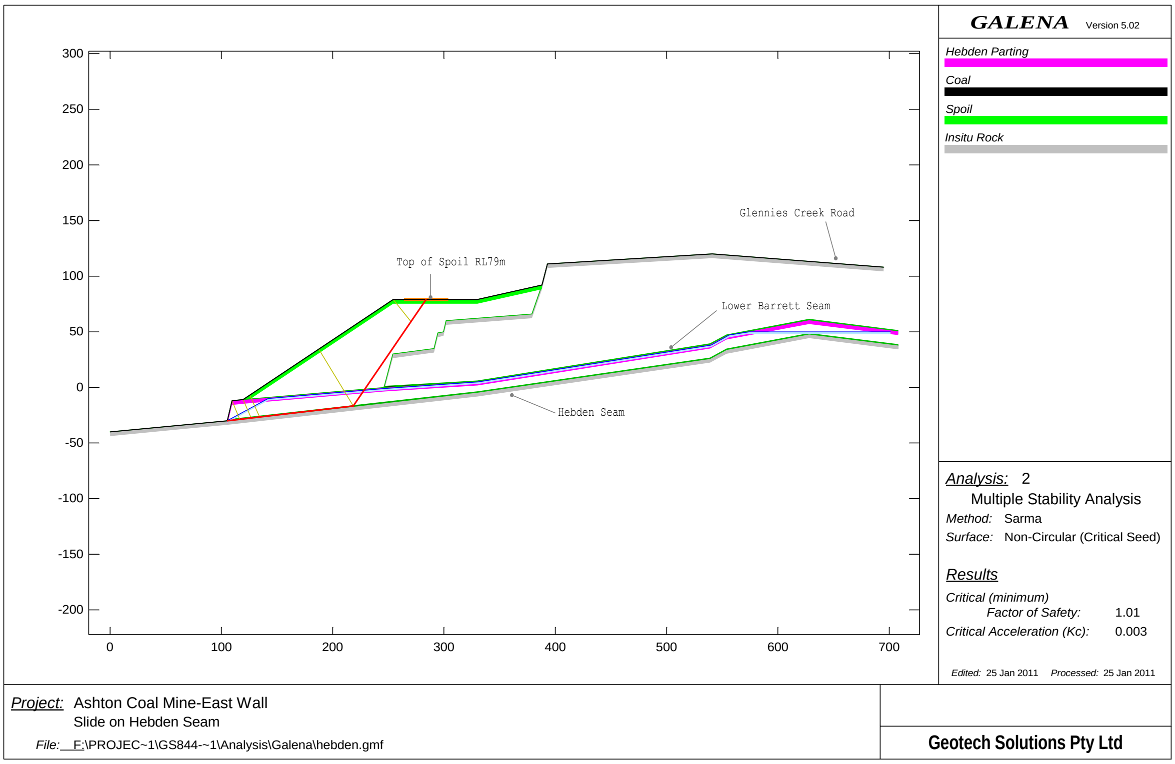

Figure 4 *With Phreatic Surface (Blue line), Factor of Safety=1.01*

To simulate shearing along a single joint plane through the Hebden parting, the cohesion in this unit was reduced to zero. It is noted this is a very conservative assumption, as it is most likely that some shearing through rock substance would be required, therefore a zero cohesion assumption is likely to underestimate the available strength in the parting.

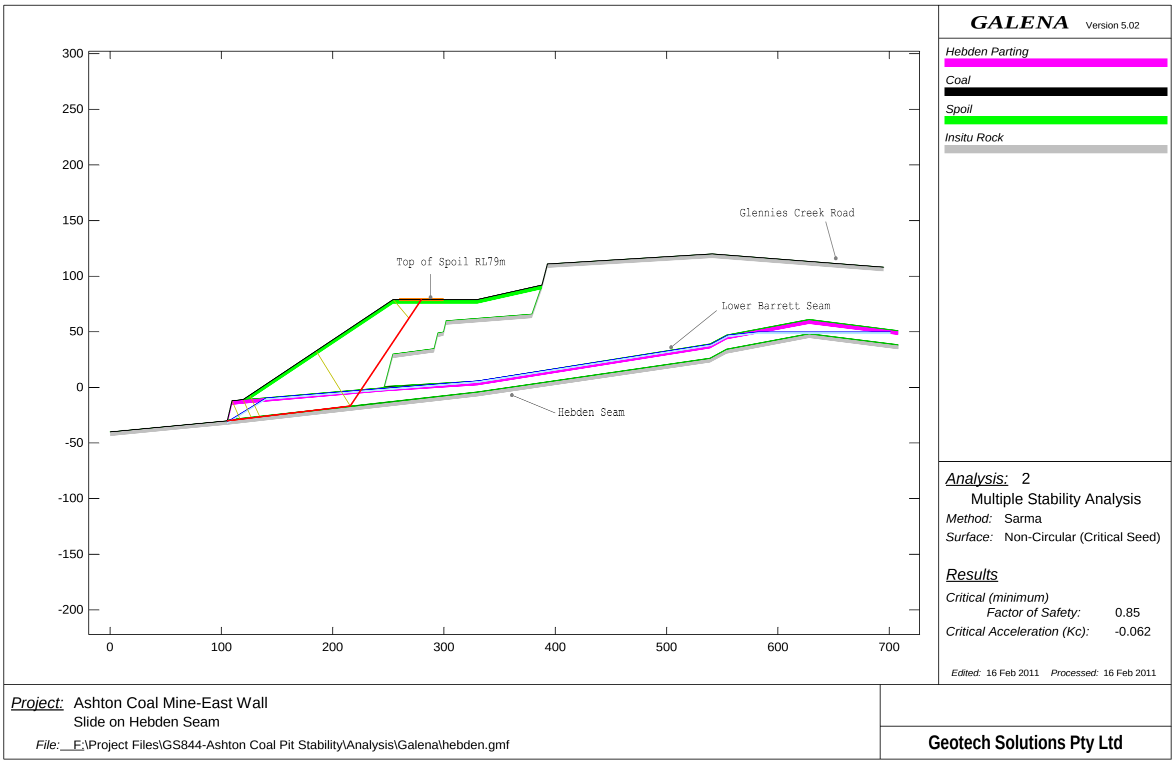

Figure 5 *With Phreatic Surface and Assuming Zero Cohesion Through Hebden Parting, Factor of Safety=0.85*

The above analyses show that some movement along the Hebden Seam and shearing through the Hebden parting and overlying spoil is possible, based on analysis results showing Factors of Safety less than 1.2. Control measures will therefore be required during mining of the parting and coal to reduce this risk, as detailed below.

3 RECOMMENDATIONS

3.1 DURING MINING

The following is recommended during mining of the Hebden parting and coal:

1. Mining to be completed under risk assessment taking into consideration the possibility that some movement may occur along the Hebden Seam which could result in movement of the overlying spoil buttress.
2. A minimum 10m wide bench should be constructed from the toe of the spoil buttress to the crest of the Hebden pit with a 1.5m high windrow near the crest of the pit. The windrow is required to catch any boulders that may become destabilised from the overlying spoil buttress.
3. Survey reflectors should be located along the 10m wide bench and crest of spoil buttress and monitored daily during mining.
4. Daily inspections of the spoil buttress crest area (~RL79m) looking for any signs of cracking.

5. Backfilling against the eastern wall of the Hebden pit and base of the spoil buttress should be completed immediately following mining of the Hebden Seam, as described below.

3.2 SPOIL TOE BUTTRESS

To increase Factors of Safety to 1.2 or greater, a spoil buttress at the toe of the slope has been included in the slope model as shown in Figure 6. We have used the most conservative model (Figure 5) and included a toe buttress in front of the slope. The model assumed c'=5kPa and phi=35° along the toe buttress/Hebden floor interface, based on the assumption that competent (unweathered) spoil will be dumped over a clean and dry Hebden floor.

As shown below, a spoil buttress of minimum base width 60m extending a minimum 5m above the Lower Barrett floor or 50m base width extending 10m above Lower Barrett floor was required to improve the Factor of Safety to 1.2 or greater.

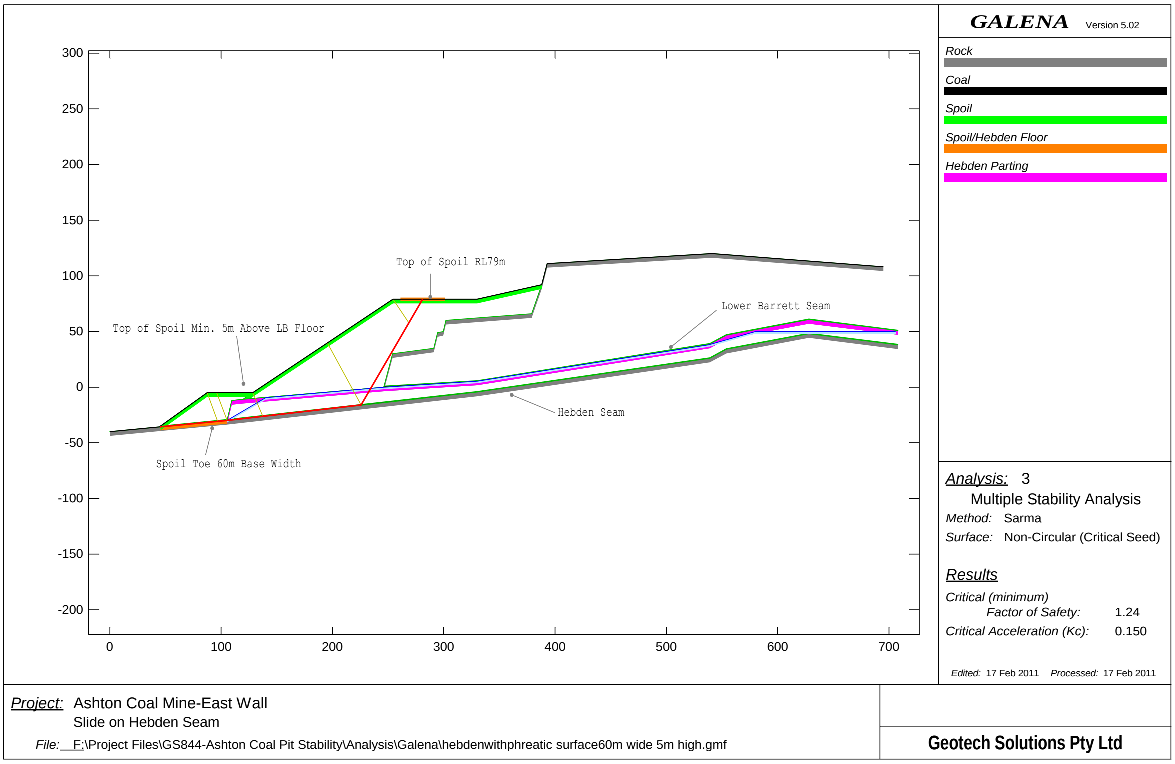

Figure 6 *With Toe Buttress and Phreatic Surface (Blue line), Factor of Safety=1.24*

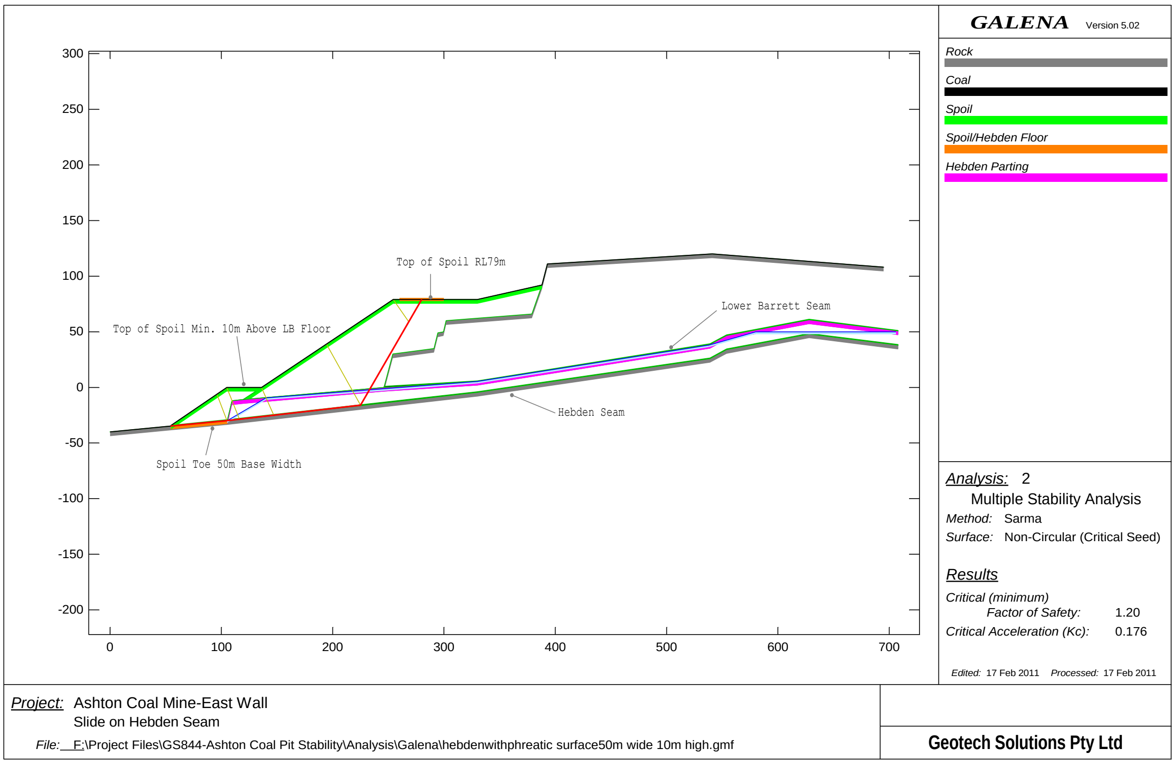

Figure 7 *With Toe Buttress and Phreatic Surface (Blue line), Factor of Safety=1.20*

3.3 PROPOSED MINING SEQUENCE

Mining in front of the eastern wall should occur in 3 mining areas, with each mining area progressively backfilled as mining advances across the wall. The minimum dimension of the toe buttress is based on a minimum width at floor level of 60m and minimum height of 5m above the Lower Barrett floor, or 50m width and minimum height 10m above the Lower Barrett floor.

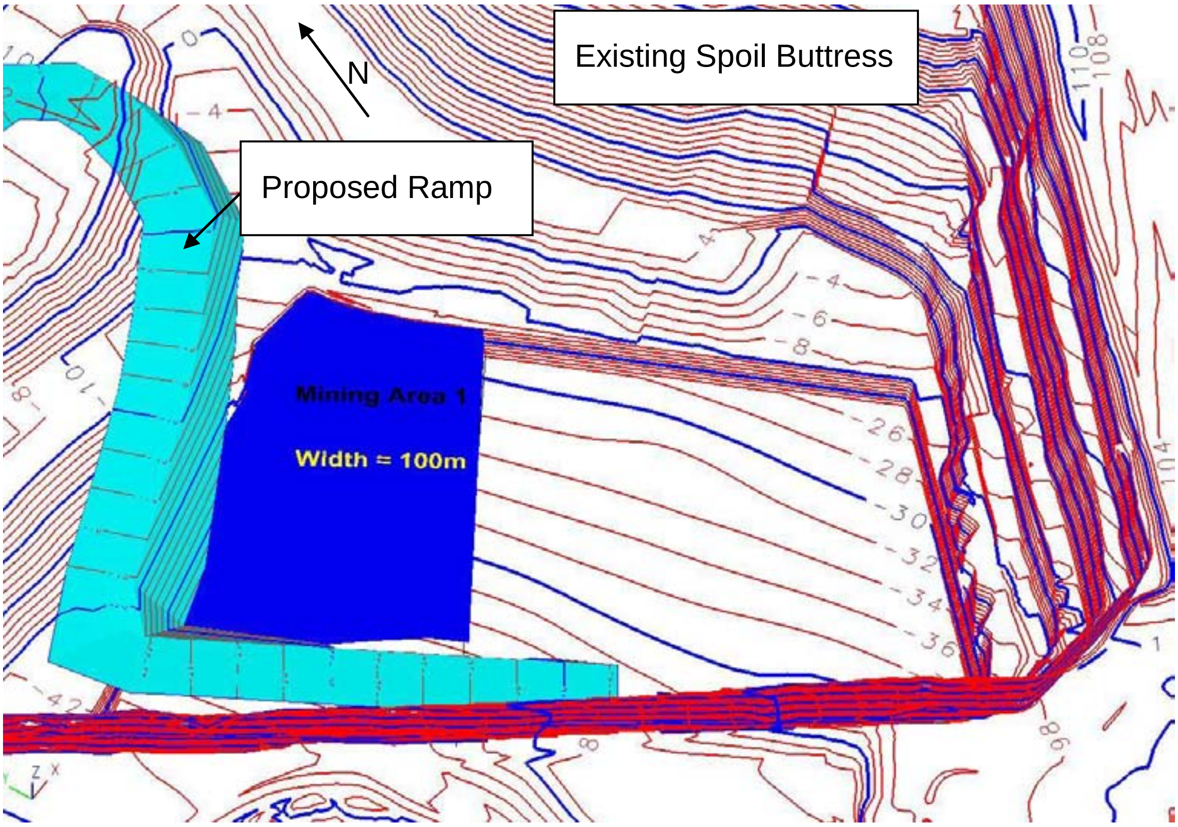

Figure 8 *First mining area with ramp*

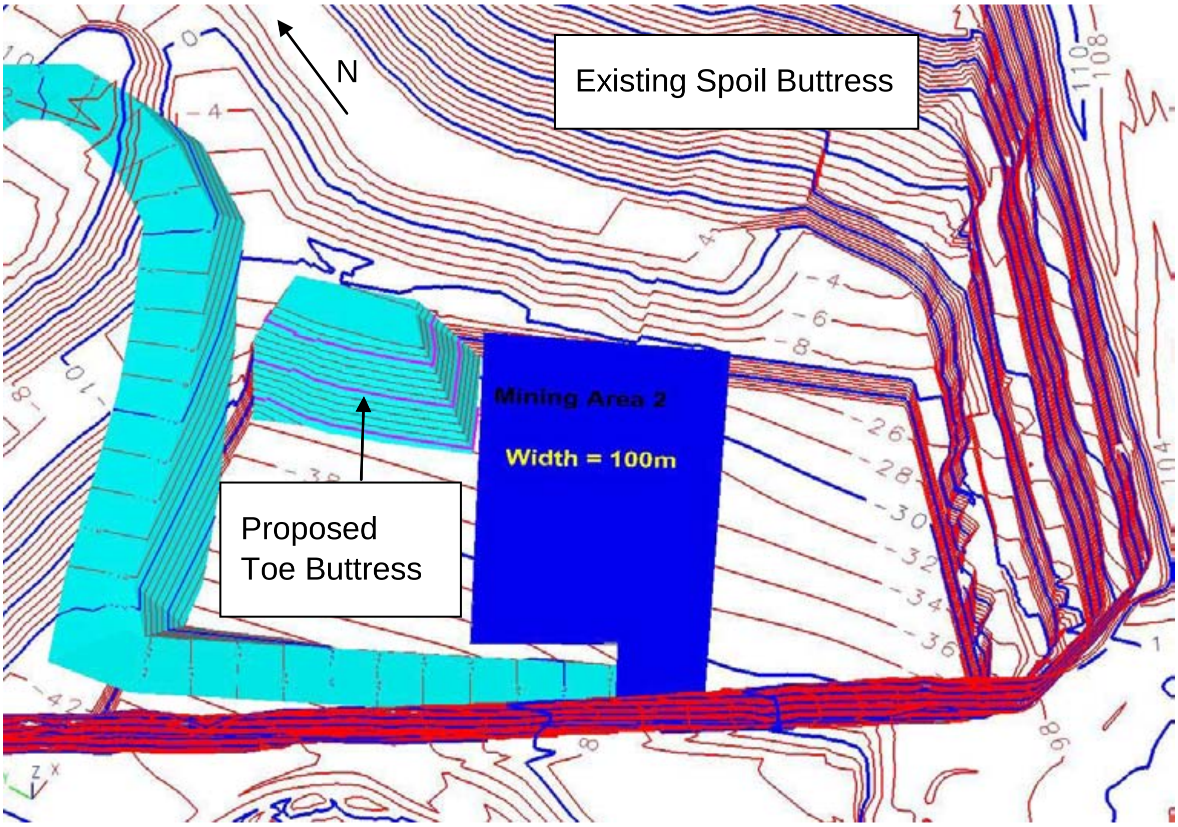

Figure 9 *2nd mining area with toe buttress infilling mining area 1*

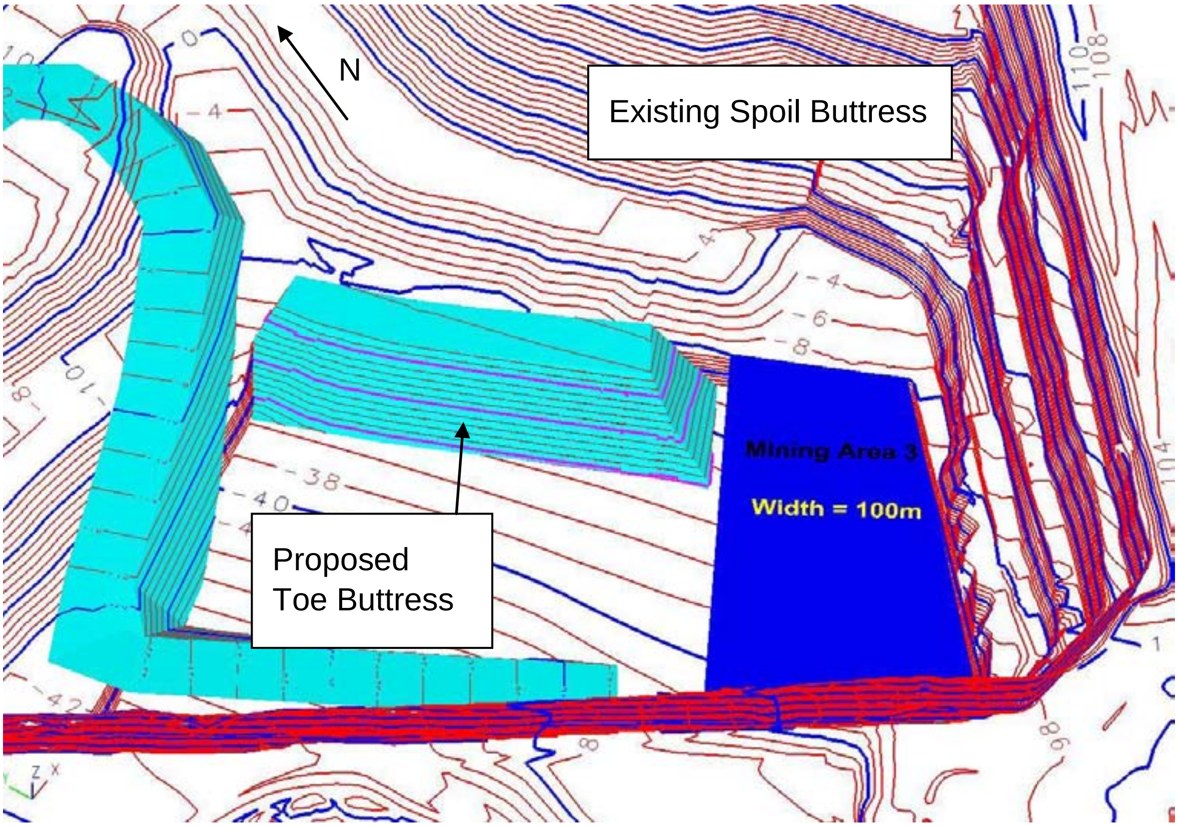

Figure 10 *3rd mining area and toe buttress infilling mining areas 1 and 2*

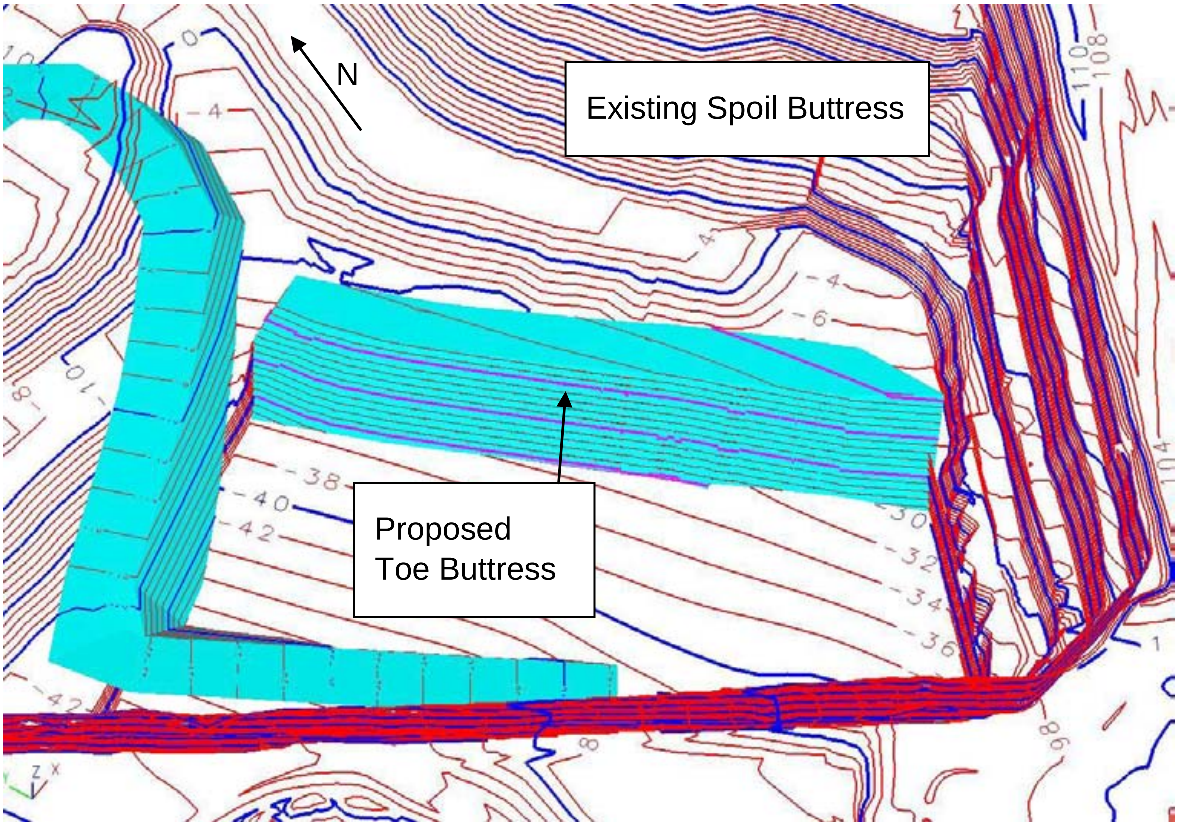

Figure 11 *Mining complete, toe buttress extending along full length of wall*

4 SUMMARY

The stability analysis results indicate:

1. Mining from Lower Barrett floor to the Hebden Seam is unlikely to result in a slope movement that would extend back to Glennies Creek Road.
2. It is possible that mining could result in movement of the front portion of the existing spoil buttress that currently supports the eastern wall.
3. Placement of a spoil 'toe' buttress of minimum 60m base width extending a minimum 5m above the Lower Barrett floor, or 50m width and 10m above Lower Barrett floor should be effective in supporting any movement of the overlying spoil buttress.

Control measures will be required during mining of the Hebden parting and coal including windrow protection and daily survey monitoring at the crest of the eastern wall of the Hebden pit, and daily inspections of the spoil crest area at RL79m looking for signs of cracking. Mining in front of the eastern wall should occur in 3 separate mining areas with each mining area progressively backfilled as mining continues across the wall.

5 LIMITATIONS

This report is based on assumed subsurface and groundwater conditions and materials strength parameters. Variations can occur from those anticipated which could adversely affect the stability of the eastern wall slope. Regular geotechnical inspections and reference to daily survey monitoring data is recommended during mining of the Hebden pit.

Yours faithfully,
GEOTECH SOLUTIONS PTY LTD

Paul Lambert
Principal Engineering Geologist

GHD CLIENTS | PEOPLE | PERFORMANCE

18 February 2011

Mike Woodard
Projects Engineer
Ashton Coal Resources
PO Box 699
Singleton NSW 2330

Our ref: 22/14925/416798
Your ref:

Dear Mike

North Eastern Open Cut
Peer Review

GHD has reviewed the revised report by Geotechnical Solutions dated 16 February 2011 and are satisfied the stabilisation issues raised in our previous email exchanges have been addressed satisfactorily.

The revised buttress dimensions are consistent with the stabilisation required against a worst case failure mechanism which is described in the revised report.

GHD endorses the recommendations provided by Geotechnical Solutions to carefully integrate the pit deepening with buttress placement and to monitor the operation for pitslope movement.

Yours sincerely

Graeme Boyd
Business Leader - Coal
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Appendix 8
Hebden Seam Recovery
Groundwater Impact Assessment

RPS Aquaterra

Ashton Coal
Hebden Seam Recovery

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Our ref: S56H\600\004c
Date: 9 February 2011

Document Status

	Issue Date	Purpose of Document
Revision A	25 January 2011	First Draft
Revision B	31 January 2011	Second Draft
Revision C	9 February 2011	Final

	Name	Position	Signature	Date
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Disclaimer

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1.0 INTRODUCTION

1.1 BACKGROUND

The Ashton Coal Project is located 14 km west of Singleton in the Hunter Valley region (Figure 1.1), between the villages of Camberwell and Ravensworth on the New England Highway. The Ashton Coal Project consists of both open cut and underground mining operations to access a series of coal seams within the Permian Foybrook Formation of the Whitingham Coal Measures (Figure 1.2).

The open cut mine, which is located north of the New England Highway, commenced operations in 2003. Coal has been recovered from several seams of varying thickness, in two open cuts – the smaller Arties Pit and the larger Barrett Pit. These are collectively known as the North East Open Cut (NEOC). Ashton Coal Pty Ltd (ACOL) is seeking a modification to the existing Ashton Coal Mine development approval to deepen the existing Barrett Pit to recover the Hebden Seam.

1.2 MINING PROPOSAL

The recovery of the Hebden Seam involves extracting 100,000 tonnes of coal by deepening the open cut operations below the current floor of the North East Open Cut pit a further 15 metres to access the Hebden coal seam. The extraction area will be located in the southern corner of the existing Barrett Pit with the coal resource being won with the same mining methodology as approved for the existing North East Open Cut operation. The layout of the proposed extension is shown in Figure 1.3. The anticipated period of excavation is 3 months.

The objective of this report is to assess the potential impacts on the groundwater environment during the recovery of the additional coal from the Hebden seam. Potential impacts on surface water and groundwater resources were assessed by comparing model outputs to simulations with and without the proposed extension of the pit.

2.0 POTENTIAL IMPACTS ON THE GROUNDWATER SYSTEM

Mining of the Ashton NEOC and underground longwall panels LW1-6A has reduced groundwater levels within the Permian to the stage where the Pikes Gully is largely dewatered over the mined longwall panel areas (Aquaterra, 2009a, 2010a and 2010b) and deeper seams down to the Lower Barrett have been dewatered over the general area of the NEOC. Within the NEOC, groundwater levels within Permian strata have been reduced to the Lower Barrett Seam.

The proposed Hebden Seam recovery will deepen the existing Barrett Pit by about 15m with the potential for additional drawdown in the Permian strata. The potential impacts from the proposed extension include:

- Incremental groundwater level drawdowns in the Permian hard rock strata.
- Incremental increase in inflow of water to the mine.
- Incremental increase in baseflow impacts

Modelling of groundwater levels (drawdown) and mine inflows has been used in this assessment to illustrate the predicted impacts.

3.0 GROUNDWATER MODELLING

3.1 BACKGROUND

The MODFLOW-SURFACT groundwater model which was used for this assessment is a derivative of the model that was utilised to predict impacts for the mine's Bowmans Creek Diversion mine plan (Aquaterra, 2009a).

It was first calibrated against interpreted 'steady state' pre-mining conditions, and was then calibrated and validated in transient mode against observed inflows and groundwater level drawdowns during the mining of the NEOC and LW1 to LW6 within the underground mine located on the southern side of the Highway.

3.2 MODELLING SOFTWARE

A 3-Dimensional finite difference model has been used, based on the MODLFOW code (McDonald and Harbaugh, 1988) in conjunction with SURFACT (Version 3) code to allow for both saturated and unsaturated flow conditions using the pseudo soil function in SURFACT. The modelling has been undertaken using the Groundwater Vistas (Version 5.16) software package.

3.3 CONCEPTUAL MODEL DESIGN

The conceptual model is a simplified representation of the real system, identifying the most important geological units and hydrogeological processes, while acknowledging that the real system is hydrogeologically and geologically more complex. The conceptual model forms the basis for use in simulating the groundwater flow. The main features of the conceptual groundwater model are described in detail within the Bowmans Creek Diversion Groundwater Assessment (Aquaterra 2009a). Alterations to the model used for this study included insertion of two additional layers to represent the Hebden Seam and the inter-burden between the Hebden and overlying Barrett Seam.

The model was set up to simulate groundwater conditions over a 132km^2 area. Because of the strong influence of other mining activities in the area, the model has explicitly included the progressive mining of the North East Open Cut (NEOC), the Ashton Underground Mine, the proposed South East Open Cut (SEOC), the ongoing underground mining of the adjacent Ravensworth longwall mine as well as the other nearby open cut mines such as the Narama pit and the former Ravensworth open cut.

In order to assess the impact of the proposed NEOC in pit extension, comparisons have been made of predicted impacts on groundwater levels "with" and "without" the proposed extension area. Reporting periods within the modelled runs were manipulated to allow the distinct impacts to be evaluated over time slices which included the end of the Hebden Seam mining after the 3 months of excavation and at 12 months. The 12 month result was selected for output purposes because the impact on drawdown had stabilised after 12 months.

Simulations were repeated to demonstrate differences in drawdown and inflow for situations with and without the proposed recovery of the Hebden Seam.

3.4 GEOLOGY AND HYDROGEOLOGY

The local geology has been represented by 17 model layers. These are largely defined by the main coal seams and the interburden intervals. The top layer (Layer 1) includes the weathered regolith and the areas of river/creek alluvium. The overburden above the Pikes Gully seam has been divided into 6 layers to allow for meaningful hydrogeological representation of the overlying coal measures and the impacts of the longwall mining on the groundwater in these coal measures. A summary description of the model layers that have been used is as follows:

- Layer 1: Bowman's Creek, Glennies Creek and Hunter River alluvium, colluvium, weathered Permian overburden (regolith) and Ravensworth spoil (backfill in the old Ravensworth open cut).

- Layers 2, 3, 4, 5, 6 and 7: Pikes Gully Seam overburden – this has been split into a number of layers to allow the simulation of fracturing to be assigned progressively to different heights above the coal seam during mining impact assessment. These layers include the full range of the lithologies of the coal measures which include the Lemington coal seams (1 to 19), and in the very western part of the area, the Bayswater 1 and 2 seams.
- Layer 8: Pikes Gully Seam.
- Layer 9: Pikes Gully – Upper Liddell interburden.
- Layer 10: Upper Liddell Seam.
- Layer 11: Upper Liddell – Upper Lower Liddell interburden.
- Layer 12: Upper Lower Liddell Seam.
- Layer 13: Upper Lower Liddell – Lower Barrett interburden.
- Layer 14: Lower Barrett Seam.
- Layer 15: Lower Barrett – Upper Hebden interburden.
- Layer 16: Upper Hebden – Lower Hebden including interburden.
- Layer 17: Basal Layer – Coal measures below Lower Barrett.

3.5 SIMULATION OF MINE EXTENSION

Additional drainage cells were included in the model to represent the excavation of the Hebden Seam and associated overburden. A separate model running with and without the extension area was constructed to evaluate additional potential groundwater impacts.

3.6 EVALUATION OF IMPACTS DURING MINE OPERATIONS

3.6.1 GROUNDWATER LEVEL IMPACTS

The objective of this assessment was to determine the potential impacts of the proposed Hebden Seam recovery on both inflow rates and stream baseflows. The potential drawdown impacts of the extension were assessed by comparing the predicted drawdown impacts of the extension against the predicated impacts without an extension. As mentioned in Section 3.3, the predicted impacts of both scenarios also takes into account the impacts of the Ashton underground mine, the proposed SEOC and neighbouring mines.

The predicted groundwater impacts, with and without the proposed extension area are compared in Figures 3.2 to 3.3. They represent groundwater conditions for time periods immediately after mining the extension area (3 months) and 9 months after that completion (i.e. 12 months after commencement).

The contours shown on Figure 3.2 and Figure 3.3 reflect the difference in the groundwater elevation of the Hebden Seam, between the two modelled scenarios (with and without the proposed extension area). They show an additional drawdown of up to 5m outside the pit wall as a result of mining in the Hebden Seam, for time periods 3 and 12 months, respectively. Due to the very low hydraulic conductivities of the Hebden Seam and the minor groundwater seepage into the pit, the drawdown impacts are predicted to be limited to the area immediately around the excavation area. The northward deflection of the 1m contour is also evident in Figure 3.2 and in Figure 3.3. These figures present the regional groundwater elevation (m AHD) of the Hebden Seam.

3.6.2 MINE INFLOW RATES

The hydrograph of the predicted inflow to the NEOC is presented in Figure 3.1. Table 3.1 shows the predicted mine inflow rates for simulations with and without the Hebden Seam recovery. The dates shown in the simulation are illustrative and represent an extension of levels over time commencing from the end of previous simulations. The trends are representative but actual dates will depend on time periods needed to obtain approvals and initiate the excavation process. For simulation purposes the excavation is assumed to be completed within the first time slice in order to conservatively demonstrate the maximum impact on inflow rates and how these will change over time. The results indicate that:

- The initial inflow to the proposed Hebden Pit Seam recovery will increase from 0.12Ml/day (without the extension) to 0.16Ml/day (with the extension)
- After a 12 month period (9 months after completion of the excavation with no further mine development) the inflow rates tend towards similar values obtained for simulations of the for the "no extension" scenario.

Table 3.1: Predicted Mine Inflow Rates with and without Hebden Seam Excavation

Predicted flow rates (ML/d)	NEOC Inflow just after start of excavation	NEOC Inflow 3 months after start of excavation	NEOC Inflow 12 months after start of excavation
With Excavation of Hebden Seam	0.16	0.15	0.13
Without Excavation of Hebden Seam	0.12	0.12	0.1

3.6.3 POTENTIAL IMPACTS ON EXISTING GROUNDWATER USERS

A search of the DWE bore database within the predicted impact zone has been conducted which has revealed no registered groundwater supply bores. The nearest registered water bore is located in Camberwell village, which will not be affected by the NEOC nor the proposed Hebden extension.

3.6.4 POTENTIAL IMPACTS ON GLENNIES CREEK

The NEOC is situated north of Glennies Creek. As there is no saturated alluvium in the mining area and no apparent baseflow contributions, the pumping or interception of groundwater from the proposed excavation of the Hebden Seam will not impact on flows in the creek.

3.7 DISCUSSION

Groundwater modelling was undertaken to assess the potential impact of the excavation of the Hebden Seam within the Barrett Pit, at Ashton's North East Open Cut Mine.

The groundwater model utilised for this assessment was based on the model used in the Bowmans Creek Diversion groundwater assessment (Aquaterra, 2009a). In particular it contains an appropriate representation of the regional groundwater flow regime, and has accounted for changes in the hydraulic properties of the rock mass as the underground mining progressed. The model also contains realistic representations of other mines in the area, in particular the Ravensworth underground mine and the Narama open cut, enabling the interfering impacts of surrounding mines to be included in the assessments,

The proposed extension area is small relative to the size of the existing open cut pit and hence the potential impacts from the proposed extension are also small and incremental within the impacts of the overall mine operations. A comparison of model predictions with and without the extension area showed that there are no hydrogeological concerns with regard to the proposed extension.

In summary the results show that:

- There is an incremental drawdown in the Permian groundwater levels. Following the proposed 3 months of mining, the strata will be dewatered immediately adjacent to the Hebden Seam excavation area. This is limited in extent due to the low hydraulic conductivity of the Permian strata.
- Mine inflows increase slightly as a result of the extension. After 3 months the inflow will be 0.15ML/day with the extension vs 0.12 ML/day without the extension. However, the trends for both cases tend to stabilize over time with negligible rates of change after 12 months.

- The groundwater levels and mine inflows have not completely equilibrated to steady state within 12 months, but trends indicate that the bulk of drawdown impacts occur within this 12 month period. The quantities involved are relatively small with inflow amounts differing by only 0.03Ml/day after 12 months for scenarios with and without the extension.
- The limited and temporary groundwater drawdown amounts predicted in the model for the Hebden Seam as a result of the proposed extension are small and will not exacerbate the hydraulic gradients which currently exist. Based on the model results the proposed extension will have no additional effect on groundwater gradients, flow rates and levels which implies that the impacts on supply, quality and any groundwater dependent ecosystems will also be negligible.

3.8 REFERENCES

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McDonald M G and Harbaugh A W, 1988. *A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model.*McDonald and Harbaugh, 1988

FIGURES

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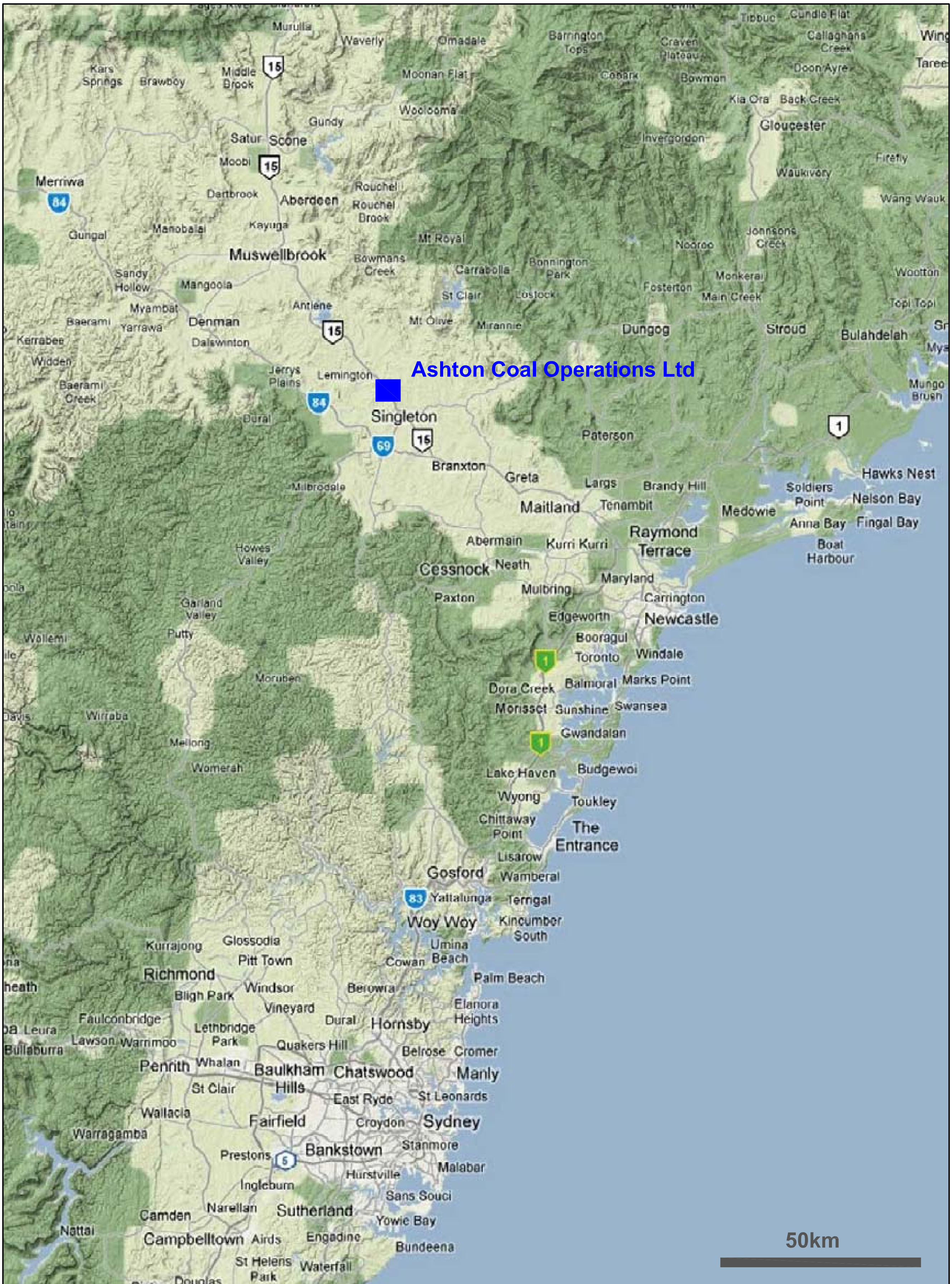

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Drawing No: S56H-001	Rev: A	
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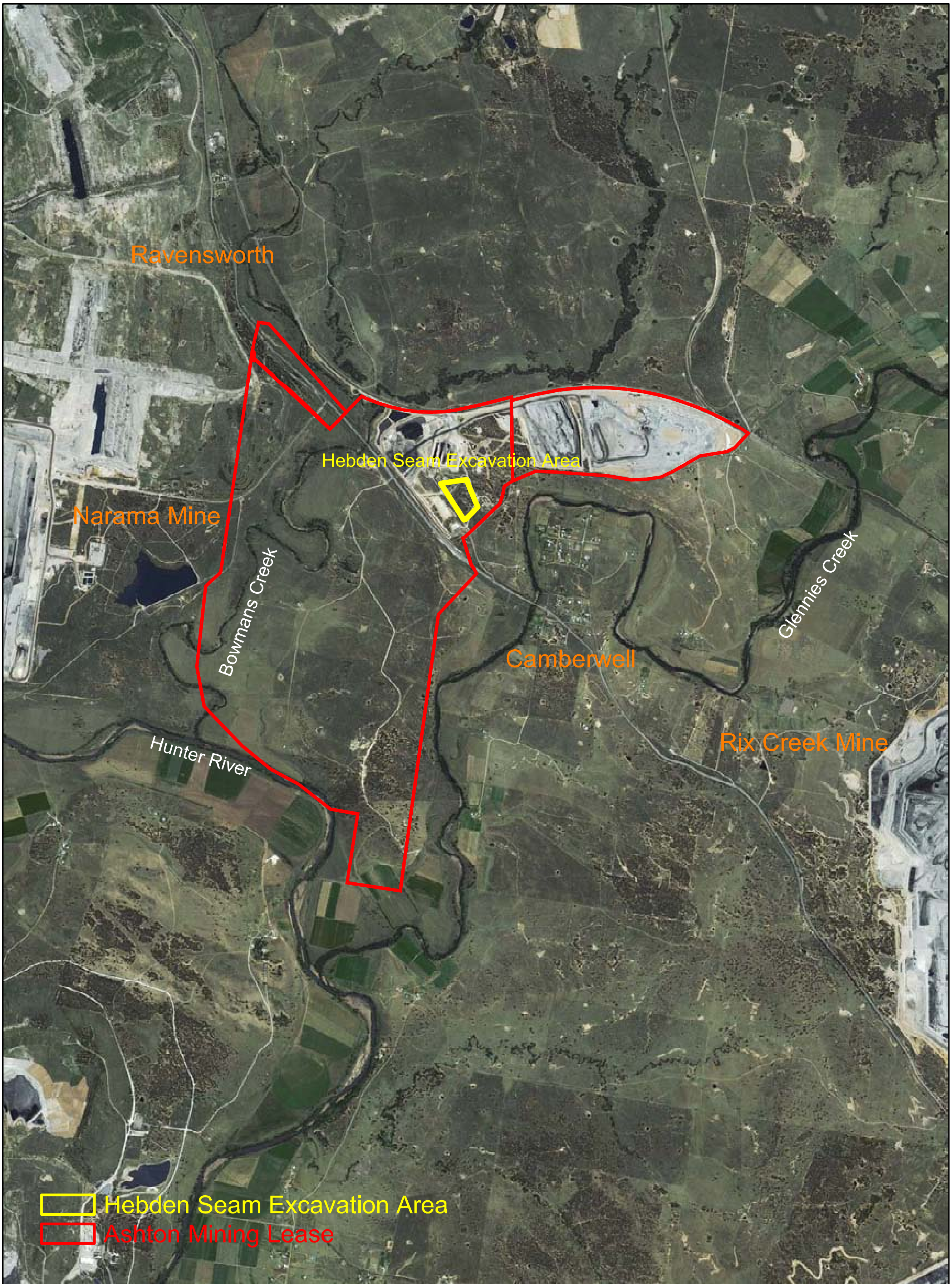

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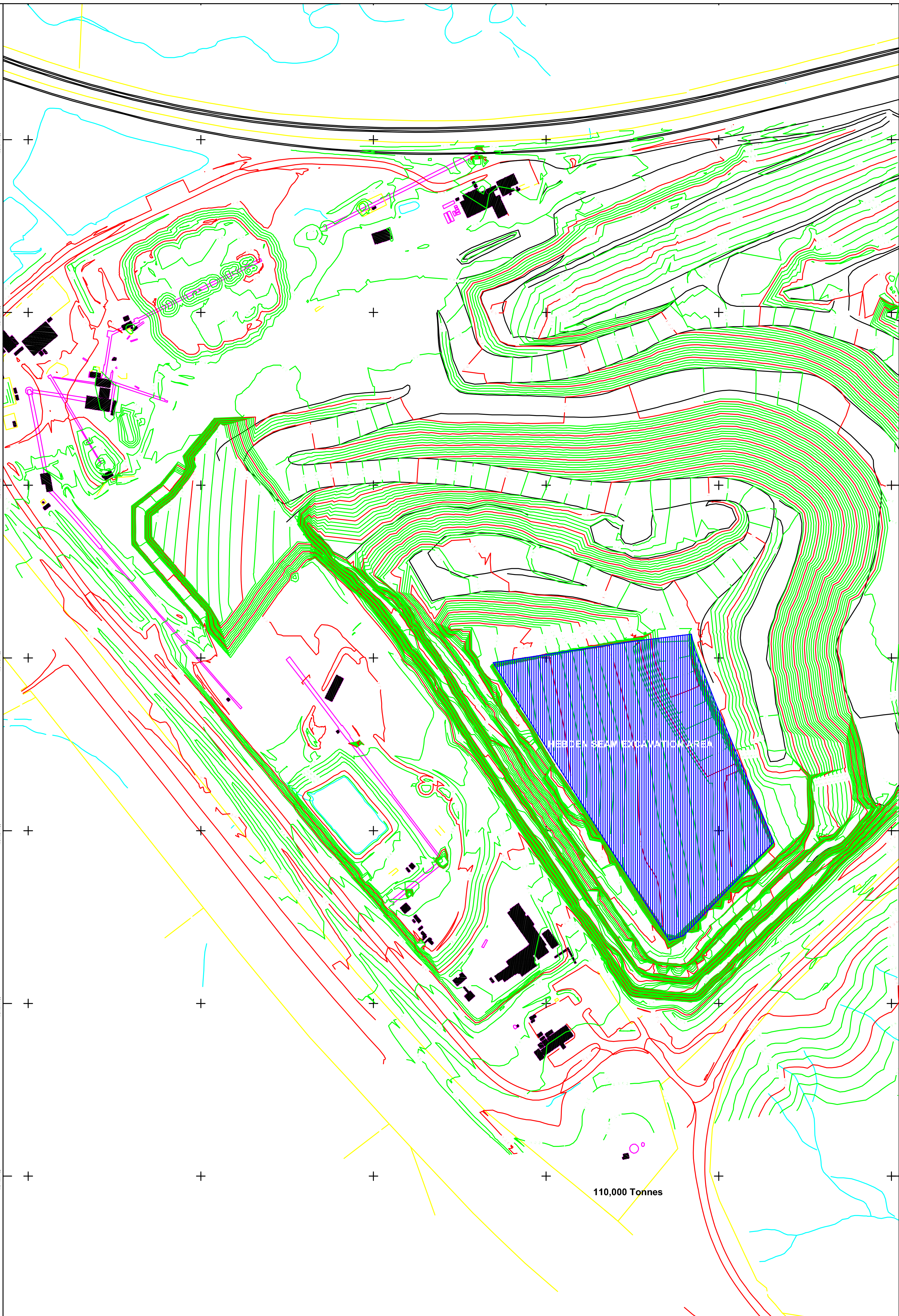

Date: 9 February 2011	Scale: as indicated	**Ashton Coal Operations Ltd**
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Drawing No: S56H-003	Rev: 0	
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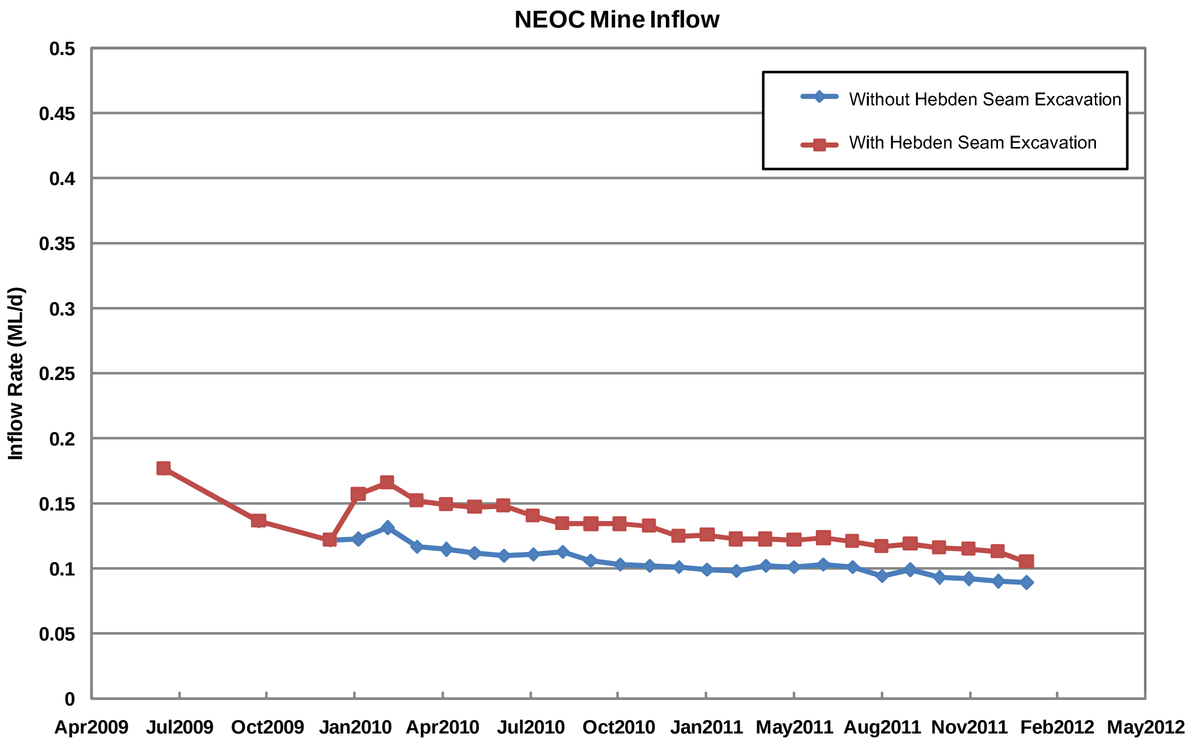

Date: 9 February 2011	Scale: as indicated	**Ashton Coal Operations Ltd**
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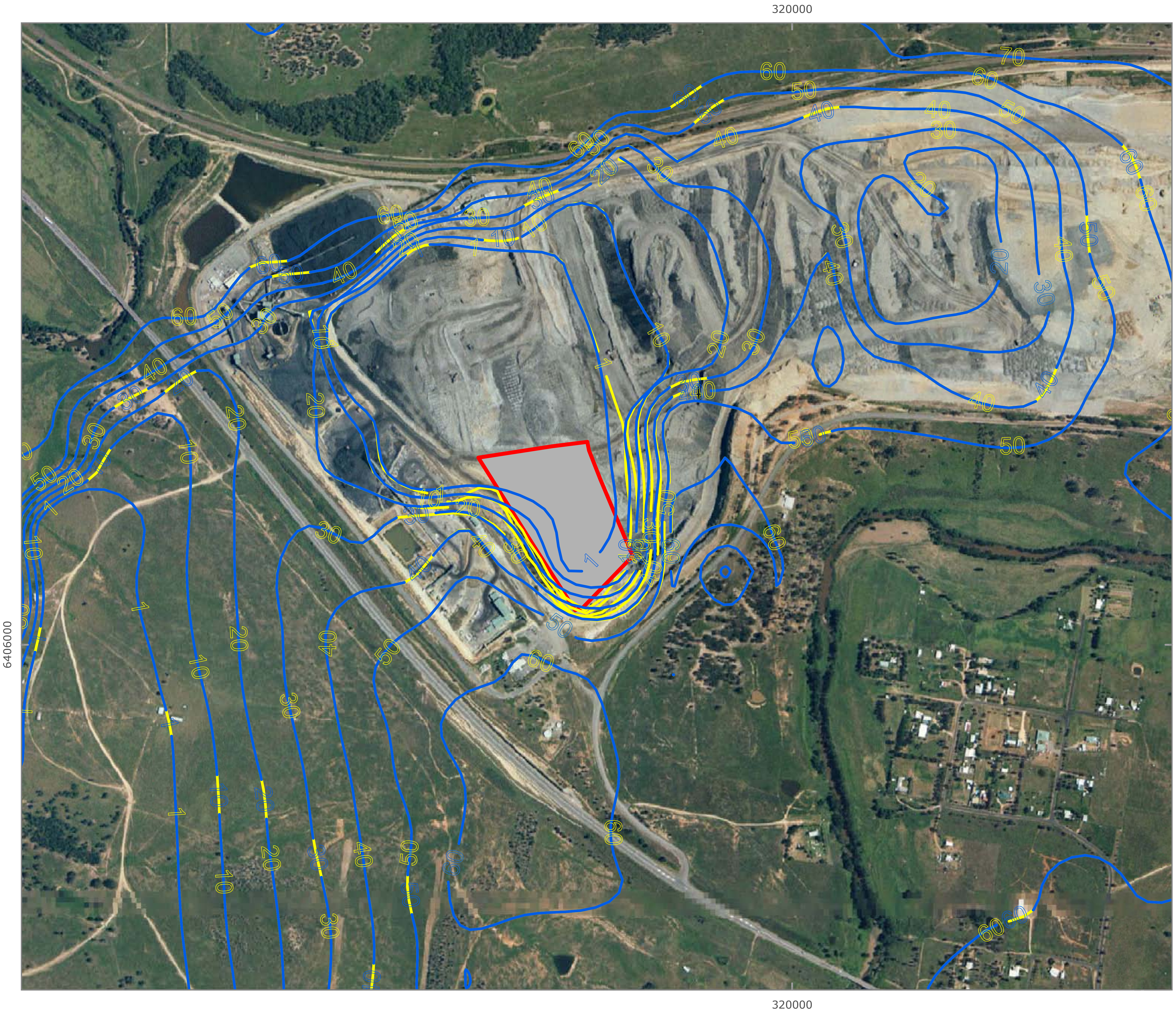
Drawing No: S56H-004	Rev: 0	
RPS Aquaterra		**Figure 3.1**



LEGEND

- Groundwater Elevation without Hebdon Seam
- Groundwater Elevation with Hebdon Seam
- Hebden Seam excavation area
- Dewatering Area

0 100 200 400 Metres

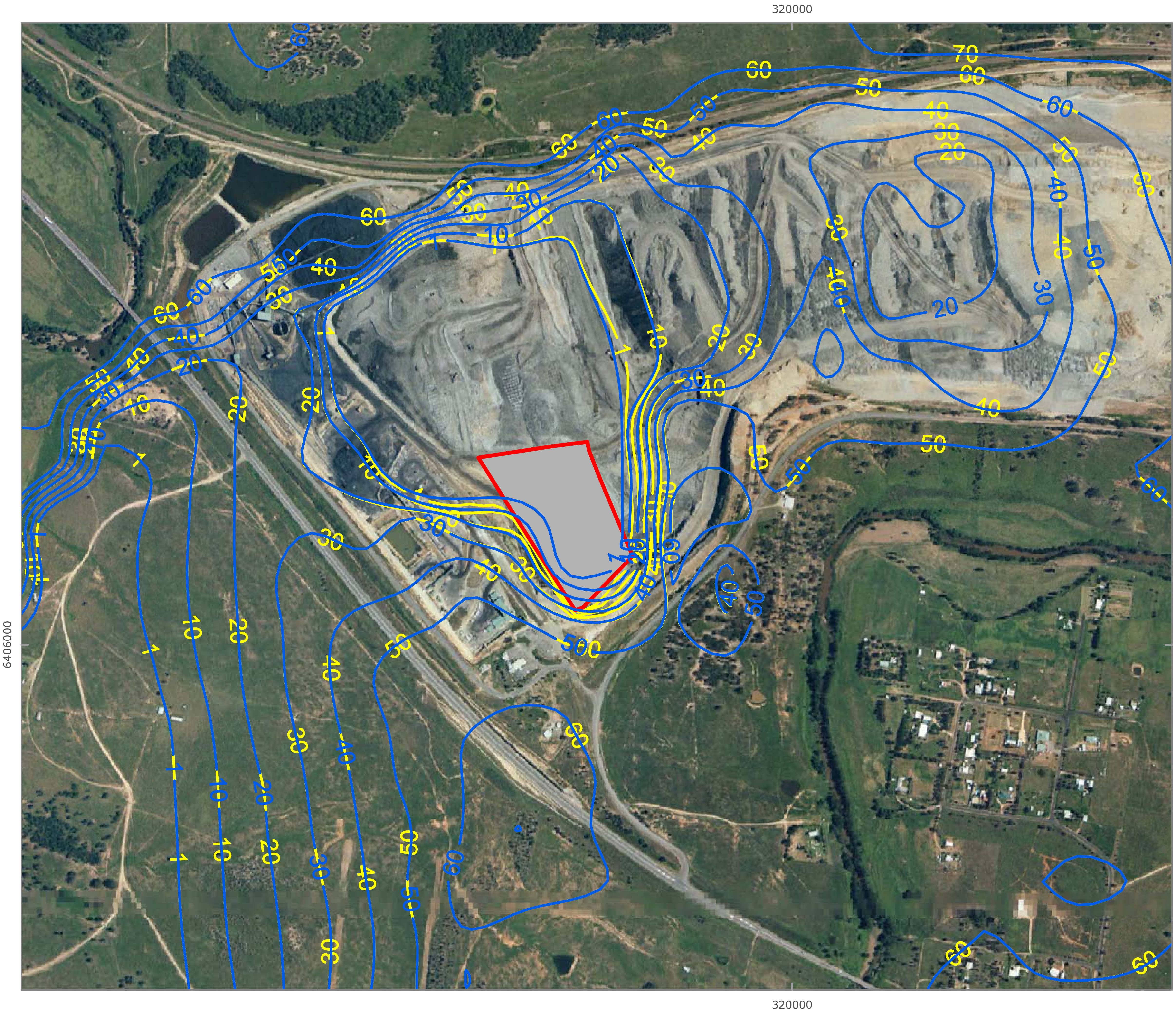
N

RPS Aquaterra

FIGURE 3.2

Predicted Regional Groundwater Elevations(mAHD) at 3 Months

AUTHOR	PZ	PROJECT NO	S56H
CHECKED BY	TL	REVISION	1
DATE	09/02/2011	DRAWING NO	008



LEGEND

- Groundwater Elevation without Hebdon Seam
- Groundwater Elevation with Hebdon Seam
- Hebden Seam excavation area
- Dewatering Area

0 100 200 400 Metres

N

RPS Aquaterra

FIGURE 3.3

Predicted Regional Groundwater Elevations(mAHD) at 12 Months

AUTHOR	PZ	PROJECT NO	S56H
CHECKED BY	TL	REVISION	1
DATE	09/02/2011	DRAWING NO	007b