APPENDIX 1

Mine Planning
Options Report

COAL ASSETS
AUSTRALIA

GLENCORE

Glendell Continued Operations Project

Mine Planning Options Report

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Executive Summary

The Glendell Mine forms part of the Mount Owen Complex located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell (refer **Figure 1**).

In addition to the Glendell Mine (Glendell Pit, also known as Barrett Pit), the Mount Owen Complex comprises mining operations at the Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit (BNP)). The Mount Owen Complex also includes a coal handling and preparation plant (CHPP) and coal handling and transport infrastructure that washes coal from all three mining operations.

The Mount Owen Complex is approved to process up to 17 million tonnes per annum (Mtpa) run of mine (ROM) coal through the CHPP with production at each of the three pits approved as follows:

- Mount Owen (North Pit) – up to 10Mtpa;
- Ravensworth East (Bayswater North Pit) – up to 4Mtpa; and
- Glendell (Glendell Pit) – up to 4.5Mtpa.

The Glendell Continued Operations Project (Project) seeks to extend the life of Glendell Mine to 2044 through the mining of 135Mt of ROM coal. The Project also proposes an increase in extraction rate over the life of the Project of up to 10Mtpa of ROM coal from the current approved 4.5Mtpa ROM.

The Project involves the continuation of the Glendell Pit to the north, the realignment of a section of Hebden Road, the diversion of a section of Yorks Creek, construction of a new mine infrastructure area (MIA) and relocation of the Ravensworth Homestead to a new recipient site.

The Project represents a brownfield continuation of the existing Glendell Pit and fits within Glencore's commitment to cap its global coal production at 150Mtpa of saleable product. The Project will occur at a time when production at Glencore's adjacent Liddell Coal Operations, and the Ravensworth East and Glendell Mines have ceased. The coal produced by the Project is 'replacement production' that will supplement Glencore's long term depleting production profile.

This report presents the key mine design options considered in development of the Project and discusses the assessment outcomes for each that have been used to inform the proposed mine plan and corresponding conceptual final landform. This report has been prepared by Glencore and forms part of an Environmental Impact Statement (EIS) to accompany an application for development consent under Division 4.1 and 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Project.

Investigations have been ongoing since 2010 and have included geological and geotechnical drilling, development and assessment of alternate mine plan and infrastructure options, consideration of alternate final landform treatments, financial evaluation of options, and consideration of environmental and social impacts.

The various mine plan and final landform options were assessed with a view of achieving a balance between optimal resource recovery and financial return, and reducing environmental and social impacts through the implementation of appropriate mitigation measures.

Technical constraints that influenced the mine plan development included:

- Location of former open cut and underground workings;
- Geotechnical and geological considerations including localised and regional geological structures (e.g. faults);
- A deposit featuring mostly thin coal seams (<2m thick); and
- The volume of recoverable coal underlying the volume of overburden (strip ratio).

The outcome of these studies was the selection of the Preferred Mine Plan that is proposed and has been assessed in the Project EIS. The Preferred Mine Plan has also been further refined throughout the impact assessment process to reduce where practicable air quality and noise impacts on sensitive receptors. A summary of the outcomes of the mine plan options assessment with regard to economic viability, technical considerations, and management of environmental and social impacts is provided in **Table 1**.

Impacts to key infrastructure elements were also assessed and considered as part of the Preferred Mine Plan development and included:

- Existing infrastructure such as the Glendell, Ravensworth East, Liddell and Mount Owen workshops and offices, Mount Owen CHPP and mining equipment;
- Impacts to Hebden Road;
- Impacts to existing watercourses including Bowmans, Yorks and Swamp Creeks; and
- Impacts to Ravensworth Homestead.

In addition to the key considerations above, the final landform and final void options investigated for the Preferred Mine Plan have had regard to:

- Surrounding constraints such as topography and land boundaries;
- Availability of material post mining for use in rehabilitation activities;
- Long term stability and safety; and
- Visual considerations.

The preferred final landform option will include a void at the northern end of the Preferred Mine Plan with filling of the approved Glendell Pit void with overburden to occur as mining progresses to the north. This will result in no change in the number of approved voids in the final landform. The majority of overburden from the Preferred Mine Plan will be emplaced in-pit (with a localised extension of the pit at Swamp Creek to assist with final landform shaping) and the landform will incorporate natural landform design elements.

The option of backfilling the proposed void to achieve a free-draining landform was assessed and was not considered practical or economically viable due to:

- The need to disturb areas of mine rehabilitation in order to access the material needed to fill the void;
- High cost associated with moving the large volume of material needed to fill the void to a free-draining surface;
- A prolongation of noise and air quality impacts well beyond the life of the mining operation; and
- Delay in final rehabilitation and mine closure in excess of 12 years.

The Preferred Mine Plan provides:

- A balanced outcome that achieves economic viability and suitable financial return whilst managing impacts through the implementation of appropriate mitigation measures;
- Continuation of an existing operation resulting in ongoing employment opportunities and economic benefits to the community and state economy, and enables the efficient use of existing infrastructure;
- An opportunity to improve upon the current approved final landform in Glendell Pit by softening traditional overburden emplacement area profiles; and
- A final void that will act as long-term groundwater sink, capturing salt and avoiding impacts on surrounding water quality.

The Preferred Mine Plan as presented and assessed in the Project EIS strikes an appropriate balance between mine planning, economic, environmental and social outcomes.

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Table 1: Summary of Mine Plan options

Option	ROM tonnes (Mt)	Approximate Mine Life (Yrs)	Royalties[1] to State of NSW ($M)	Economically Viable (Provides Financial Return)?	Technically achievable?	Reasonable and Manageable Environmental, Cultural and Social Impact?	Reasonable and Feasible Mine Plan?	Comments
Preferred Mine Plan: GCO Project	135	22	710				Yes	Preferred Mine Plan provides best balance between mine planning, economic, environmental and social outcomes
Option 1: No project	12	3	0				No	If no project then economic benefit of the project will be lost
Option 2: Maximum Resource Recovery	>150	>25	>780				No	Mining through Bowmans Creek and Liddell Underground is technically challenging. Diversion of Bowmans Creek unlikely to offset associated impacts. Also likely impacts on biodiversity and cultural heritage.
Option 3: Hunter Valley Dyke Constrained	145	25	750				No	Technical challenges associated with mining into the Liddell Underground.
Option 4: Yorks Creek Constrained	100	20	520				No	Truncated mine plan reduces ability to achieve a suitable return on capital investment.
Option 5: Swamp Creek Constrained	100	18	520				No	Truncated mine plan reduces ability to achieve a suitable return on capital investment. Potential for additional void in final landform and need for out-of-pit overburden emplacement area.
Option 6: Homestead Mine Around (within 100m)	89	18	460				No	Potential long term stability issues associated with highwall void to east of homestead. Homestead would be subjected to blast vibration and visual setting would change with void to east and dump to south
Option 7: Homestead 500m standoff (900m standoff)	57 (35)	10 (7)	290 (190)				No	Significant reduction in resource recovery and mine life making economically unviable with reduced revenue to the State.
Option 8: Underground Extraction	10	5-8	50				No	Geology and geometry not favourable for underground mining. Also significantly reduced resource recovery (approximately 7% of Preferred Mine Plan) for high capital expenditure

Legend: Key consideration met | Key consideration partially met | Key consideration not met

[1] Based on $8.20/product tonne in line with the Economic Impact Assessment (refer Ernst & Young 2019, Appendix 30), undiscounted

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1 Introduction

1.1 Background

The Glendell Mine forms part of the Mount Owen Complex (MOC) located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell (refer **Figure 1**).

In addition to the Glendell Mine (Glendell Pit, also known as Barrett Pit), the MOC comprises mining operations at the Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit (BNP)). The MOC also includes a coal handling and preparation plant (CHPP) and coal handling and transport infrastructure that washes coal from all three mining operations.

The MOC is approved to process up to 17 million tonnes per annum (Mtpa) run of mine (ROM) coal through the CHPP with production at each of the three pits approved as follows:

- Mount Owen (North Pit) – up to 10Mtpa;
- Ravensworth East (Bayswater North Pit) – up to 4Mtpa; and
- Glendell (Glendell Pit) – up to 4.5Mtpa.

The Glendell Continued Operations Project (Project) seeks to extend the life of Glendell Mine to 2044 through the mining of 135Mt of ROM coal. The Project also proposes an increase in production over the life of the Project of up to 10Mtpa of ROM coal from the current approved 4.5Mtpa ROM coal. The increase in production occurs at a time when production in Mount Owen's North Pit is decreasing (and in Bayswater North Pit has ceased) and thus the approved throughput of 17Mtpa ROM coal at the Mount Owen CHPP will not be exceeded.

Key aspects of the Project include the continuation of the Glendell Pit to the north, the realignment of a section of Hebden Road, the diversion of a section of Yorks Creek, construction of a new mine infrastructure area (MIA) and relocation of Ravensworth Homestead. The key components of the Project are summarised in **Table 2**.

The Project represents a brownfield continuation of the existing Glendell Pit and fits within Glencore's commitment to cap its global coal production at 150Mtpa saleable product. The Project will occur at a time when production at Glencore's adjacent Liddell Coal Operations, and the Ravensworth East and Glendell Mines have ceased. The coal produced by the Project is 'replacement production' that will supplement Glencore's long term depleting production profile.

Table 2: Summary of Key Project Components

Project Element	Description
Extraction limit	Overall increase in extraction rate for the Glendell Pit from current approved 4.5 Mtpa to up to 10 Mtpa. It is noted that the production rate will ramp up over the life of the Project as mining progresses further north and as approved operations at Ravensworth East and Mount Owen ramp down such that the approved processing throughput of 17Mtpa at the MOC CHPP is not exceeded.
Project life	Extension of the life of Glendell Mine to approximately 2045 – this presents an extension of approximately 22 years
Additional ROM extracted	Approximately 135 million tonnes
Mining area	Extension of open cut mining operation to the north of the existing Glendell Mine, west of the Ravensworth East Mine and south of the Liddell Mine.
Mining method	Open cut mining using excavators and trucks
Interactions with other mining operations	Continued integration with MOC in relation to coal handling and processing, water management under the GRAWTS, surface infrastructure and coal transport.
Key mine infrastructure	New MIA to be established with continued use of the MOC CHPP and associated surface infrastructure to be established post-approval Construction of a heavy vehicle access road to the new MIA
Public infrastructure relocations	Relocation of part of Hebden Road post-approval Relocation of sections of transmission lines and other service infrastructure as required for mine progression
Coal handling and processing (CHPP)	Use of existing MOC CHPP infrastructure in the current location. No change to approved CHPP throughput of up to 17 Mtpa Size and location of ROM and product stockpile areas will be unchanged from the current mine operations. Given that the current Mount Owen consent authorises the use of the CHPP and associated infrastructure to 2037 this Project will need to consider and seek approval for ongoing use of this infrastructure through to 2044.
Coal Transport	No change in product coal train movements
Equipment fleet	Use of existing and new mining fleet to reflect increase in production and length of mine extension.
Water management System	Integration with existing MOC Water Management System (WMS) and with Greater Ravensworth Area Water and Tailings Scheme (GRAWTS)
Overburden, coarse reject and tailings management	Overburden to be placed in-pit or over previous mine rehabilitation. Coarse rejects to be disposed in overburden emplacement areas in accordance with the Mount Owen Continued Operations (MOCO) project approval. Tailings disposal within existing mining voids in accordance with Mount Owen consent.
Creek Diversions	Realignment of a section of Yorks Creek in approximately 2026 Upper portion of Swamp Creek catchment diverted to Bettys Creek in final landform
Final void	Final void located to the north of approved Glendell Pit void within the Glendell Pit Extension.

Rehabilitation and final landform	Final landform to be in line with current design standards and industry practice
Workforce	Expected that there will be an overall increase in operational workforce but within the current employment levels associated with the MOC. Some short term increases in workforce associated with construction periods.
Operating hours	No change
Mine access	From the realigned Hebden Road
Ravensworth Homestead	Relocation of Ravensworth Homestead to allow access to underlying coal reserves

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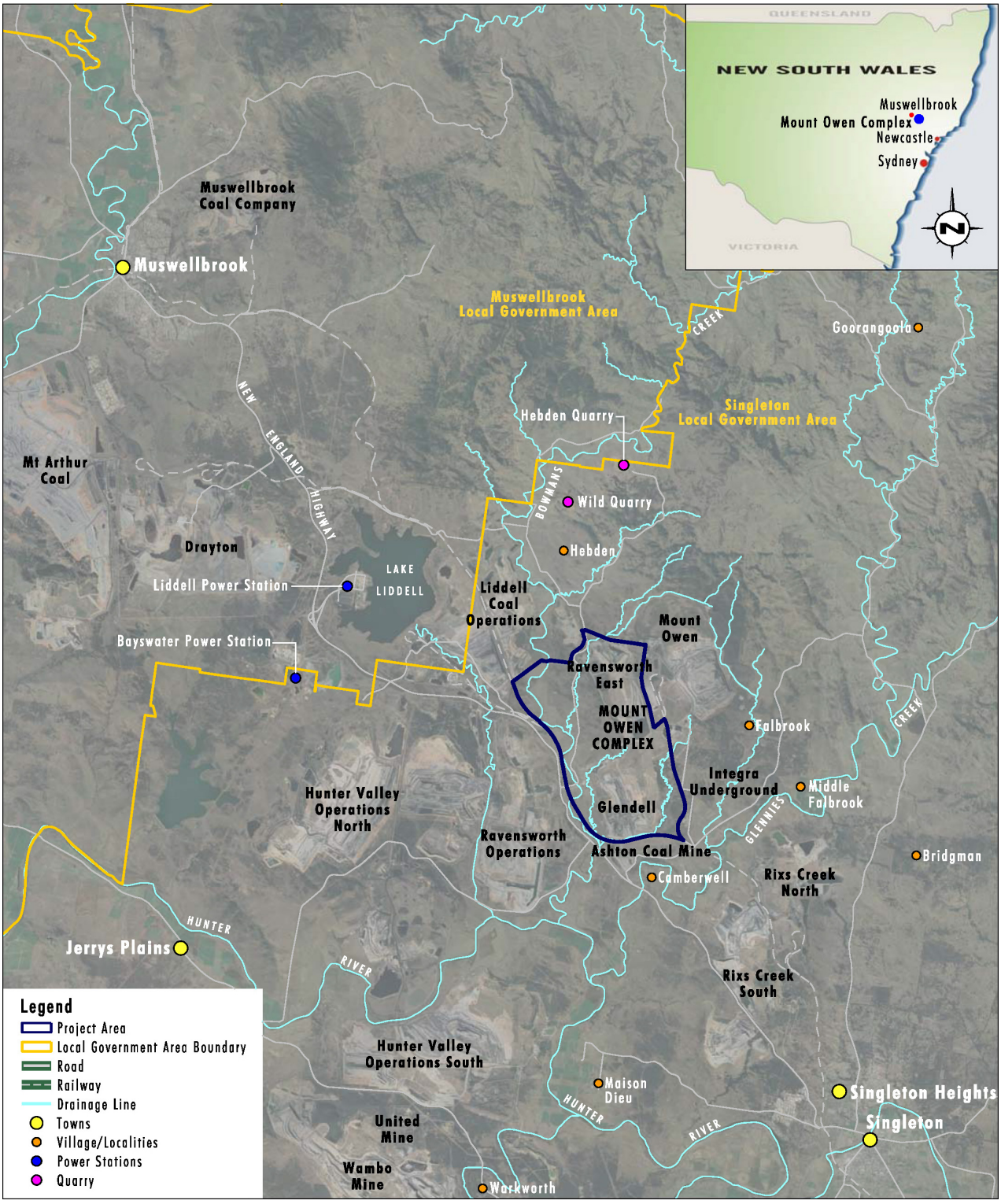

Figure 1: Regional Locality Plan

1.2 Document Structure

This report has been prepared to support the Project EIS and includes:

- An overview of the approach and key drivers for the mine design for the Project (**Section 2**)
- Assessment of mine plan options and selection of the Preferred Mine Plan (**Section 3**)
- Discussion on alternate infrastructure options considered and selection of preferred infrastructure options to suit the Preferred Mine Plan (**Section 4**)
- Final landform design overview and final void option assessment for the Preferred Mine Plan (**Section 5**)
- A conclusion and list of key references (**Section 6** and **Section 7**)

2 Mine Design Approach

This section identifies the key factors considered in mine plan development and the key aspects that have been considered in developing the conceptual final landform for the Project.

2.1 Key Mine Design Considerations

2.1.1 Preliminary Project Assessment

Glencore have a thorough internal project assessment process by which all major projects are planned and assessed. Each phase has progressive and increasing expectations on the mine planning process that requires increasing definition and refinement of the mine plan and the scope of the Project. It is in the Feasibility Phase that more detailed exploration drilling and mine planning is completed, the Project's viability is evaluated, and a comprehensive EIS is developed and submitted to the NSW Government for assessment.

The Preferred Mine Plan is based on the outcomes of deposit characterisation, constraints analysis, social and environmental impact assessment, and economic analysis. Deposit characterisation considers coal seam structure and coal quality through exploration drilling of open and cored sample holes and analysis of those holes and samples. Constraints analysis considers physical, tenure, tenement, environmental (including preliminary air quality and noise modelling) and social constraints. Economic analysis considers inputs such as the mining schedule, staffing levels, coal product quality, capital costs, operational costs, transport costs, taxes and royalties. Royalty estimates are based on $8.20 per product tonne in line with the Economic Impact Assessment (Ernst & Young 2019, Appendix 30).

In addition to the consideration of balancing the physical site constraints, environmental, social, geological, safety and legislative requirements, a key driver for the mine design is achieving a mine plan that provides a suitable return on investment for the Glencore shareholders. All of these factors have been considered in the selection and development of the Preferred Mine Plan for the Project.

The following discussion provides further information regarding some of the key mine planning drivers for the Project including mine plan alternatives considered throughout the development of the Preferred Mine Plan.

2.1.2 Geological Setting

The coal seams and overburden layers within the Project area are well known due to experience gained in mining this geology at the MOC and within the greater Ravensworth Area, and through an extensive exploration program that has occurred since 2010. The exploration program has confirmed that the seams within the Project area are consistent with those within the existing approved Glendell Mine and adjacent mining areas with some local variations in quality, thickness, depth and interval separation.

Strata and coal seams outcropping in the vicinity of the Project are Late Permian Wittingham Coal Measures with the seams of the Vane Subgroup predominantly within the Project area (Lemington to Hebden seams). The typical stratigraphy and target seams within the existing approved operations and Project area is contained in **Figure 2**.

The structural geology of the Project area is depicted in **Figure 3** and includes features such as faults, folds and dykes traversing the area. Three key regional geological features have been considered in the mine design and are:

a) Camberwell Anticline, which is centrally located within the proposed Project area, trending north-south with strata gently dipping (<20 degrees) away from the fold axis, which plunges gently to the north. A section running west-east across the anticline is contained in **Figure 4**.

b) Hunter Valley Block Fault Zone (BFZ), which occurs in the north of the Project area and is composed of a series north east striking horst and graben type normal fault structures, with typical displacements of less than 12m. The Block Fault Zone is generally 250-300m wide, and is accompanied by some minor <4m thick igneous intrusions.

c) Hunter Valley Dyke, which occurs to the north of the BFZ striking northeast, with typical intrusive thickness of up to 15m and associated cindered coal thicknesses (either side of the intrusion) of up to 15m.

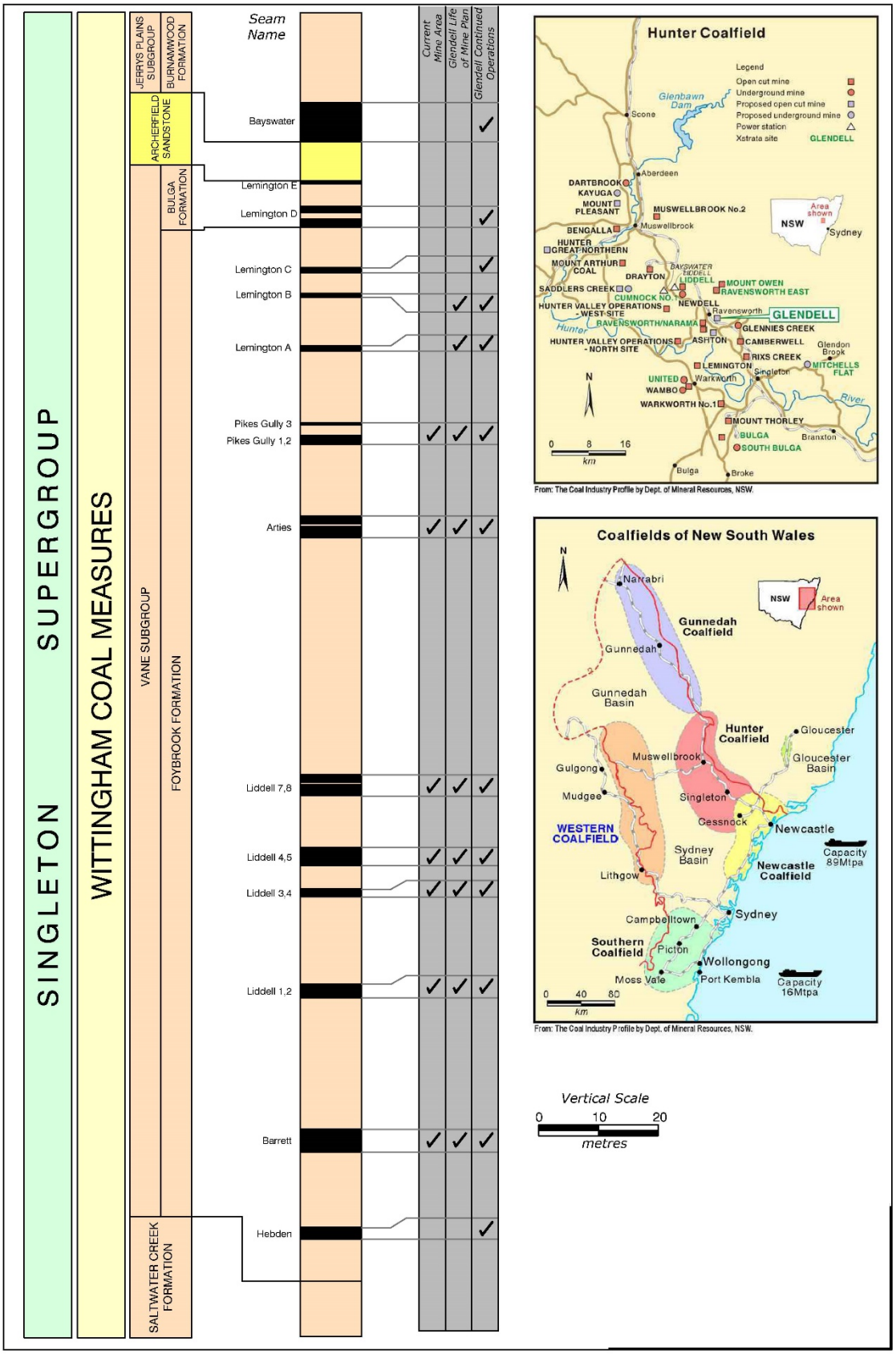

Figure 2: Typical Stratigraphic Profile

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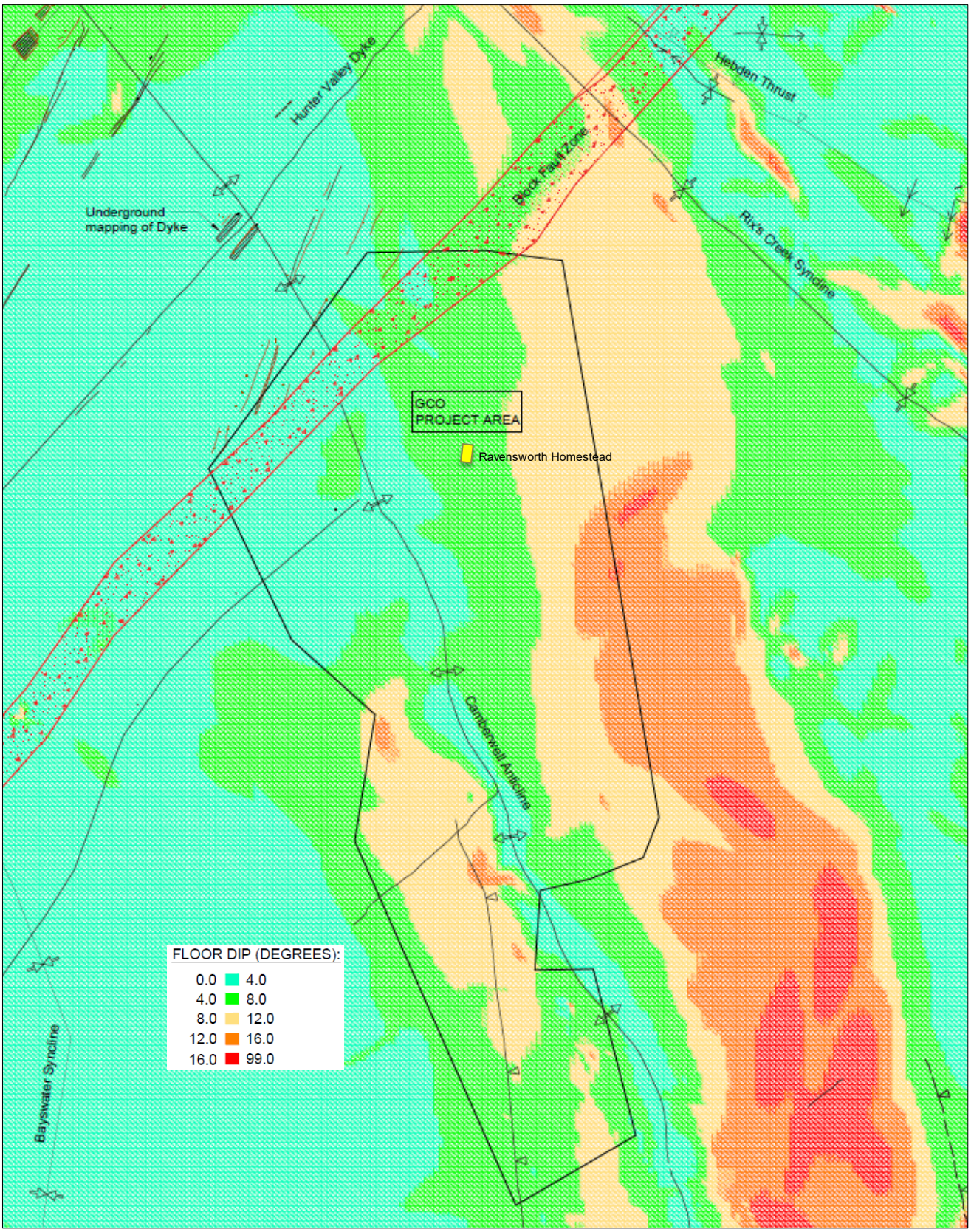

Figure 3: Regional Geological Structure and Bedding Dip

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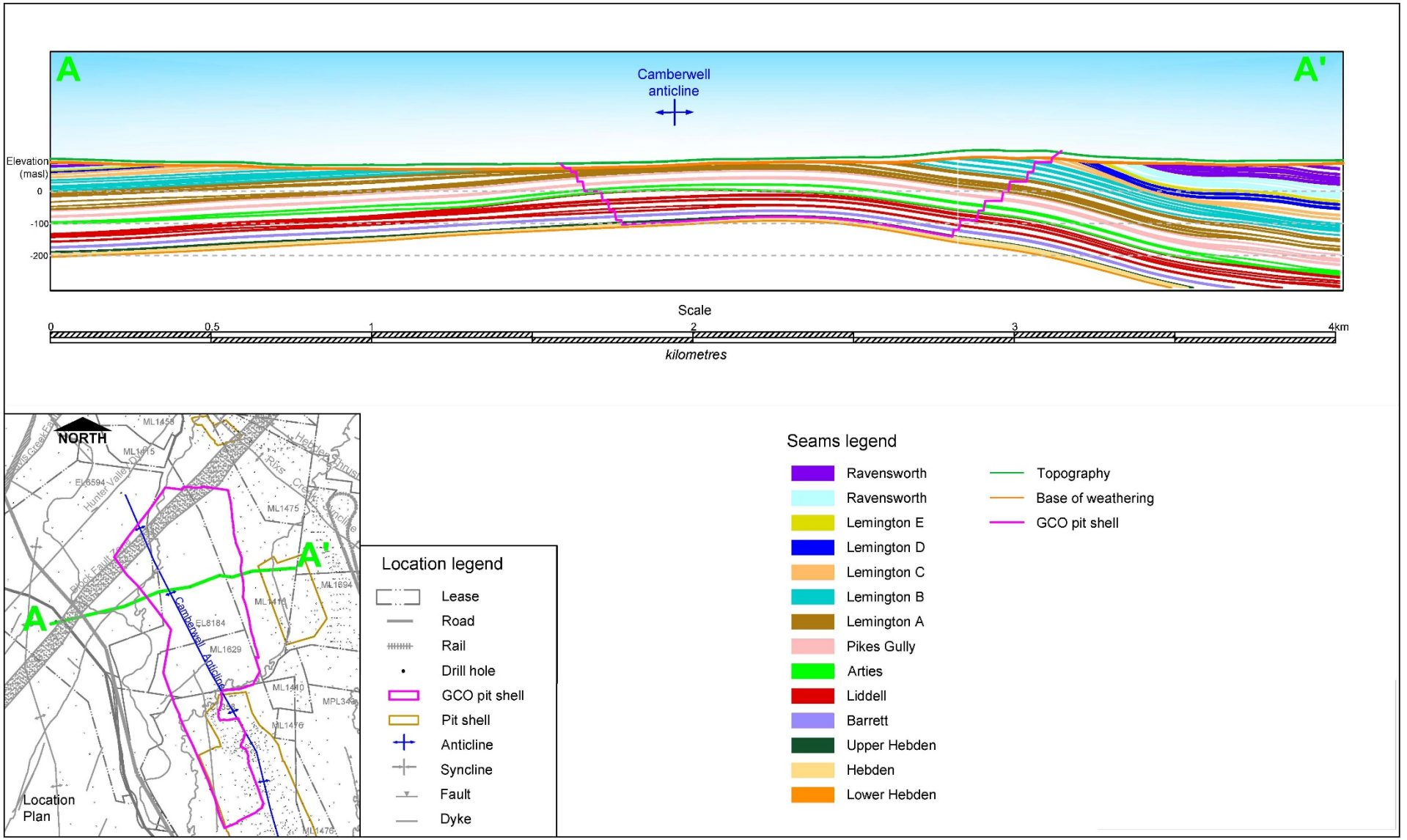

Figure 4: Cross Section West East through Project area

2.1.3 Mine Plan Considerations

The key drivers in the planning of a mine are to optimise resource recovery whilst balancing mine operation, economic, environmental and social considerations. The mine planning studies focussed on selecting the area to be mined, the seams to be mined, the mining method and the direction/progression of the mining operation. Once these key features were determined, further work was then undertaken to refine the mine plan including assessment and consideration of environmental and social constraints.

Technical aspects that required consideration during mine plan development included:

- Location of former open cut and underground workings to the east, south and north of the target area as shown in **Figure 5**;
- Geotechnical and geological considerations including interaction and influence of regional and localised geological structures discussed in section 2.2.2 and shown in **Figure 3**;
- The overall higher complexity of mining and lower efficiency of resource recovery as a result of the impact of the old Liddell underground workings on the surrounding geology in combination with the increased risk of interaction with the workings that are filled with water;
- A deposit featuring many thin coal plies and working sections of varying coal quality;
- Variations in the thickness of the different coal seams and differing thicknesses of overburden and interburden material in the area impacting run-of-mine (ROM) and product strip ratios. Strip ratios, that is the cubic metre volume of overburden required to be removed to recover a tonne of ROM or product coal, is a factor in assessing economic value. The ratio of economic coal to overburden and the product quality of the coal seams are key drivers for determination of mine floor (deepest mined seam); and
- Health, safety and legislative requirements.

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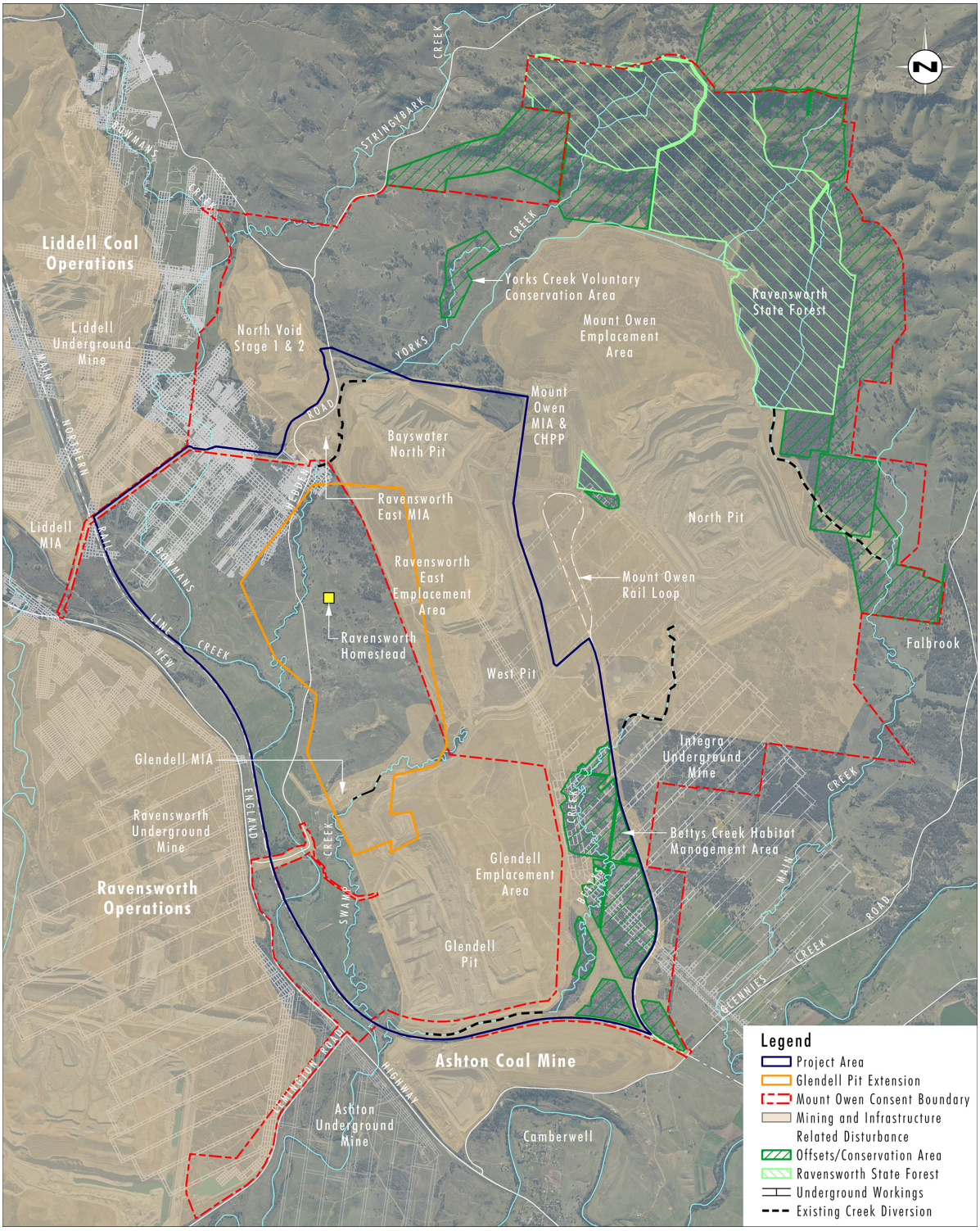

Figure 5: Key Considerations in Mine Plan Development

In addition to the technical aspects identified above, the mine plan options considered have had regard to environmental and social factors including:

- Impacts on surface water systems such as Bowmans Creek, Yorks Creek, Swamp Creek and associated alluvial aquifers, and groundwater systems including the flooded Liddell underground workings;

- Surface infrastructure such as roads, power lines, and other utilities;

- Cultural heritage impacts, both Indigenous and European;
- Current land use, ecology, and composition eg. Biodiversity, Biophysical Strategic Agricultural Land (BSAL);
- Community impacts such as noise, air quality, visual and traffic;
- Final landform and post-mining environment, including land-use considerations and voids.

Other mine planning considerations included:

- Existing mining operations including voids and overburden emplacement areas (eg, surrounding dump heights);
- The capacity of the Mount Owen CHPP and other existing infrastructure;
- The potential for utilisation of existing mining fleet in the most efficient manner both from a productivity perspective and a life cycle perspective; and
- Mobile equipment density in the mining area and optimal coal mining rates.

The above factors are taken into consideration in designing the location and sequencing of mining to enable the quality and quantity of coal extracted to be managed to meet market specifications and optimise production and operational efficiencies across the life of the Project.

2.2 Additional Mine Design Considerations

2.2.1 Viability of Underground Mining

The potential option of conducting underground mining was reviewed for the Project. Given that the current Glendell mining operation is an existing open cut operation and that the deposit characteristics of the geology within the Project area is such that it consists of many thin coal seams, the option for extraction utilising underground mining methods was not considered viable. More detail on the viability of underground mining is included in **Section 3.10**.

2.2.2 Markets and Selection of Target Seams

The targeted coal seams in the Project area are currently mined by operations in the MOC and surrounds including Liddell Coal Operations and Ravensworth Surface Operations. Exploration across the Project area and subsequent coal quality analysis indicates that the resource will output similar types of coal products as are currently being produced from the MOC. The Project ROM coal will be processed at the existing Mount Owen CHPP to produce both semi-soft coal for use in steel manufacture and thermal coal of varying quality for use in coal-fired power stations. It is anticipated that the majority of coal from the Project will be exported to Asia (Japan, Taiwan, China and South Korea).

The current Glendell mining operation mines to the floor of the Barrett seam, with the ROM strip ratio and coal quality making it uneconomic to mine deeper. However the deposit characteristics within the Project area to the north results in a decrease in the ROM strip ratio due to a thickening of the Hebden seam making it viable to mine deeper.

2.2.3 Alternative Overburden Emplacement

The majority of the mine planning options considered sought to reduce impact on undisturbed ground by focusing on overburden emplacement within the current Glendell Pit void and then within the Preferred Mine Plan void when pit progression was sufficient. However as the majority of the Project coal resource is situated in a lease held by the Liddell joint venture, CCL708, the alternative of hauling overburden to the Liddell voids was assessed for feasibility. This assessment considered:

- Haulage requirements to transport material from the Project area to the Liddell voids, which included increased haulage distance resulting in more trucks and associated ancillary equipment (bulldozers, graders, water carts), and the requirement to cross over Bowmans and Yorks Creeks. An alternative that involved the commencement of open cut mining at the northern end of the resource area and mining in a southerly direction was considered to mitigate some of these impacts, however this alternative was not considered reasonable and feasible due to the start-up costs associated with the excavation of an initial 'box-cut';

- Impact on land use and surrounding environment with increased interactions with environmentally sensitive areas such as the Bowmans Creek alluvium and associated surface water systems;

- Community impacts such as noise and air quality associated with the exposed long haul road that would link the Project area to Liddell Coal Operations (LCO);

- Delay to mine closure for LCO;

- Loss of future tailings emplacement areas identified for use under the GRAWTS;

- Impacts to final landform and post-mining environment, including land-use considerations and voids both at LCO and MOC;

- Economic viability.

Based on the above considerations, it was determined that the option of overburden emplacement in the Liddell voids was not reasonable and feasible. Out-of-pit overburden emplacement within the Project area in a number of locations was also considered, however due to resource sterilisation and limitations to the available work area this emplacement option was also deemed not reasonable and feasible.

A selection of alternative options considered for overburden emplacement, including a potential option that sterilises reserves in the north are shown in **Figure 6**. The Preferred Mine Plan involves overburden emplacement within the existing Glendell mining area with continued in-pit emplacement in the Glendell Pit Extension void as mining progresses northwards. The benefits of this overburden emplacement strategy includes:

- Efficient continuity of mining operations that is economically viable;

- Smaller area of disturbance for greater resource recovery;

- Removes the void in the existing Glendell mining area;

- Reduces the size of the final void in the Preferred Mine Plan; and

- Removes direct environmental interaction with Bowmans Creek.

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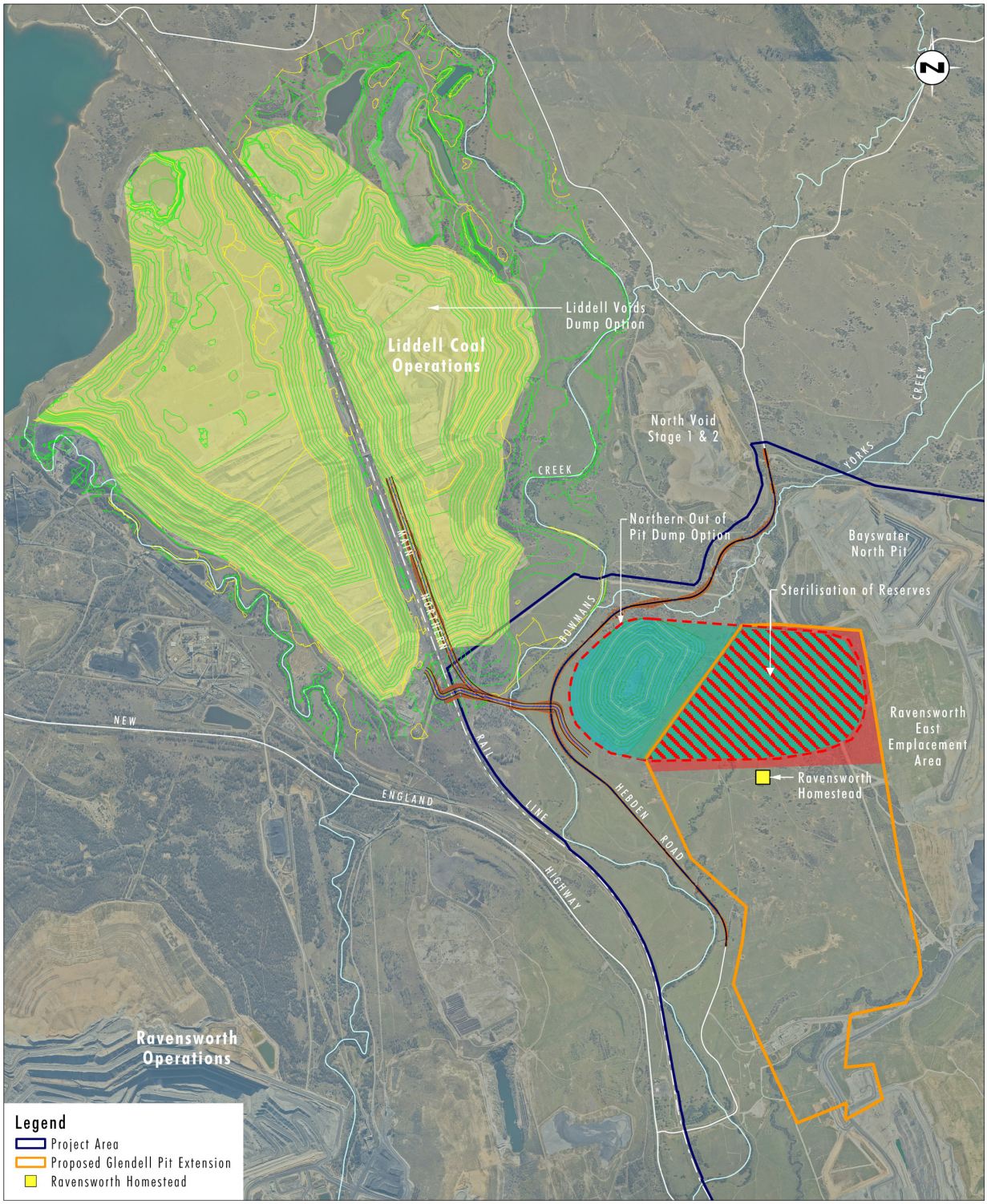

Figure 6: Alternate Overburden Emplacement - Glendell and Liddell Mining Areas

3 Mine Plan Options

The following section discusses the mine plan options investigated and assessed and the Preferred Mine Plan. For several of these mine plan options multiple sub-options were assessed.

3.1 Introduction

The Preferred Mine Plan was chosen as it provides the best balance between optimal resource recovery and financial return, and reducing environmental and social impacts through the implementation of appropriate mitigation measures. The Preferred Mine Plan has been continually optimised as further information on the resource has been gained through exploration drilling, and through the completion of environmental and infrastructure studies.

The mine plan options considered during the development of the Preferred Mine Plan were:

- No Project
- Maximise resource recovery and extend the existing Glendell Pit to LCO
- Mine into the former Liddell Underground workings
- Avoid Yorks Creek
- Avoid Swamp Creek
- Mine around/standoff the Ravensworth Homestead
- Underground extraction of target seams.

Mine plan options that were not considered reasonable and feasible early on during the mine planning phase have been developed to a concept level only and are provided in this report for comparison purposes only.

The Preferred Mine Plan and mine plan options are discussed further below. The mining footprint associated with each mine plan option and the Preferred Mine Plan is shown in **Figure 7.**

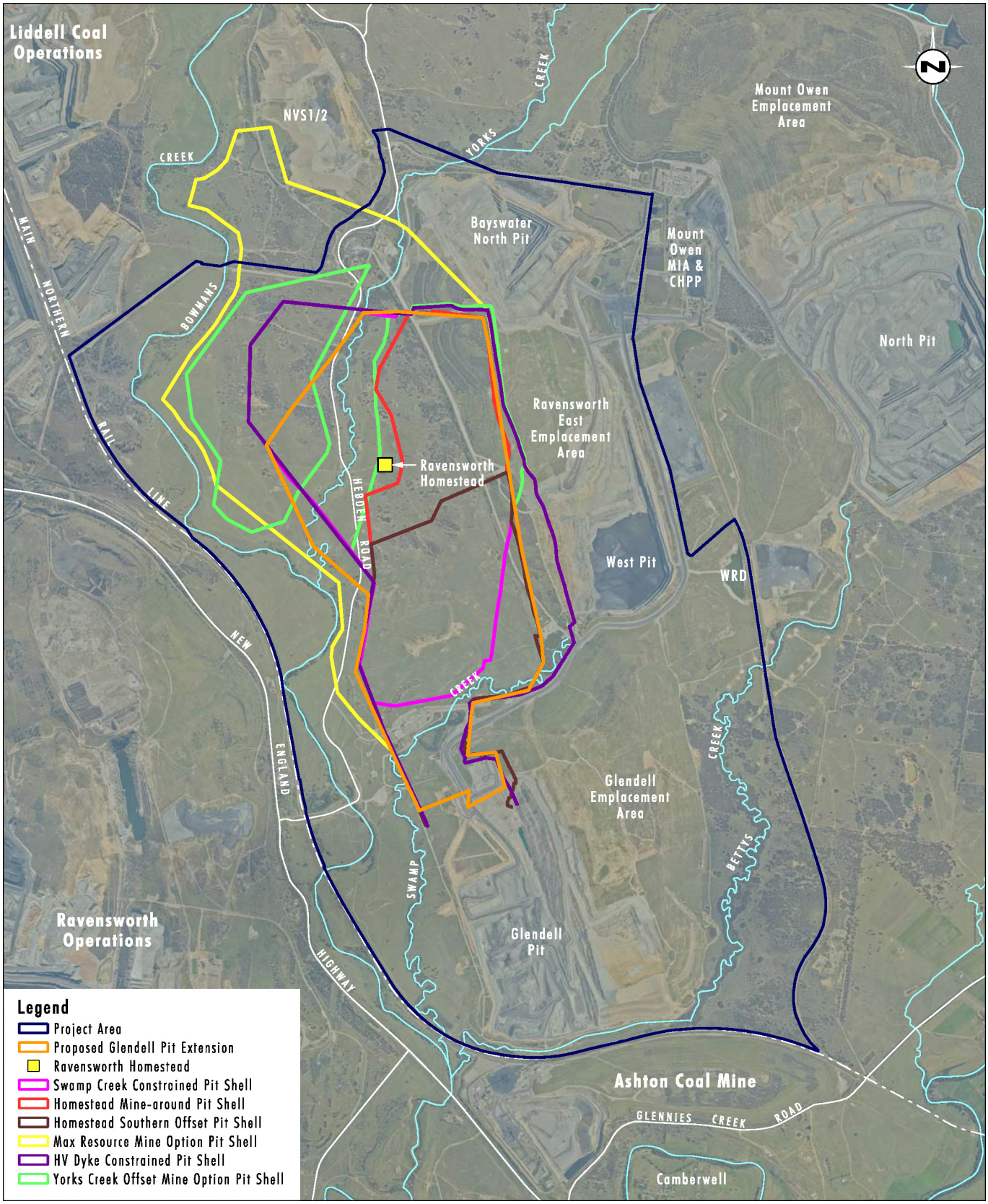

Figure 7: Preferred Mine Plan and Mine Plan Options

3.2 Preferred Mine Plan

The Preferred Mine Plan as proposed by the Project will extract approximately 135 Mt of ROM coal and extend the life of the Glendell mining operations by approximately 22 years (to 2044), providing continued employment opportunities and additional ongoing social and economic benefits. The proposed mine layout is shown in **Figure 8** and is bounded by the following constraints:

- Minimum 200m offset from Bowmans Creek high bank to the west;
- Ravensworth East former mine workings to the east and current Glendell mining operations to the south; and
- The former Liddell Underground workings to the north.

The Preferred Mine Plan will continue the progression of the Glendell Pit highwall to the north into tenements owned by Glencore and its JV partner. The proposed open cut mine continuation will mine through:

- A section of Swamp Creek that represents the headwaters of the existing creek, with the upstream catchment of Swamp Creek now part of the MOC Water Management System;
- The location of the existing Glendell MIA, requiring a new MIA to be constructed, and redesign of the Swamp Creek drainage area prior mining in the area;
- The site of the existing Ravensworth Homestead necessitating the need to record and salvage the associated archaeology before the homestead complex is relocated to a new recipient site;
- A section of Hebden Road requiring the construction of a new section of road to the west of the proposed pit footprint; and
- A section of Yorks Creek requiring the construction of a new section of creekline that will connect to Bowmans Creek to the north of the proposed pit footprint.

The northern limit of the Preferred Mine Plan is defined by the location of the Block Fault Zone and extent of the former Liddell Underground workings. The Liddell Underground workings are flooded with water, and by not mining into these workings the risk of inrush and strata failure is controlled.

Strip ratio considerations drive the depth of the pit, with mining initially progressing down to the Barrett seam (which is the basal seam in the existing Glendell Pit), then stepping down to the Hebden seam as the seam thickens further to the north. In addition to the increase in depth the pit progressively widens and these conditions contribute to overburden emplacement being required to 200mAHD, rather than the 165mAHD in the current approved operations at Glendell. Further there is no additional void created in the final landform.

The production rate for the Preferred Mine Plan peaks at 10Mtpa ROM coal as the mine widens out and as it progresses further away from receptors in Camberwell. An increase in the approved production from 4.5Mtpa to 10Mtpa ROM coal will assist in maintaining operational efficiencies and throughput at the Mount Owen CHPP. The increase in production occurs at a time when production in Mount Owen's North Pit is decreasing and thus the approved throughput at the Mount Owen CHPP will not be exceeded.

The majority of the proposed disturbance area for this project has been previously impacted by past agricultural land practices and consists of derived native grassland communities interspersed with small woodland areas along drainage lines and regrowth.

Whilst the Project will make use of the existing CHPP infrastructure at the Mount Owen mine, there is capital expenditure associated with extending the existing Glendell mine that includes new infrastructure and mining equipment.

The capital cost necessitates the development of the available coal resource within the proposed mining footprint to ensure that the Project is financially robust and sustainable, and provides an adequate return on investment to Glencore shareholders.

The Preferred Mine Plan will provide a direct economic benefit to the NSW government of approximately $963M (undiscounted, $398M in NPV terms) in the form of company tax ($167M attributable to NSW), royalties ($710M) and payroll tax ($86M).

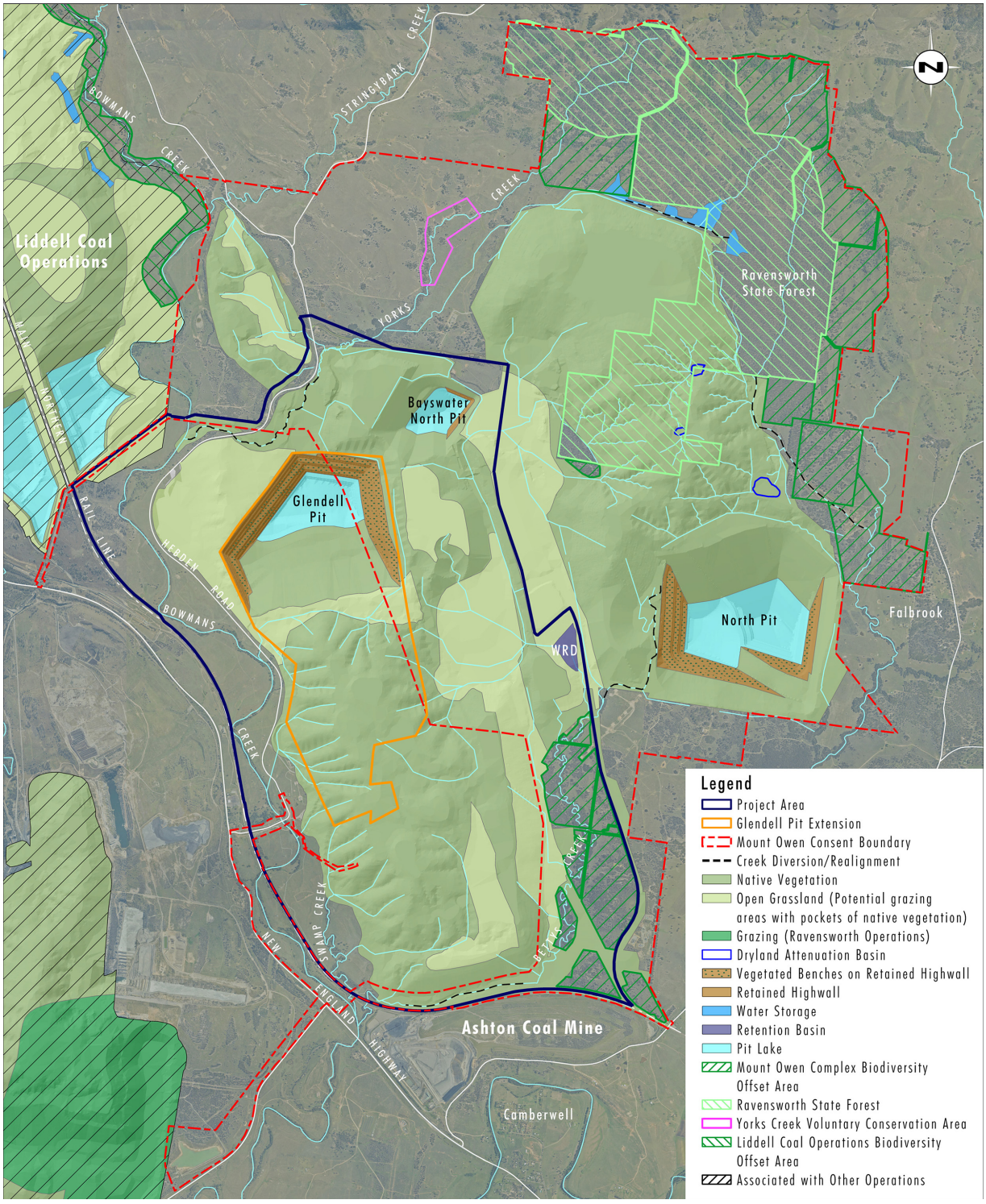

Figure 8: Project Conceptual Mine Plan

The mine plan options discussed below are not considered reasonable and feasible due to either their reduced economic benefits (to both the state of NSW and Glencore) or their potential environmental impacts or a combination of both. The Preferred Mine Plan (the Project) is considered to provide the best balance between environmental and social impacts, and associated economic benefits to the residents in the local area and state of NSW.

3.3 Option 1 - No Project (Do Nothing)

The option of not proceeding with the Project was considered. Not proceeding with the Project would mean the cessation of mining at Glendell in approximately 2023. The current approved final landform is shown in **Figure 9**.

Not progressing with the Project would have some potential benefits to the local community and environment in terms of avoiding some of the impacts from mining. If the Project does not proceed there would be no need to divert a section of Yorks Creek, relocate the Ravensworth Homestead or a section of Hebden Road. However, these potential benefits need to be balanced against the economic and social benefits of the Project.

Should the mining operation cease and the Project not be pursued, then approximately 135Mt of ROM coal will remain unmined, which will result in a loss in royalties to the State of NSW of around $710M (undiscounted). Additionally, the opportunity for ongoing employment opportunities for a workforce of up to 690 skilled, full-time, local personnel will be lost and the broader economic flow on effects through expenditure with contractors, suppliers and manufacturers who are currently equipped to supply the mining industry with goods and services will not be realised. For example, in 2017, the Glendell Mine spent approximately $120 million with 400 suppliers. This direct spend resulted in over 1,450 equivalent jobs supported and over $160 million in value added.

As a result of the lost economic benefits to both the state of NSW and Glencore, the do nothing option has not been pursued.

Mine Planning Options Report

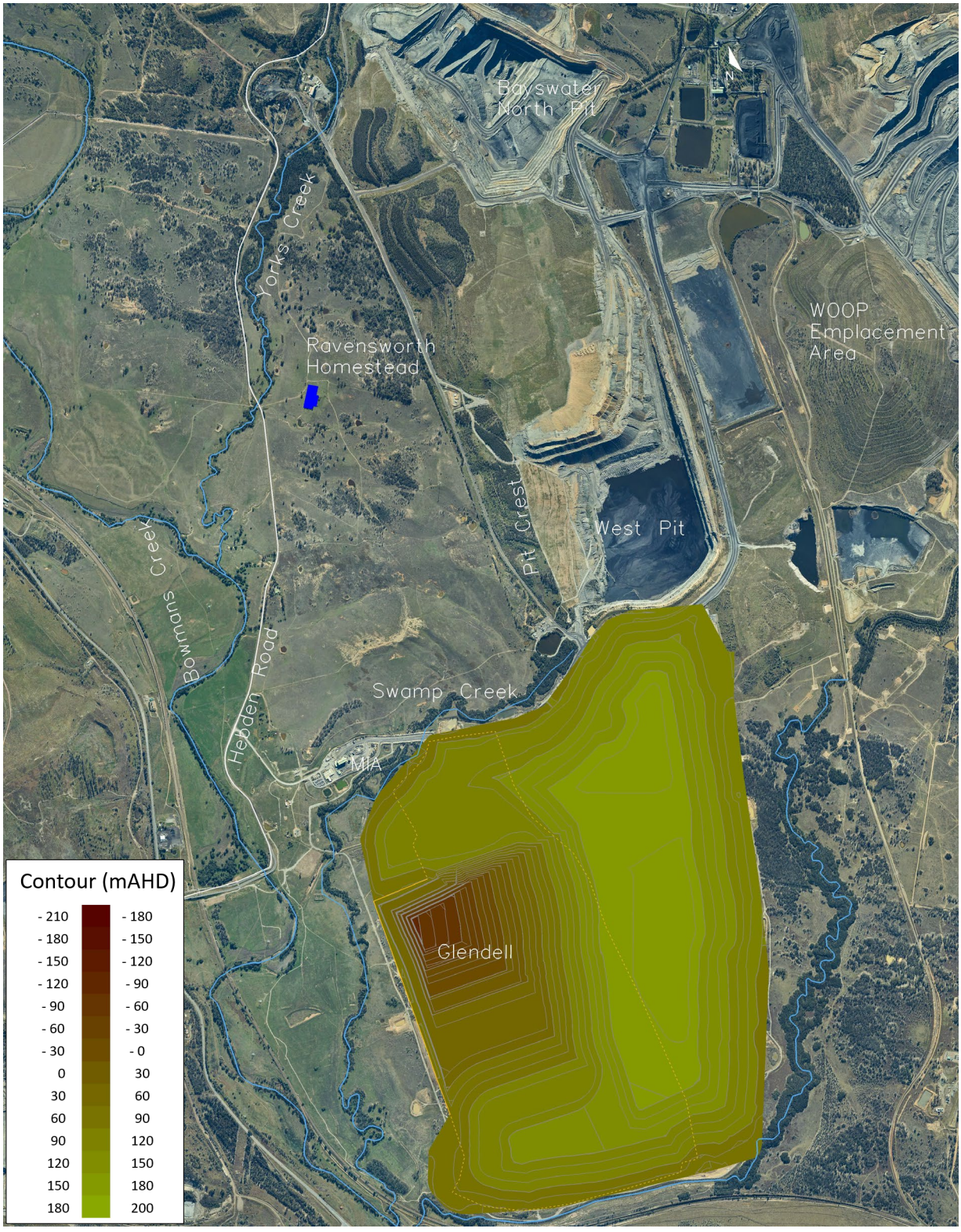

Figure 9: Current Approved Glendell Mining Area Final Landform

3.4 Option 2 – Maximise Resource Recovery

Coal reserves extend across the Ravensworth area and underlie the Main Northern Rail Line, New England Highway and Bowmans Creek. The option of extending open cut mining (through Bowmans Creek) into areas that are currently occupied by the Main Northern Rail Line and the New England Highway is not considered reasonable and feasible due to the cost and disruption impact associated with relocating this infrastructure.

The option of an extended mine footprint that linked the Preferred Mine Plan with LCO to the north-west was examined. The extension of mining beyond the Preferred Mine Plan to LCO would require mining through the former Liddell Underground workings and Bowmans Creek. This option would extend the life of mining operations in the area significantly (by potentially a further 10 years beyond the Preferred Mine Plan) whilst maintaining efficient use of the existing Mount Owen CHPP and transport infrastructure. This option requires the consideration of a number of technical and environmental factors that include:

- Technically challenging to mine through the former Liddell Underground workings due to the workings being flooded with water and the ground overlying the workings is fractured. These factors would require careful consideration and management for any future mining operation.

- Mining through Bowmans Creek would have significant impact on Bowmans Creek and its associated alluvial aquifer. The diversion of Bowmans Creek to enable open cut mining would be extremely complex and expensive with the diversion likely to be staged with its final reinstatement being over mine overburden, which would be technically challenging and result in a high level of landscape modification.

- Requirement for alternative alignments for the diversion of Hebden Road and Yorks Creek that would be sub-optimal in terms of both cost and environmental impact.

- Impact on known features of Aboriginal cultural heritage value (Bowmans Creek engraving site and scarred tree). Additionally, Bowmans Creek is considered of high cultural value to the Aboriginal community.

- Mining through additional areas of identified Biophysical Strategic Agricultural Land (BSAL)

- Lack of adequate void space in the existing Glendell Pit for overburden emplacement early in the mine life requiring overburden emplacement on previously rehabilitated overburden areas over and above that required for the Preferred Mine Plan or use of out-of-pit emplacement areas, which would increase the disturbance area and potentially sterilise coal.

Based on the above technical and environmental aspects, extension of the Preferred Mine Plan to link with LCO is not considered reasonable and feasible.

An additional maximum resource recovery option considered involved the mine being constrained by Bowmans Creek but intersecting the alluvium (see **Figure 10)**. Despite this option not requiring Bowmans Creek to be diverted the other abovementioned challenges still applied and mining beyond the Preferred Mine Plan into the Bowmans Creek alluvium and Liddell underground mine is not considered reasonable and feasible.

Mine Planning Options Report

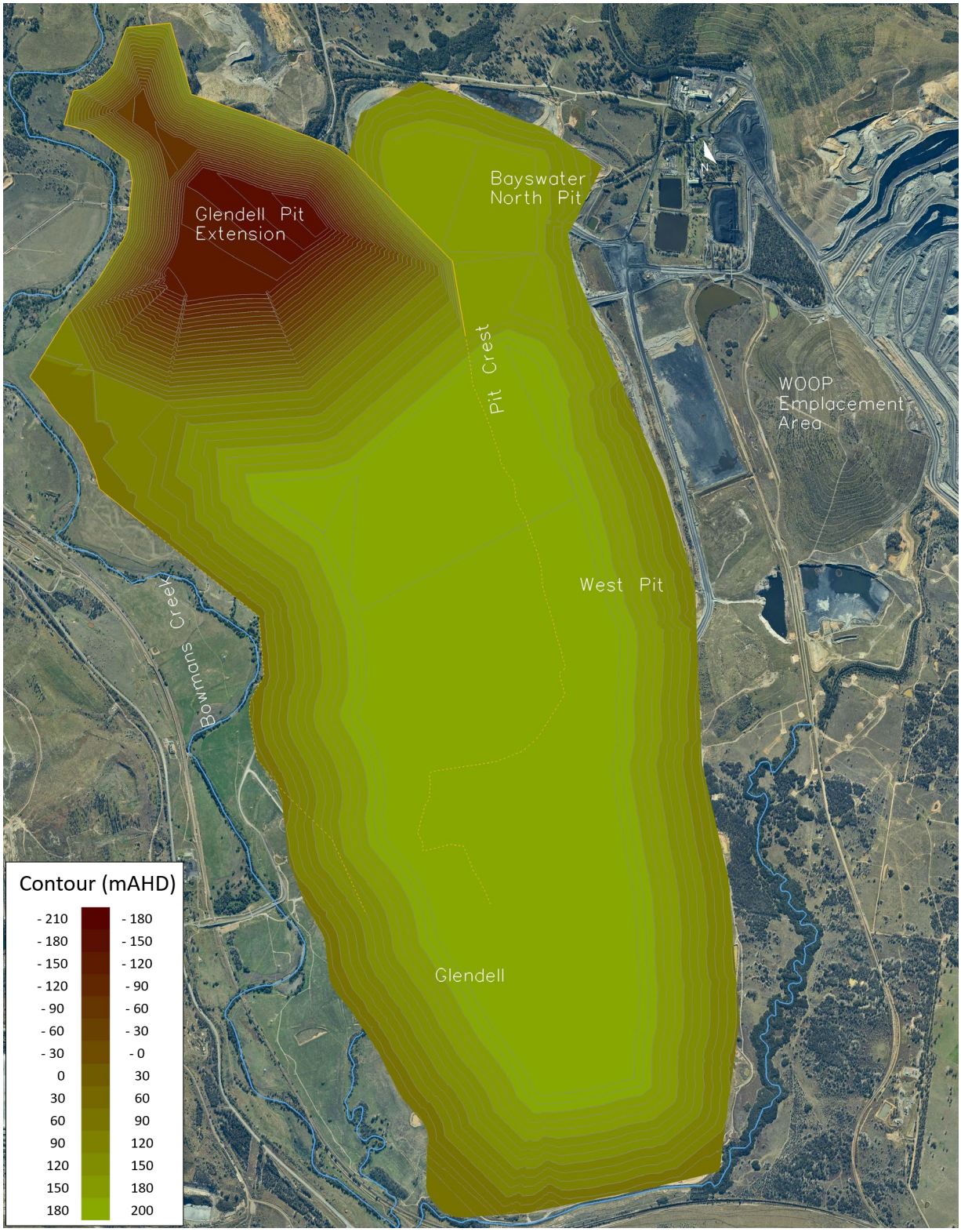

Figure 10: Bowmans Creek Constrained Max Recovery Option

3.5 Option 3 – Hunter Valley Dyke constrained

An option of extending the Preferred Mine Plan to the north up to the Hunter Valley Dyke was examined and requires mining into the southern extent of the former Liddell Underground workings. Under this option the mine layout was constrained to provide a minimum 200m offset from the high bank of Bowmans Creek to the west and the Hunter Valley Dyke at the crest to the north (refer **Figure 11**). This option allows for the extraction of additional coal resources and extends the duration of mining by a further 5 years beyond the Preferred Mine Plan with no significant impact on Bowmans Creek and associated alluvium.

One of the key considerations diminishing the feasibility of this option is the technically challenging mining conditions (similar to Option 2) associated with mining into the Liddell Underground workings. Mining into the Liddell Underground workings would require significant management of water and water pressure from the flooded workings to mitigate inrush and strata failure risks.

Constraining the mine layout at the dyke is part of the risk mitigation consideration for this option as there are limited headings through the dyke that present an opportunity to seal and dewater the workings to the south; however, the ability to successfully seal and dewater the workings for the purpose of open cut mining in this area is unknown.

As a result of the uncertainty associated with being able to successfully seal the underground workings to enable future open cut mining, the control of inrush and strata failure risk was not deemed acceptable and the option of mining through the Liddell Underground mine up to the Hunter Valle Dyke is not considered reasonable and feasible.

Mine Planning Options Report

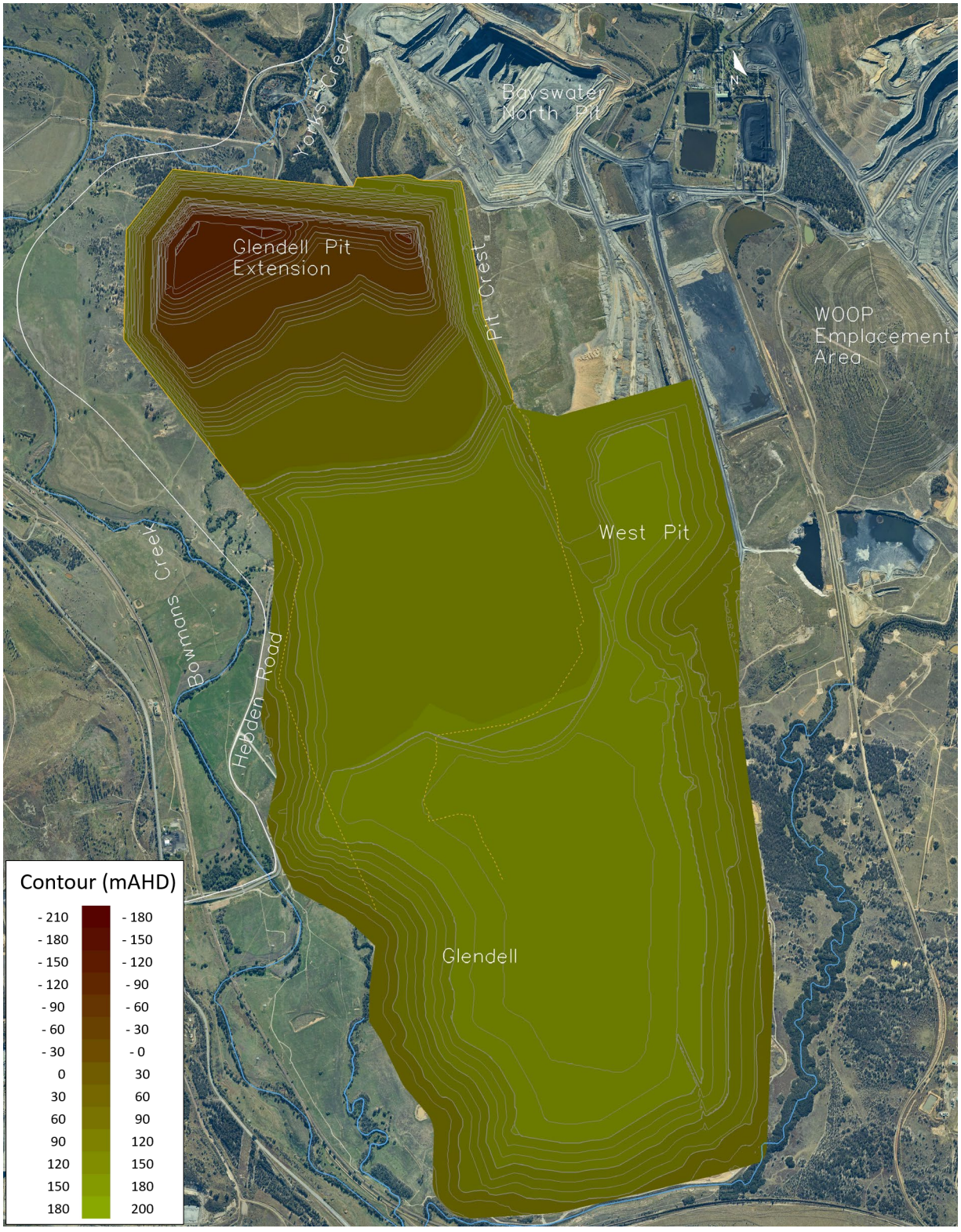

Figure 11: Hunter Valley Dyke/Liddell UG constrained option

3.6 Option 4 – Yorks Creek constrained

Avoiding mining through Yorks Creek was considered as a mine plan alternative to avoid direct impacts on Yorks Creek and associated alluvium and to limit impact on Hebden Road. By not mining through Yorks Creek it negates the need to construct a creek diversion. A range of different mine plan layouts were considered whilst retaining the existing Yorks Creek alignment, including mining up to a southern offset from the creek only, and also the mining of a satellite pit on the northern side of the creek between Yorks and Bowmans Creeks into the former Liddell Underground workings as shown in **Figure 12**.

The truncation of the mine plan to standoff Yorks Creek results in the loss of approximately 35Mt of ROM coal when compared to the Preferred Mine Plan. This equates to a reduction in mine life of 7 years (at an assumed average production of 5Mtpa) and a loss in royalties to the state of NSW of approximately $180M (undiscounted) when compared to the Preferred Mine Plan. Further, this option requires a substantial outlay in capital for the purchase of mining equipment, construction of a new MIA and relocation of the Ravensworth Homestead. Under a truncated mine plan, the reduced mine life and profitability results in this option being a less desirable investment choice for Glencore to pursue.

In order to recover some of the coal sterilised by stopping short of mining through Yorks Creek, the option of opening a satellite pit over the former Liddell Underground mine, between Yorks and Bowmans Creeks, was investigated. For the reasons mentioned above in Options 2 and 3, mining into the Liddell Underground workings is considered technically challenging. Additionally, the mining of a satellite pit would:

- require the construction of haul roads and bridge crossings over existing Hebden Road and Yorks Creek for the haulage of overburden for emplacement within the extended Glendell Pit and coal to the Mount Owen CHPP; and
- introduce an additional void into the final landform.

The extent of resource sterilisation and inability to achieve a suitable return on capital investment as a result of a truncated mine plan coupled with the technical challenges of mining into the Liddell Underground mine make the option of stopping short of Yorks Creek (with a potential satellite pit between Yorks and Bowmans Creek) not reasonable and feasible.

Mine Planning Options Report

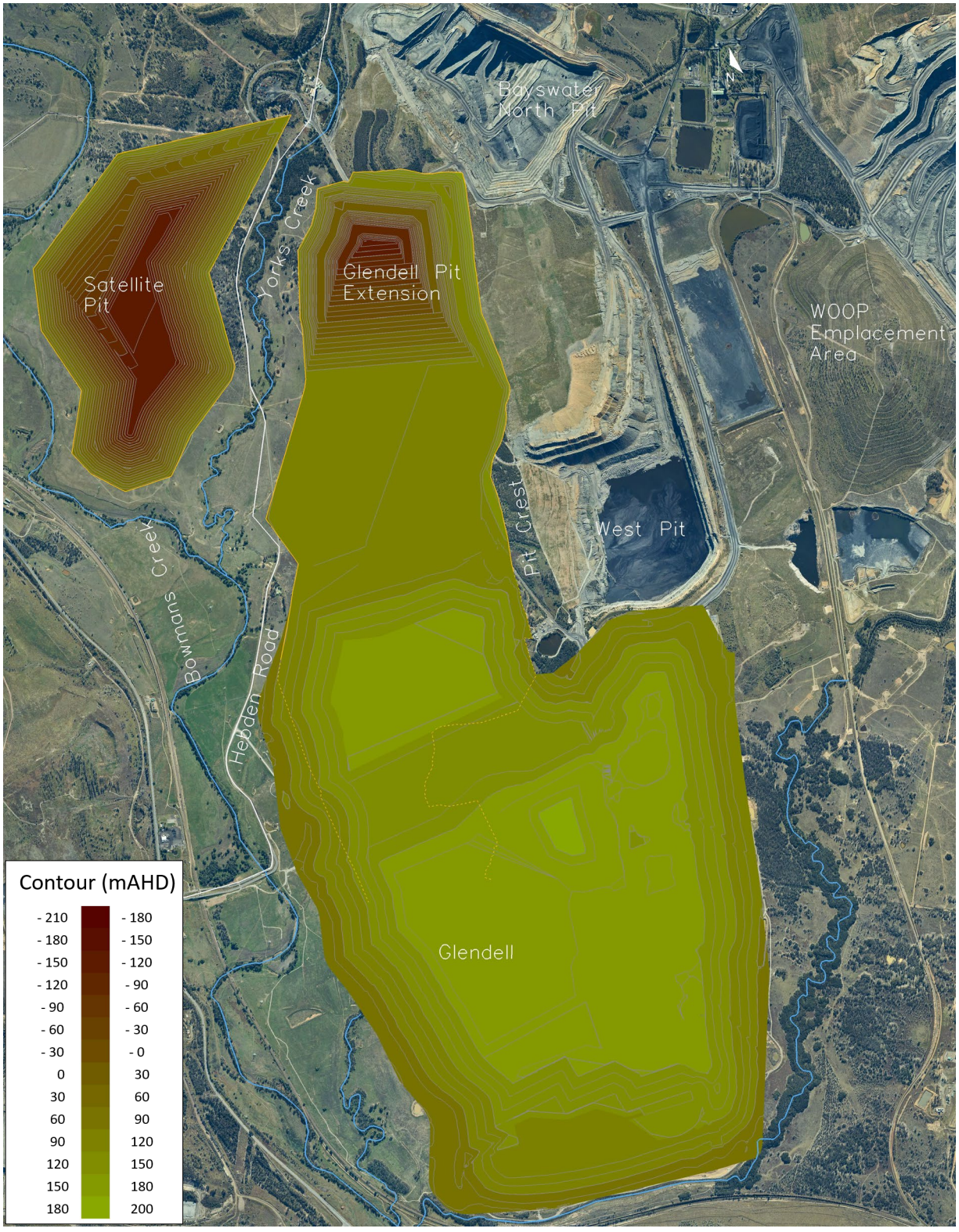

Figure 12: Yorks Creek Constrained Mine Layout option

3.7 Option 5 – Swamp Creek constrained

The option of starting a new open cut mine immediately north of Swamp Creek and the existing Glendell MIA was also considered. The advantage of this option is that it retains the existing Swamp Creek alignment and associated alluvium as well as the current Glendell MIA, which are proposed to be mined through under the Preferred Mine Plan.

The mine layout for this option was constrained by a minimum 200m offset from the high bank of Bowmans Creek to the west similar to the Preferred Mine Plan. However, various northern limitations were considered for this option including standing off Yorks Creek, the Hunter Valley Dyke, and former Liddell Underground workings. Stopping the mine short of Yorks Creek is not considered viable due to the associated loss of resources. Further, mining into the Liddell Underground workings and standing off the Hunter Valley Dyke is considered technically challenging and not ideal. For this reason a northern mining limit similar to the Preferred Mine Plan that stands off the Liddell Underground workings is considered less risky (refer **Figure 13**).

The commencement of a new open cut mine immediately north of the existing Glendell MIA and Swamp Creek presents a number of challenges. Firstly, the startup costs are extremely high due to a high initial strip ratio as it takes time to develop the mine to its full depth and reach steady state production, which subsequently impacts coal flow and the economic viability of the operation. Secondly, overburden from the new open cut mine would need to be hauled long distances to either the existing Glendell Pit void or Liddell voids (which are considered too far away) and this has an associated cost implication. In addition, these longer hauls require the purchase of additional mining equipment in order to maintain productivity. The cost implication of longer hauls and additional capital expenditure on mining equipment significantly impacts the economic viability of this option. Finally, this option sterilises approximately 35Mt of ROM coal between the existing Glendell Pit and the new open cut mine through the retention of Swamp Creek and the existing Glendell MIA.

Similar to Option 4, the loss of 35Mt of ROM coal results in a loss in royalties to the state of NSW of approximately $180M (undiscounted) when compared to the Preferred Mine Plan. Also, the loss of reserves, high upfront costs to establish the initial box cut and considerable capital investment required for this option means that a suitable return on investment would not be achieved for Glencore shareholders. For these reasons the option of commencing a new open cut mine immediately to the north of Swamp Creek and the existing Glendell MIA is not considered reasonable and feasible.

Mine Planning Options Report

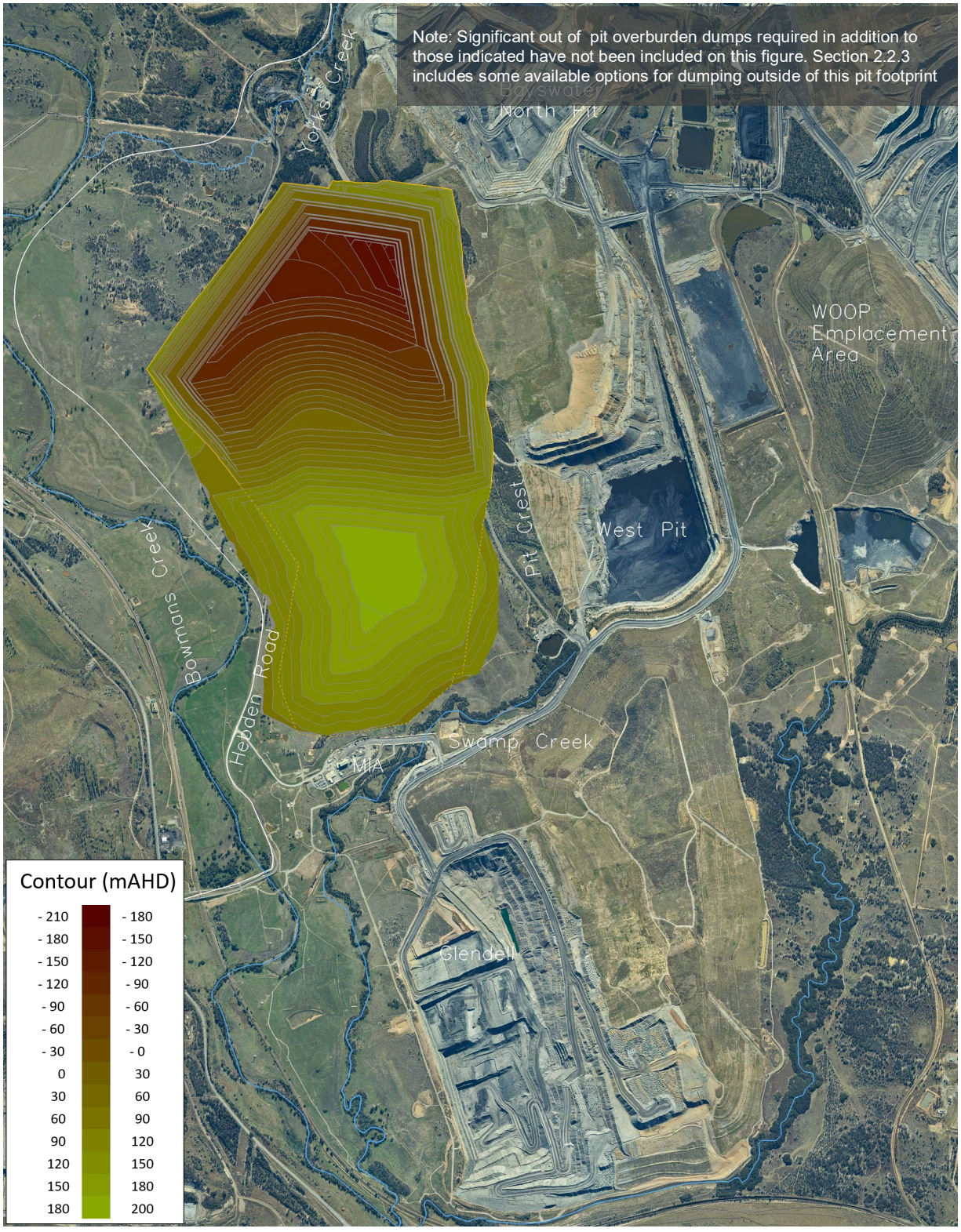

Figure 13: Swamp Creek Constrained Mine Layout Option

3.8 Option 6 – Mine Around Ravensworth Homestead to Within 100m

Mining around the Ravensworth Homestead to within 100m of the buildings was assessed for feasibility. For this option, the pit footprint was also designed to avoid Hebden Road and standoff Yorks Creek (refer **Figure 15**). Leaving the homestead in place and mining around it results in the sterilisation of approximately 46Mt of ROM coal compared to the Preferred Mine Plan. This equates to a loss in revenue to the state of NSW in the form of royalties in the order of $250M (undiscounted). Further, the loss of reserves and truncated mine life associated with this option means that it is difficult to achieve a suitable return on capital investment.

In addition to the financial impacts of this option, retention of the homestead insitu and mining around it to within 100m requires consideration of:

- The impacts of blast vibration on the buildings;
- The longterm stability of the open cut highwall to the east and its potential interaction with the homestead buildings;
- The visual catchment and outlook from the homestead post-mining;
- The constraints on the mining operation; and
- Accessibility to and usage of the homestead both during mining and post-mining.

To operate within 100m of the homestead a 30mm/s ground vibration limit has been adopted (though it is noted that the current blast vibration limit for the homestead for the Glendell mine is 5mm/s) with drill and blast practices significantly constrained in the vicinity of the homestead. Managing the blast vibration to 30mm/s would have a large cost implication and impact the viability of the mining operation as it would have to significantly vary its drill and blast practices to include a larger number of smaller blasts, with varying diameter drill holes and bench heights. Leaving the building group in-situ will also subject it to blast vibration (with the buildings most likely requiring some form of bracing), which overtime will lead to its gradual deterioration. Additionally, the building group would be at risk from fly rock impacts.

In regard to the longterm stability of the open cut highwall, the homestead is situated to the east of the Camberwell anticline hinge, a major geological feature that runs north-south along the proposed mining area. Mining around the homestead and leaving it sitting on a pillar of coal and rock will present highwall stability issues due to the wall being down-dip of the anticline. The dipping of the wall back into the pit coupled with increased vibration from blasting has the potential to result in wall failure and loss of the homestead into the pit. A stability analysis was completed on this and is shown in **Figure 14**.

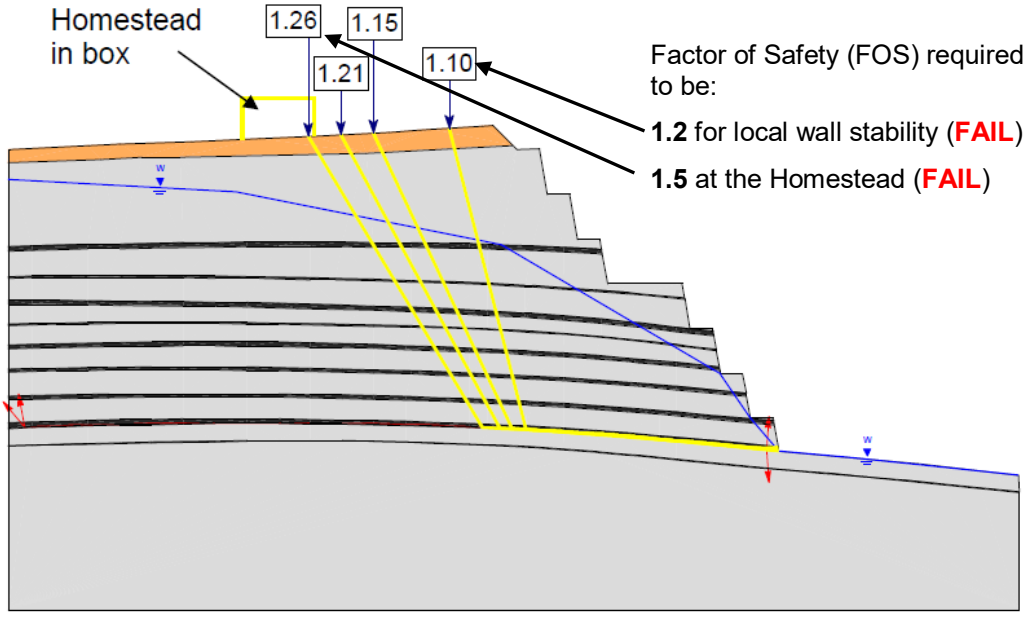

Figure 14: Slope Stability Analysis at Homestead Location

Mining to within 100m of the homestead will also significantly change the homestead's outlook and visual catchment resulting in the loss of contextual relevance to its original heritage landscape setting. At the conclusion of mining, the visual catchment immediately to the south of the homestead if it were to remain in situ would be dominated by an artificial hill approximately 100m above natural surface and a mine void with its floor located approximately 200m below natural surface situated to the east and north-east of the homestead. A conceptual final landform design is shown in **Figure 15**.

Mining around the homestead will result in narrower and steeper in-pit working areas, and restricted mining rates due to mobile equipment density. Design changes such as not mining as deep where the pit narrows, and refining the eastern limit to reduce the overall strip ratio through this area have also been considered, noting that these options result in a further reduction in reserves recovered.

Finally, if left insitu the homestead would remain isolated and inaccessible while mining and rehabilitation activities are being undertaken.

Given the economic (sterilisation of coal reserves) and financial impacts, the potential blast vibration impacts, change in visual catchment and setting, and isolation and inaccessibility of the homestead, the option of leaving the homestead insitu and mining around it to within 100m is not considered reasonable and feasible.

Mine Planning Options Report

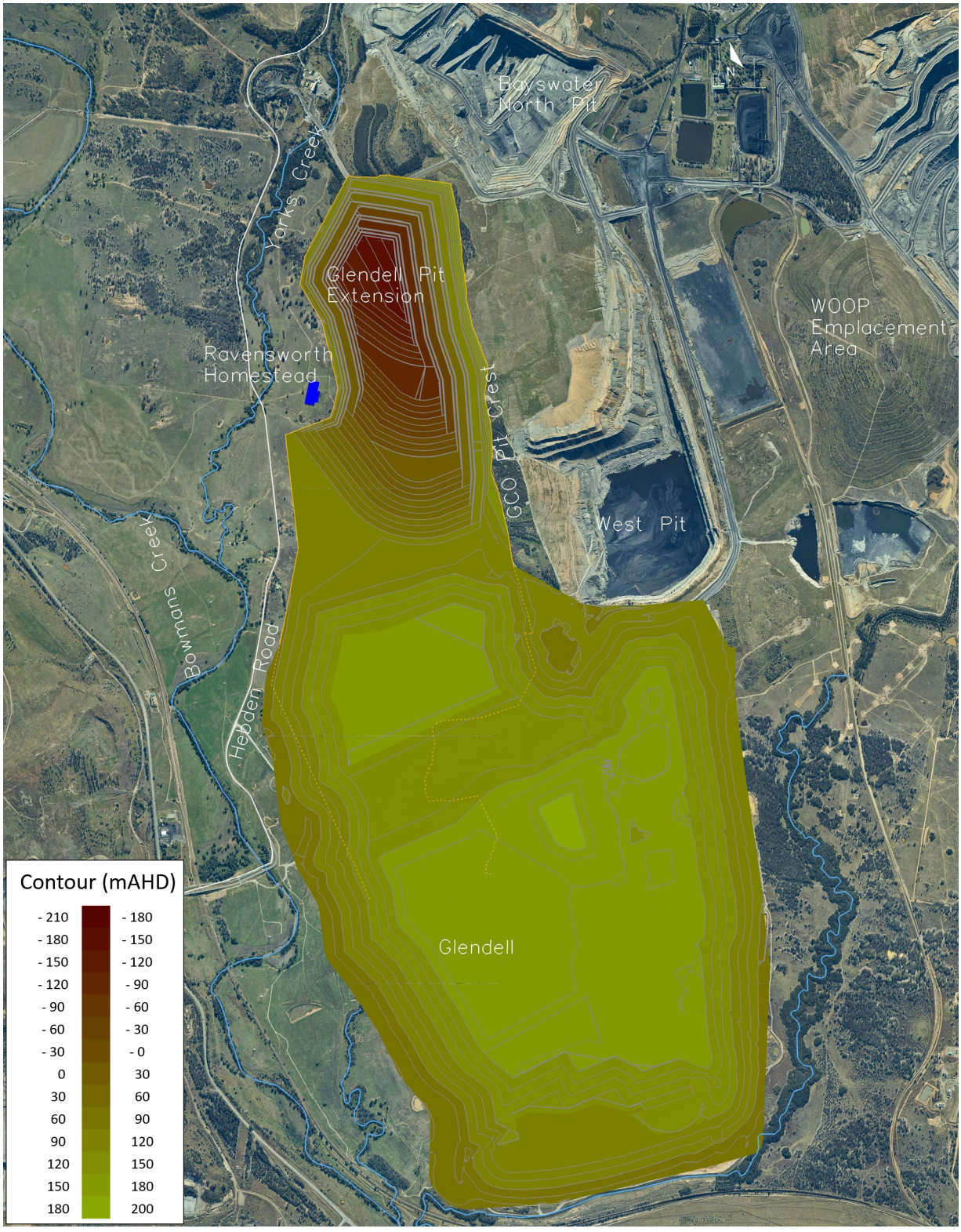

Figure 15: 100m Homestead Mine Around Final Landform Concept

3.9 Option 7 – Ravensworth Homestead Southern Offset

The option of stopping the open cut mine short of the Ravensworth Homestead 500m to the south was also investigated. The driver for stopping 500m from the homestead was to remove the potential for fly rock damage from blasting (mining industry standard practice) and to further reduce the extent of blast vibration on the buildings.

Similar to the Preferred Mine Plan, this option assumed continuation of the Glendell Pit to the north requiring mining through the upper section of Swamp Creek and the location of the existing Glendell MIA. The pit crest was then stopped a distance of 500m from the homestead (refer **Figure 16**).

Stopping the mine 500m from the homestead sterilises approximately 80Mt of ROM coal and reduces the life of the mine by 11 years when compared to the Preferred Mine Plan. This reduction in resources equates to a significant loss in royalties to the state of NSW of around $420M (undiscounted). Further, and similar to Option 6, the loss of reserves and truncated mine life associated with this option means that it is difficult to achieve a suitable return on capital investment as upfront spend is required on the construction of a new MIA and purchase of mining equipment. Consequently, Glencore would be highly unlikely to invest in a mine plan that stops mining 500m from the homestead.

Aside from the economic and financial impacts of this option there are a number of potential benefits associated with this option to the local community and environment that includes:

- Reduction in the duration of mining related impacts (noise, air quality etc); and
- Reduced impacts on the Ravensworth Homestead in terms of blast vibration, and visual catchment and setting relative to Option 6 (refer to **Figure 16** for conceptual final landform plan).

Notwithstanding the above benefits, if the homestead was left insitu it will continue to remain isolated, unoccupied and inaccessible while mining and rehabilitation activities are being undertaken.

A further standoff option involving the cessation of mining 900m to the south of the homestead was also investigated (approximate southern boundary of the Core Estate Lands). At this distance, the predicted blast vibration at the homestead is around 5mm/s (unconstrained). Stopping the mine 900m from the homestead reduces the proposed mine life by approximately 15 years and sterilises approximately 100Mt of ROM coal relative to the preferred option. This sterilisation of reserves equates to a loss in revenue to the state of NSW in the form of royalties of around $520M (undiscounted). A suitable return on investment would not be achieved for this option due to the sterilisation of reserves and reduced mine life.

Given the significant economic and financial impacts associated with standing off the homestead a distance of 500m or more, it is highly unlikely that Glencore would be willing to invest capital in a truncated pit option. It is acknowledged that this option does provide potential benefits to the local community and environment in terms of reduced mining related impacts (noise, air quality etc) and reduced impacts on the Ravensworth Homestead (blast vibration, visual catchment and setting), however if left insitu the homestead will continue to remain isolated, unoccupied and inaccessible while mining and rehabilitation activities are being undertaken. For these reasons, the option of standing off the homestead a distance of 500m or more is not considered reasonable and feasible.

Mine Planning Options Report

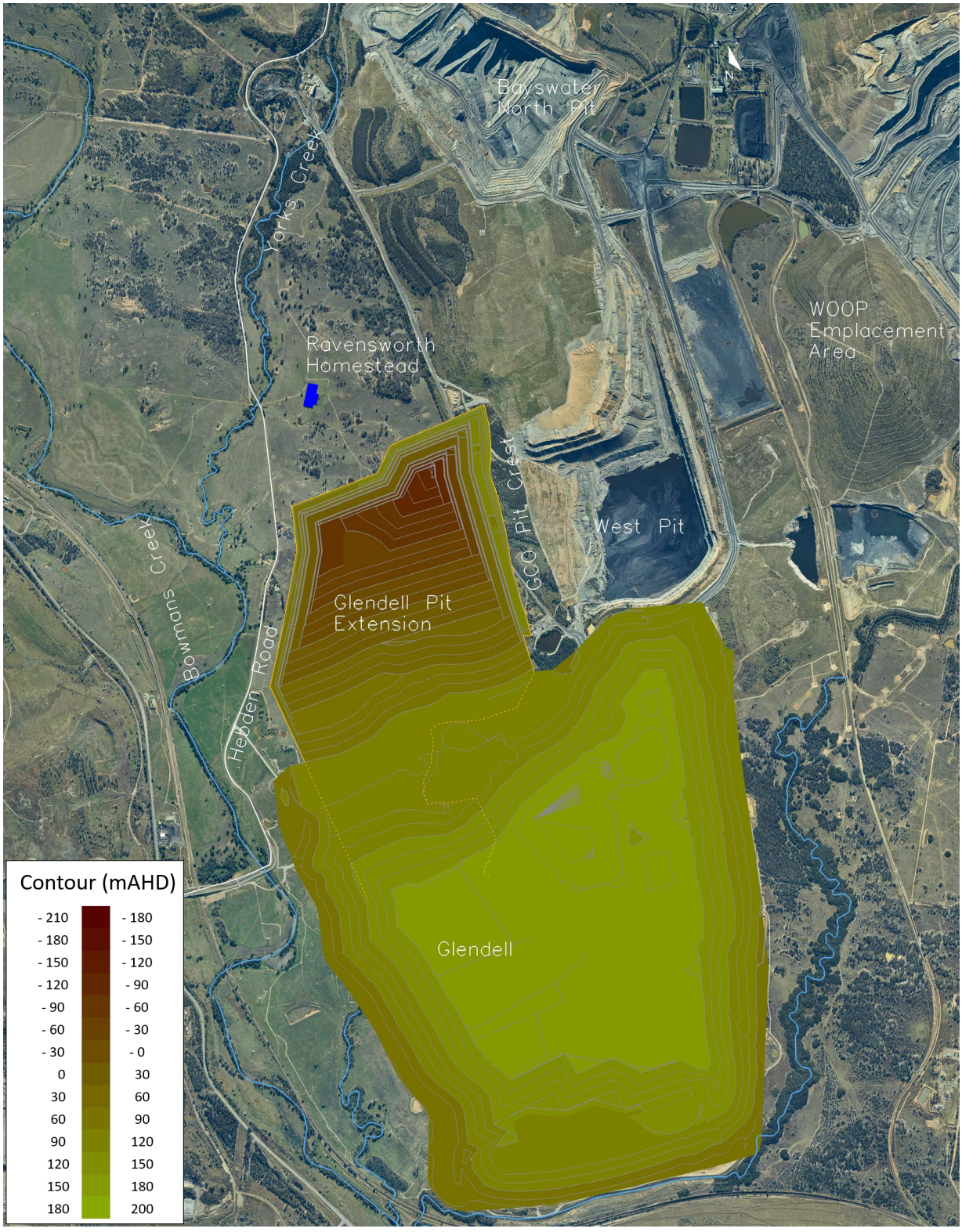

Figure 16: 500m Homestead Offset Conceptual Final Landform

3.10 Option 8 – Underground Mining Extraction

As an alternative to the open cut mining methodology the extraction of resources in the Project area using underground mining methods was considered. The benefit of this option is that it would reduce the impact on the surface, negating the need to construct a new MIA or relocate the Ravensworth Homestead and Hebden Road, and reduce impacts on Yorks and Swamp Creeks. However, underground mining is not considered economically viable for resource extraction in the area for the following reasons:

- The geometry of the resource is restrictive to underground mining as there is an anticlinal hinge (Camberwell Anticline) that runs south-north through the middle of the target resource area (refer **Figure 3**). This would constrain the orientation of any underground mine and the operability of underground mining equipment;

- The geotechnical environment of the anticline and the intersecting Block Fault Zone increase the potential for localised stress concentrations increasing outburst risk. Also, there is additional potential for localised 2-5m faults within the target resource area as identified in current operations and exploration drilling of the area, which would make underground mining technically challenging;

- Underground mining would restrict recovery to one main seam group at most and would not enable recovery of coal seams less than 2m thick. The main target seam group would be limited to the Liddell seam (due to high quality and seam thickness) and this would leave upward of 125Mt of ROM coal unrecovered compared to the Preferred Mine Plan. This loss of reserves equates to over $650M (undiscounted) in lost revenue in the form of royalties to the state of NSW;

- There is a high capital cost associated with the establishment of an underground mine and the coal tonnes available for recovery within the resource area are insufficient to ensure the economic viability of the operation and provide a suitable return on investment;

- Whilst mining does not occur from the surface there are still surface subsidence impacts that could impact existing creeklines and shallow alluvial aquifers. Additionally, subsidence could impose additional stresses, potentially significant, on any surface infrastructure including the homestead buildings resulting in cracking and instability.

For the above financial and technical reasons, underground mining extraction across the resource area is not considered reasonable and feasible.

3.11 Summary

A summary of the outcomes of the mine plan options assessment with regard to economic viability, technical considerations, and management of environmental and social impacts is shown in **Table 3**.

Mine Planning Options Report

Table 3: Summary of Mine Plan options

Option	ROM tonnes (Mt)	Approximate Mine Life (Yrs)	Royalties[1] to State of NSW ($M)	Economically Viable (Provides Financial Return)?	Technically achievable?	Reasonable and Manageable Environmental, Cultural and Social Impact?	Reasonable and Feasible Mine Plan?	Comments
Preferred Mine Plan: GCO Project	135	22	710				Yes	Preferred Mine Plan provides best balance between mine planning, economic, environmental and social outcomes
Option 1: No project	12	3	0				No	If no project then economic benefit of the project will be lost
Option 2: Maximum Resource Recovery	>150	>25	>780				No	Mining through Bowmans Creek and Liddell Underground is technically challenging. Diversion of Bowmans Creek unlikely to offset associated impacts. Also likely impacts on biodiversity and cultural heritage.
Option 3: Hunter Valley Dyke Constrained	145	25	750				No	Technical challenges associated with mining into the Liddell Underground.
Option 4: Yorks Creek Constrained	100	20	520				No	Truncated mine plan reduces ability to achieve a suitable return on capital investment.
Option 5: Swamp Creek Constrained	100	18	520				No	Truncated mine plan reduces ability to achieve a suitable return on capital investment. Potential for additional void in final landform and need for out-of-pit overburden emplacement area.
Option 6: Homestead Mine Around (within 100m)	89	18	460				No	Potential long term stability issues associated with highwall void to east of homestead. Homestead would be subjected to blast vibration and visual setting would change with void to east and dump to south
Option 7: Homestead 500m standoff (900m standoff)	57 (35)	10 (7)	290 (190)				No	Significant reduction in resource recovery and mine life making economically unviable with reduced revenue to the State.
Option 8: Underground Extraction	10	5-8	50				No	Geology and geometry not favourable for underground mining. Also significantly reduced resource recovery (approximately 7% of Preferred Mine Plan) for high capital expenditure

Legend: Key consideration met; Key consideration partially met; Key consideration not met

[1] Based on $8.20/product tonne in line with the Economic Impact Assessment (refer Ernst & Young 2019, Appendix 30), undiscounted

4 Infrastructure Alternatives

The Preferred Mine Plan requires the construction of a new MIA, relocation of a section of Hebden Road, diversion of the lower reach of Yorks Creek and relocation of the Ravensworth Homestead to a new recipient site. This section discusses the different options considered for each infrastructure element and identifies the preferred infrastructure option.

4.1 Mine Infrastructure Area

The existing Glendell MIA is located immediately north of the current approved Glendell Pit. The Preferred Mine Plan involves the continuation of the Glendell Pit to the north where it will mine through the location of the existing MIA and thus require the construction of a new facility.

A number of MIA options have been considered for a replacement MIA and are summarised in **Table 4**. shows the location of alternate MIA options considered and the location of the preferred MIA option.

The preferred option for the MIA (as part of the Preferred Mine Plan) is the construction of a new, purpose built facility to the north-west of the Glendell Pit Extension area.

Table 4: Options analysis for alternate MIA options considered

Option	Benefits / Opportunities of Option	Constraints / Weaknesses of Option
Preferred Option: Construct new MIA to the North-West of the Glendell Pit Extension	▪ Does not rely on completion of mining at other operations. ▪ Does not interact with other infrastructure relocations ▪ New, purpose built facility to latest standards provides best support and lowest maintenance burden for the project ▪ Operational efficiencies ▪ Close proximity to proposed mining operation relative to other options	▪ Potentially higher capital cost relative to other options ▪ Additional clearing relative to other options (grassland), though situated within the Project's Additional Disturbance Area
Option 1: Construct new MIA to the South-East of the Glendell Pit Extension	▪ Does not rely on completion of mining at other operations. ▪ New, purpose built facility to latest standards provides best support and lowest maintenance burden for the project	▪ Potentially higher capital cost relative to other options ▪ Additional clearing relative to other options ▪ Additional road and rail overpasses required ▪ Inside a known pit area if east of the MOC rail loop or in the Habitat management area to the west ▪ Interface with Integra UG subsidence in the workshop likely to be an issue ▪ Access into the pit gets more difficult as the pit progresses to the north ▪ In the area of rail infrastructure approved under MOCO project ▪ Overall increase in disturbance footprint for the Project

Option	Benefits / Opportunities of Option	Constraints / Weaknesses of Option
Option 2: Utilise Liddell MIA (including construction of a temporary MIA before Liddell MIA is available)	▪ Avoids the need for a new MIA to be constructed. ▪ Optimises the use of existing infrastructure.	▪ Liddell MIA does not become available for several years after a new Glendell MIA is required. This would necessitate a temporary MIA being constructed until the Liddell MIA becomes available. ▪ The area required for the temporary MIA would be similar to the proposed MIA under the Preferred Option and would be located with a suitable offset from the proposed pit extents. ▪ Additional operational considerations and costs with managing two facilities. ▪ Some upgrade and refurbishment of Liddell infrastructure is likely to be required ▪ Requires the construction of haul road bridges over the relocated Hebden Road, Bowmans Creek and Main Northern Rail Line for heavy vehicles to move from the Liddell MIA to the Glendell Pit Extension. These construction works and ongoing presence of a bridge over Bowmans Creek may have impacts on Bowmans Creek, particularly during high flow events which would need to be managed. ▪ Overall increase in disturbance footprint for the Project
Option 3: Utilise Ravensworth East MIA	▪ Avoids the need for a new MIA to be constructed. ▪ No increase in disturbance footprint. ▪ Optimises use of existing infrastructure, albeit the majority of existing infrastructure would most likely need to be removed as not fit for purpose.	▪ Existing Ravensworth East MIA is required for maintenance of equipment used for mining at Bayswater North Pit and Glendell Pit until approximately 2022. ▪ Facilities would require significant upgrade and refurbishment to cater for Project relative to current requirements. ▪ The Ravensworth East MIA is located within the proposed footprint of the Yorks Creek Realignment works potentially requiring a sub-optimal realignment to avoid the area
Option 4: Utilise Mount Owen MIA	▪ Avoids the need for a new MIA to be constructed. ▪ No increase in disturbance footprint. ▪ Optimises use of existing infrastructure.	▪ Mount Owen MIA is required for maintenance of equipment used for mining at Mount Owen Mine until approximately 2037. Facilities would require significant upgrade to cater for Project relative to current requirements.
Option 5: Construct Temporary MIA close to pit and relocate as pit progresses	▪ Avoid cost of permanent facility ▪ Able to maintain close proximity to pit ▪ Reduced Mine Closure effort	▪ Construction of a temporary style installation is only viable for a short term mine life and as such is not a feasible option for the Preferred Mine Plan ▪ Operational disruption during relocation works ▪ Cost of relocation works

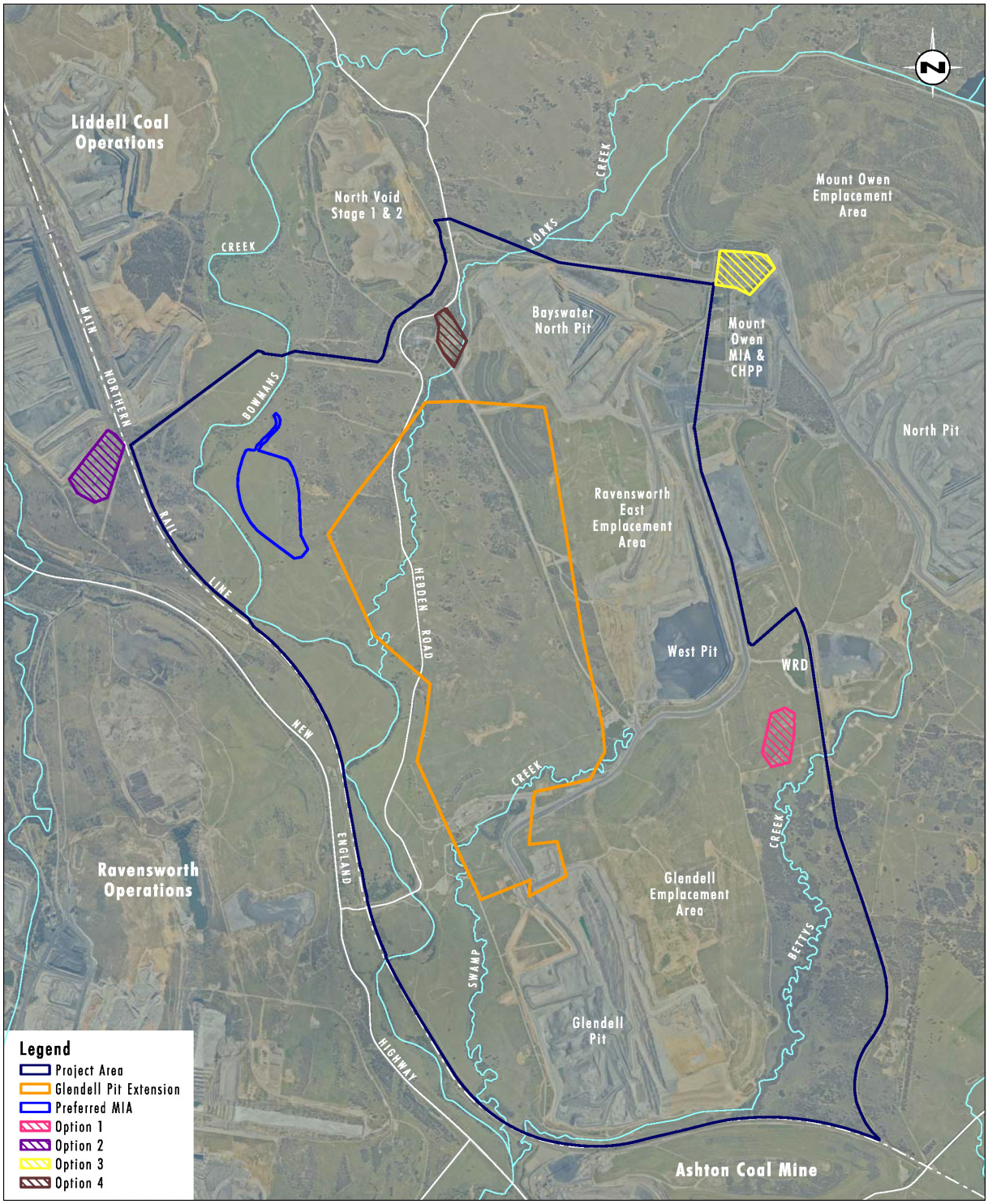

Figure 17: Mine Infrastructure Area Location Options

4.2 Yorks Creek Diversion

Yorks Creek is an ephemeral watercourse that includes an existing diversion to the north of the Project area. The Preferred Mine Plan involves the continuation of the Glendell Pit to the north where it will mine through the lower reach of Yorks Creek. In order to maintain the connectivity of flows from the upper Yorks Creek catchment into Bowmans Creek it is necessary to provide a diversion around the Glendell Pit Extension area.

A number of alternate alignments for the Yorks Creek diversion around the Preferred Mine Plan were considered and are shown in **Figure 18** and described in **Table 5.**

The preferred option is to divert Yorks Creek immediately to the northwest of the Glendell Pit Extension area and proposed MIA. The preferred option incorporates geomorphological design elements to provide a more natural and stable watercourse. Further details are provided in the GCO Project EIS Section 3.2.9.

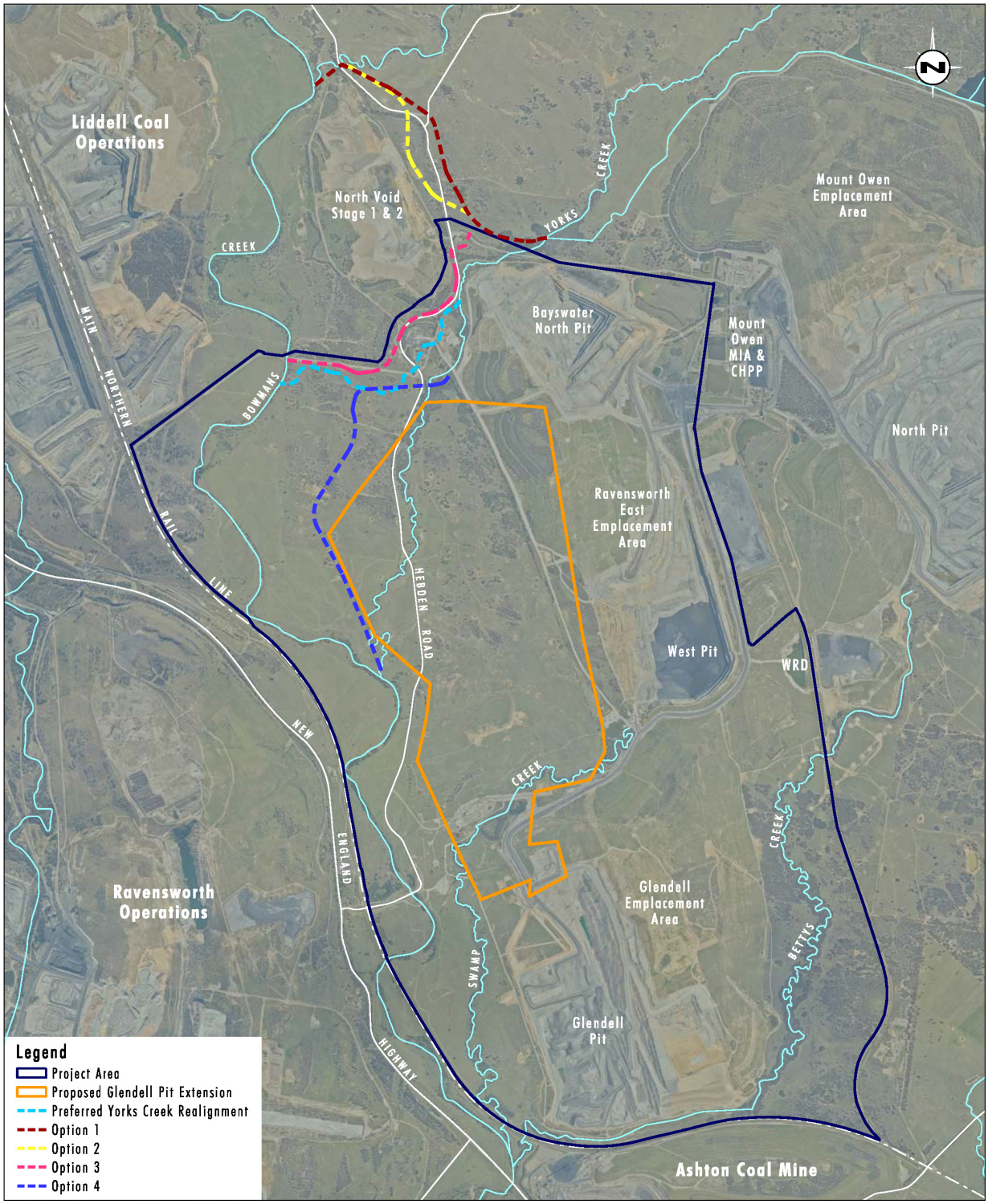

Figure 18: Yorks Creek Realignment Options

Table 5: Yorks Creek Diversion Options

Option	Benefits / Opportunities of Option	Constraints / Weaknesses of Option
Preferred Option: Realign Yorks Creek to the north-west of Preferred Mine Plan	▪ Smaller depth of cut relative to other options considered ▪ Reduces the size of the final void catchment relative to other option considered ▪ Part of diversion involves rework of existing diversion of Yorks Creek through former Swamp Creek open cut mine	▪ Requires demolition of Ravensworth East MIA and importing of fill in the area
Option 1: Realign Yorks Creek to north west and discharge into Stringy Bark Creek. Diversion to stay on eastern side of Hebden Road.	▪ Avoids need for demolition of Ravensworth East MIA	▪ Large depth of cut relative to preferred diversion option (>30m) ▪ Results in a larger final void catchment relative to Preferred Mine Plan ▪ The topography and proximity of former mine workings make the realignment corridor tight with limited ability to introduce geomorphic design elements ▪ Most expensive option relative to other options considered
Option 2: Realign Yorks Creek to the north west and discharge into Stringy Bark Creek. Diversion to run along western side of Hebden Road.	▪ Avoids need for demolition of Ravensworth East MIA	▪ Large depth of cut relative to preferred diversion option (>17m) ▪ Results in a larger final void catchment relative to Preferred Mine Plan ▪ The topography and proximity of former mine workings make the realignment corridor tight with limited ability to introduce geomorphic design elements
Option 3: Realign Yorks Creek to west of Hebden Road and south along road and conveyor corridor alignment	▪ Avoids need for demolition of Ravensworth East MIA ▪ Reduced earthworks by utilising existing conveyor cutting ▪ Hebden Road crossing further upstream	▪ Loss of floodplain storage, requires significant works at northern Hebden Road section to raise above creek invert ▪ Impacts existing tailings, power and communications infrastructure within the conveyor corridor ▪ Requires dam above Ravensworth East MIA with potential inundation
Option 4: Realign Yorks Creek south along western boundary of Glendell Pit Extension to the existing Yorks Creek confluence with Bowmans Creek	▪ Discharges into existing Yorks Creek confluence with Bowmans Creek	▪ Requires dam above the pit operation (which poses a safety risk) and inundation of Ravensworth East MIA ▪ Requires haul road crossing of creek ▪ Additional length and cost of diversion, significant cuttings required to avoid other project infrastructure and pit

4.3 Hebden Road Relocation

Hebden Road provides the main access road for the MOC, Hebden Quarry and residents in Hebden with connectivity to the New England Highway at the northern and southern extents. The Preferred Mine

Plan involves the continuation of the Glendell Pit to the north where it will mine through a section of Hebden Road that will require relocation.

A number of alternate alignments for the Hebden Road relocation around the proposed mining footprint were considered and are shown in **Figure 19** and described in **Table 6.**

The preferred option is to realign Hebden Road to the west of the Glendell Pit Extension area and new MIA. The preferred option incorporates an upgrade to the standard of the road so that the realigned carriageway and shoulders are increased in width and match the recent upgrade works completed for the MOCO Project (new rail overbridge and dual lane bridge crossing over Bowmans Creek).

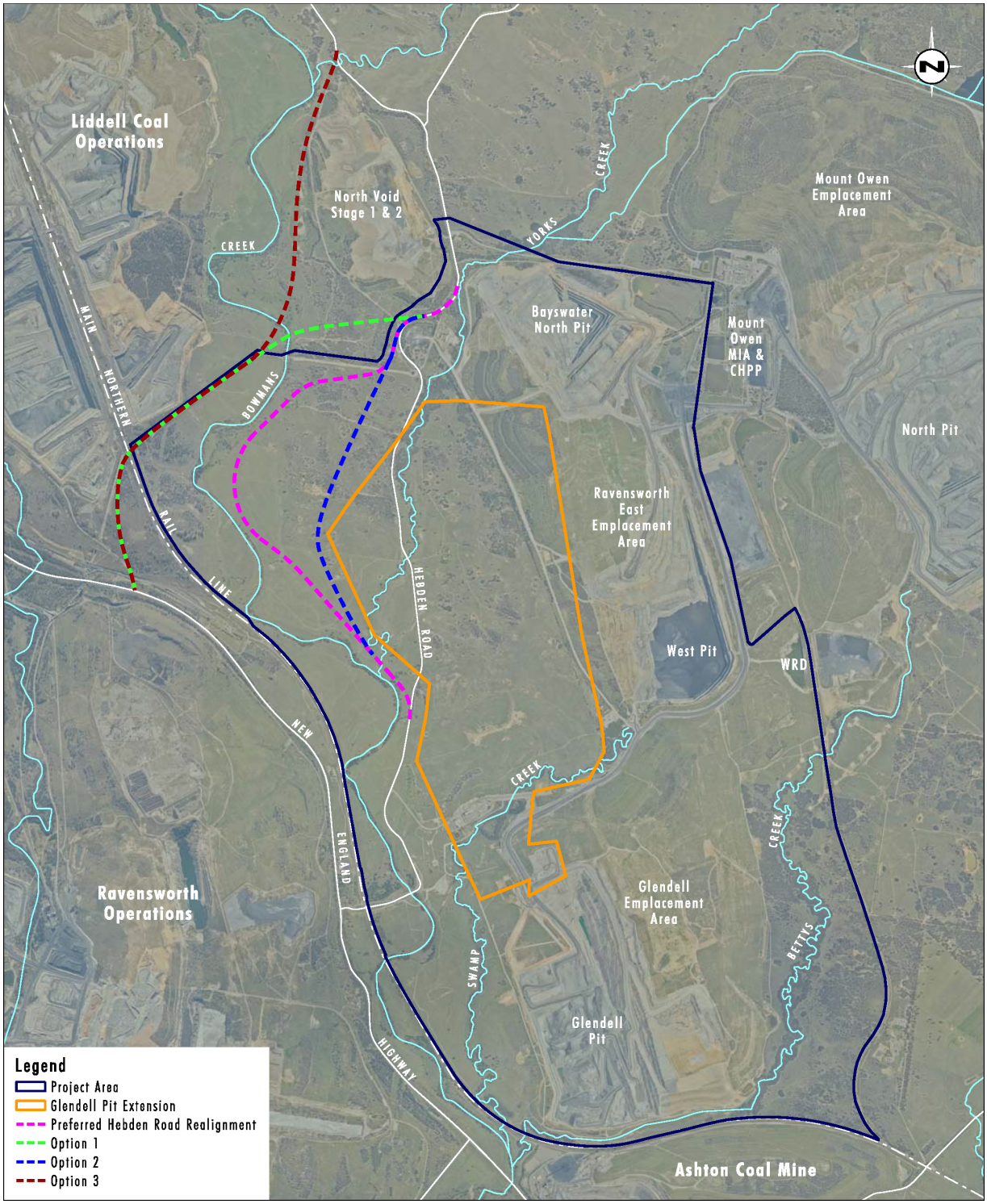

Figure 19: Hebden Road Relocation Options

Table 6: Options analysis for alternate Hebden Road options considered

Option	Benefits / Opportunities of Option	Constraints / Weaknesses of Option
Preferred Option: Relocate Hebden Road west of pit extents and MIA	▪ Unimpeded movement of mining equipment from the MIA to the Glendell Pit Extension without crossing Hebden Road ▪ Increased visual separation from Hebden Road to the final void ▪ Reduced number of blast closures in later years relative to Option 2 ▪ Relocated Hebden Road has approach from west for Ravensworth Farm homestead relocation option, which is similar to current situation ▪ Retains use of MOCO Project Hebden Road upgrade works (new bridge over Bowmans Creek and bridge over Main Northern Rail Line).	▪ Increased length compared to Option 2 ▪ Closures for blasting required during mine operation
Option 1: Relocate Hebden Road north of pit extents and MIA with connection between Hebden Road at Ravensworth East MIA and Old New England Highway	▪ No closure required for blasting during mine operation ▪ Unimpeded movement of mining equipment from the MIA to the Glendell Pit Extension without crossing Hebden Road ▪ Increased visual separation from the Hebden Road to the final void	▪ Lose ability to utilise recent bridge and roadwork upgrades constructed as part of MOCO Project ▪ Requires three bridges (two more than other options): o Hebden Road over Main Northern Rail Line and Bowmans Creek; and o MIA Access Road over Bowmans Creek (south of Yorks Creek realignment confluence) ▪ High cost option ▪ Increase in required disturbance area for the Project
Option 2: Relocate Hebden Road immediately west of pit extents and east of MIA	▪ Reduced length of road compared to the Preferred Option ▪ Simplified horizontal geometry ▪ Retains use of MOCO Project Hebden Road upgrade works	▪ Requires an additional bridge over relocated Hebden Road for movement of mining equipment from the MIA to the Glendell Pit Extension ▪ Closures for blasting required during mine operation, including in the latter years of mine life ▪ Higher vertical geometry would provide less visual separation between the road and the final void
Option 3: Relocate Hebden Road north of pit extents and MIA with connection between Hebden Road at Stringybark Creek crossing and Old New England Highway	▪ No closure required for blasting during mine operation ▪ Unimpeded movement of mining equipment from the MIA to the Glendell Pit Extension without crossing Hebden Road ▪ Increased visual separation from the Hebden Road to the final void	▪ Lose ability to utilise recent bridge and roadwork upgrades constructed as part of MOCO Project ▪ Requires four bridges (three more than other options): o Hebden Road over Main Northern Rail Line, Bowmans Creek and Stringybark Creek; and o MIA Access Road over Bowmans Creek (south of Yorks Creek realignment confluence) ▪ Highest cost option ▪ Increase in required disturbance area for the Project

4.4 Relocation of Ravensworth Homestead

The Preferred Mine Plan will necessitate the removal of the Ravensworth Homestead to a new recipient site. Details on the homestead relocation option identification, investigation and assessment process completed by Glencore is provided in the Ravensworth Homestead Relocation Option Identification and Assessment Report provided in Appendix 23f of the GCO Project EIS.

A range of relocation options that included submissions from the broader community were investigated and assessed by the Ravensworth Homestead Advisory Committee (RHAC) and Glencore. The assessment of these relocation options considered:

- Whether the recipient site was located within Singleton Local Government Area (LGA)
- The manner in which the buildings would need to be relocated to the recipient site (either by moving the buildings largely intact or by dismantle and rebuild)
- The topography, setting and visual catchment of the recipient site
- The proposed ownership model and whether the end use would fulfil a community need
- Public accessibility and whether the proposed end use was likely to be commercially viable.

The outcome of the detailed investigations and assessment has resulted in the following two relocation options:

- **Ravensworth Farm** – involves the intact relocation of the homestead buildings to a Glencore-owned site situated on the original Bowman '10,000 acre' land grant (refer **Figure 20**). The buildings would be used by Glencore as administration facilities during mining with possible options post-mining including return to use as a private homestead with an attached landholding or some other function to suit future land use and interest in the Ravensworth area.
- **Broke Village** – this is a proposal by members of the Broke-Forwich community and involves the dismantle and rebuild of the homestead buildings to McNamara Park in Broke (refer **Figure 21**). The homestead complex would form the village square with building usage to include administration and exhibition space, café, restaurant, cellar door, tourist information, market stall space, and central point for regional events. The complex would be owned by the community with the financial benefits used to fund other Broke initiatives. This option will be subject to secondary approvals and the securing of land tenure.

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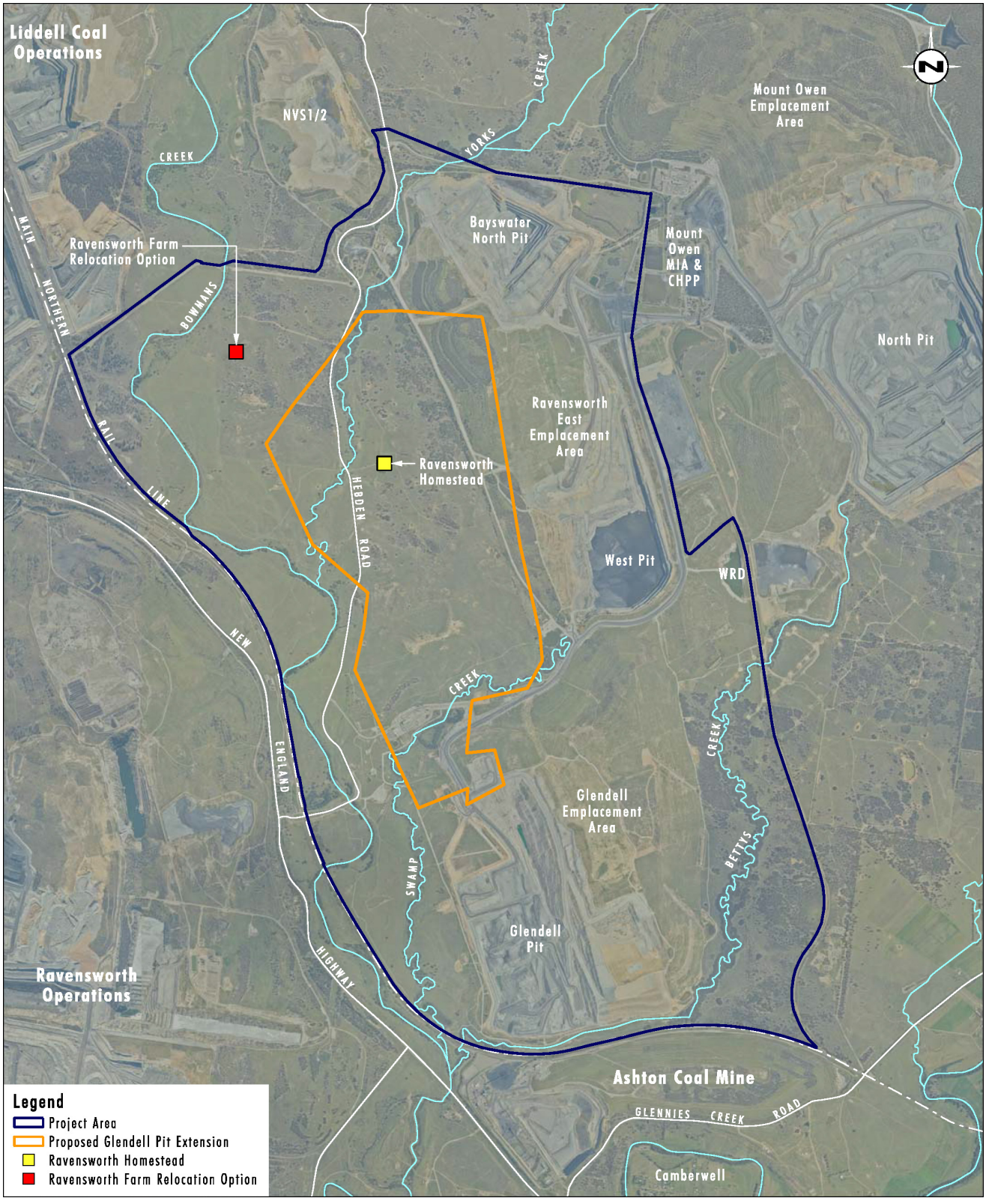

Figure 20: Ravensworth Farm

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Figure 21: Broke Village

4.5 Summary

The preferred infrastructure arrangement for the Preferred Mine Plan is shown in **Figure 22** and includes:

- Construction of a new MIA to the west (eastern side of Bowmans Creek);
- Relocation of Hebden Road to the west (eastern side of Bowmans Creek);
- Diversion of Yorks Creek to the north-west; and
- Relocation of Ravensworth Homestead to either Ravensworth Farm or Broke Village.

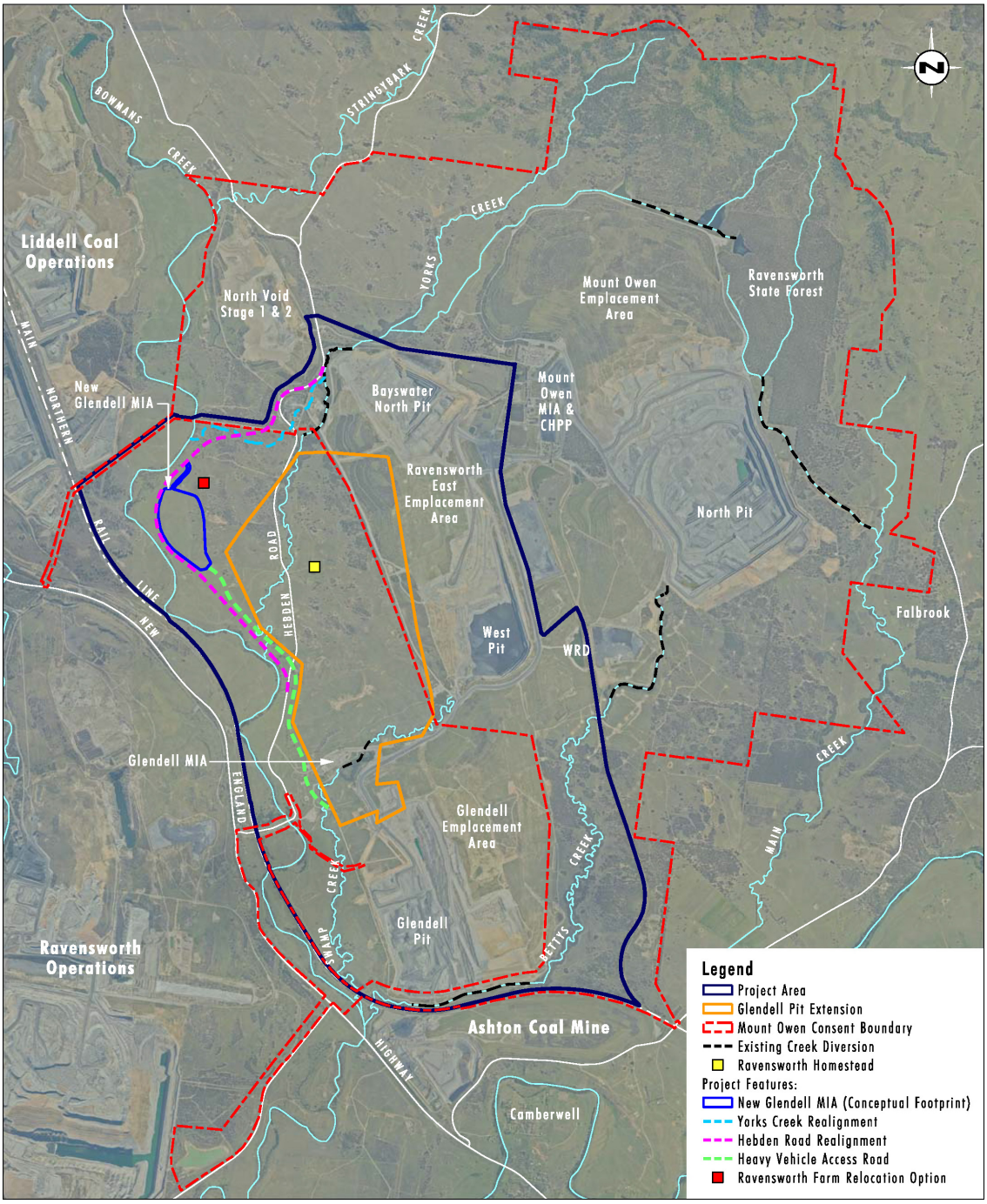

Figure 22: Key Infrastructure for the Preferred Mine Plan

5 Final Landform Options

A number of post mining final landform and final void concepts were considered for the Preferred Mine Plan. Relevant mine plan design features applicable to establishing the final landform and development of the Preferred Mine Plan include:

- Re-establishment of Swamp Creek drainage area through the Ravensworth East final landform;
- Continued establishment of riparian vegetation along the diversion of Yorks Creek;
- Capping of completed tailings storage facility; and
- Establishment of a rehabilitated and stable landform, constituting a mixture of woodland and grassland areas, using natural landform design principles and revegetation techniques.

This section outlines the final landform considerations and the proposed final void arrangement for the Preferred Mine Plan.

5.1 What is a Final Void?

Open cut mining involves the displacement of material to access a resource within the ground which often results in the formation of large pits or 'voids' where that material has been removed. Where a void is left after mining, it is typically referred to as a 'final void' (DPE 2017).

The 'final void' is considered to be the area within the crest of the final high wall surrounding the predicted long term water recovery level of the pit lake and excluding the low wall. The low wall has been excluded from the definition of a final void due to its reduced slopes and ability for rehabilitation opportunities as described within this report.

It is important to note that not all areas defined as a final void render the land unusable and final voids may have future value beyond the scope of this report.

5.2 Why Are Final Voids Required?

As discussed in **Section 2**, the Project has been designed to optimise resource recovery and operational efficiencies at the MOC whilst reducing where practicable environmental and social impacts.

Both current and future mining at Glendell associated with the proposed project will result in a net volume deficit between the total volume of material excavated from the pit and the total waste material remaining for emplacement in-pit following the processing and sale of coal. Therefore it is not possible to reinstate the topography to pre mining levels across all previously mined and future mining areas.

At the commencement of mining, "out of pit" overburden emplacement areas are required to provide for the initial start-up operating area before emplacement of mine overburden within the pit void (in-pit) can commence. This means that for the out of pit emplaced material to be put back into the mine shell at the completion of mining it must be rehandled (effectively mined twice). This rehandle of material can place a significant financial burden on the mining operation at the completion of mining, and would prolong the environmental and social impacts of the mine.

The Project proposes to utilise the void space provided by the existing Glendell Pit for overburden emplacement. The emplacement of overburden from the Glendell Pit Extension into the Glendell Pit void:

- Makes more efficient use of available space and results in no additional void in the final landform;
- Removes the need for the disturbance of new areas for out of pit overburden emplacement purposes; and
- Contributes to an integrated landform with the existing operations.

Similar to the current approved Glendell Pit, the Preferred Mine Plan will retain a void in the final landform.

5.3 Final Landform Design Aspects

Glencore takes a proactive approach to mine closure planning and undertakes progressive development of rehabilitation works in conjunction with mining activities. Final landforms are designed to comprise natural landform design elements and include undulating surfaces and drainage lines that maintain consistency with the surrounding natural terrain and the existing rehabilitation in the area.

Glencore is committed to reducing risks to the community from any residual voids through effective mine planning and through the development of effective final void designs and has committed to design final voids that are safe, stable and non-polluting.

Throughout the life of the Project the following factors will be considered:

- The ongoing refinement of the life of mine plan to consider final void implications at each stage of planning;
- Recognition that due to the dynamic nature of mining, mine plans may change through time in response to economic, geotechnical and environmental factors. As such, void positions/size/characteristics may change from that initially envisaged in the proposed mine plans, however, the design of the final voids in each mine plan iteration will meet acceptable outcomes; and
- Final void and rehabilitated landform designs need to consider opportunities for the economic diversification of an area following the cessation of mining and be considered as part of the detailed mine closure planning process.

Glencore's overarching commitments for final void design are further described as:

- Safe – associated with safe access and egress into voids by people and animals, and in the case of specific water quality issues, related to safe access and use of that water;
- Stable – associated with control of risk of geotechnical wall failures, slips and similar mass movement or high erosion rates;
- Non-polluting – associated with control of geochemical risks and water quality impacts on important aquifers, creeks or surrounding ecosystems with the baseline and existing condition of the receiving waters to be considered when determining acceptable water quality standards; and
- Sustainable – associated with the ability to remain a stable system that supports some stabilising vegetation cover (where needed) and can satisfy the desired outcomes of safety, stability or that of not polluting into the future.

Glencore has established design principles which will be applied to the final void developed as part of the Project. These include:

- All final void rock slope angles will be determined by geotechnical investigations to ensure they are safe and stable;
- Safety berms will be established along the top of each highwall. These safety berms and associated drainage will be designed to prevent excessive runoff flowing over the face of the highwall;
- The void slopes and highwall benches will be revegetated where practicable and appropriate; and
- The highwall benches will be revegetated with a suitable native vegetation mix using local species, where appropriate, above the predicted final void water level.

The geometry of the Preferred Mine Plan adds a level of complexity to the final landform with overburden emplacement constrained due to dipping seams, a narrow pit in the early years of the project, and a progressively deepening pit floor, which influences the maximum landform height and final void volume.

The Surface Water Impact Assessment (GHD 2019, Appendix 17) and Groundwater Impact Assessment (AGE 2019, Appendix 16) completed for the Project EIS have found that the final pit lake water levels will gradually recover over time until an equilibrium state is reached at approximately -60mAHD in the Project Area final void (approximately 160m below natural ground level).

It is anticipated that the long term pit lake recovery levels would fluctuate with time and conditions however are predicted to generally stabilise at a lower level than under pre-mining conditions and will not discharge to the natural creek system. Under this condition, the final void will act as a long term groundwater 'sink'.

High walls may be selectively blasted and shaped for visual amenity and geotechnical stability. This is dependent on any further geotechnical assessments as the operation nears the completion of mining and as the high wall is progressively exposed for inspection and assessment.

The design of the void will be continually reviewed and refined over the life of the mine as mining progresses. The final void and final landform designs for the Project will be provided in the Mining Operations Plan (MOP) and will be subject to the approval of Division of Resources and Geoscience (DRG) or, if required, the relevant planning approval obtained.

5.4 Landform Options

Integral with the establishment of the Preferred Mine Plan, an assessment was undertaken to review the landform with a view to reducing the final void size and improving the design of the void that is proposed to remain.

Final void and final landform options assessed for the Project were the preferred option and a no void option. Impacts of the no void option include ongoing noise and dust generation, potential destruction of established rehabilitation, delays in establishing final landform and land use, and associated costs that significantly affects the Project's viability.

The assessment completed on the final void options discussed below have been completed at a concept level to determine their feasibility with consideration of potential impacts and indicative costs.

A summary of the final void options considered is provided in **Table 7** and a visual comparison of the proposed final void option and the no void option for the Preferred Mine Plan is provided in **Figure 23** and **Figure 24**.

Table 7: Summary of Final Void Options

Mine Plan Option	Void Features
No Project	**No Project Case – Existing Approved Void** There is an approved final landform including a final void in the existing Glendell approved mining area. The current approved final void includes a catchment area of 339Ha.
Preferred Mine Plan - Preferred Void Option	**Preferred Void Option (as included in the EIS)** Backfilling of the existing Glendell Pit void and progressive filling of the Glendell Pit Extension void as mining progresses to the north. Also includes some backfilling against the existing Ravensworth East overburden area. The concept final landform incorporates natural landform design elements with a single final void at the northern end of the Glendell Pit Extension. Treatment of the proposed final void in accordance with the Glencore Final Void protocol including: • Battering top layers of weathered strata to improve long term stability of high walls • Battering of internal backfill slopes to 10 to 18 degrees to maximise post mining habitat areas down to the predicted equilibrium water level • Softening of internal high wall angles to reduce the geometric form and achieve a more natural form The proposed final void is expected to have a catchment area of 321Ha.
Preferred Mine Plan - No Void Option	**Full Backfill - No Void (not practical or economically viable)** Backfilling of the existing Glendell Pit void and progressive filling of the Glendell Pit Extension void as mining progresses to the north. Once coal extraction is complete, the Glendell Pit Extension void would be filled with overburden sourced from rehabilitated overburden area/s to produce a free-draining surface. This option has the following impacts: • Requires rehandle of approximately 255Mbcm from existing rehabilitated mining area/s to fill the proposed mining void to approximately 90mAHD to achieve a free-draining landform. Note that there is insufficient material available to completely reinstate the post-mining landform to its pre-mining topography. • Disturbs more than 350 hectares of rehabilitated land established during the Project • Approximate 12 year extension of site works post-mining including prolongation of potential air quality and noise impacts, and delay in mine site rehabilitation Remaining remnants of high walls may be selectively shaped for visual amenity and geotechnical stability reasons

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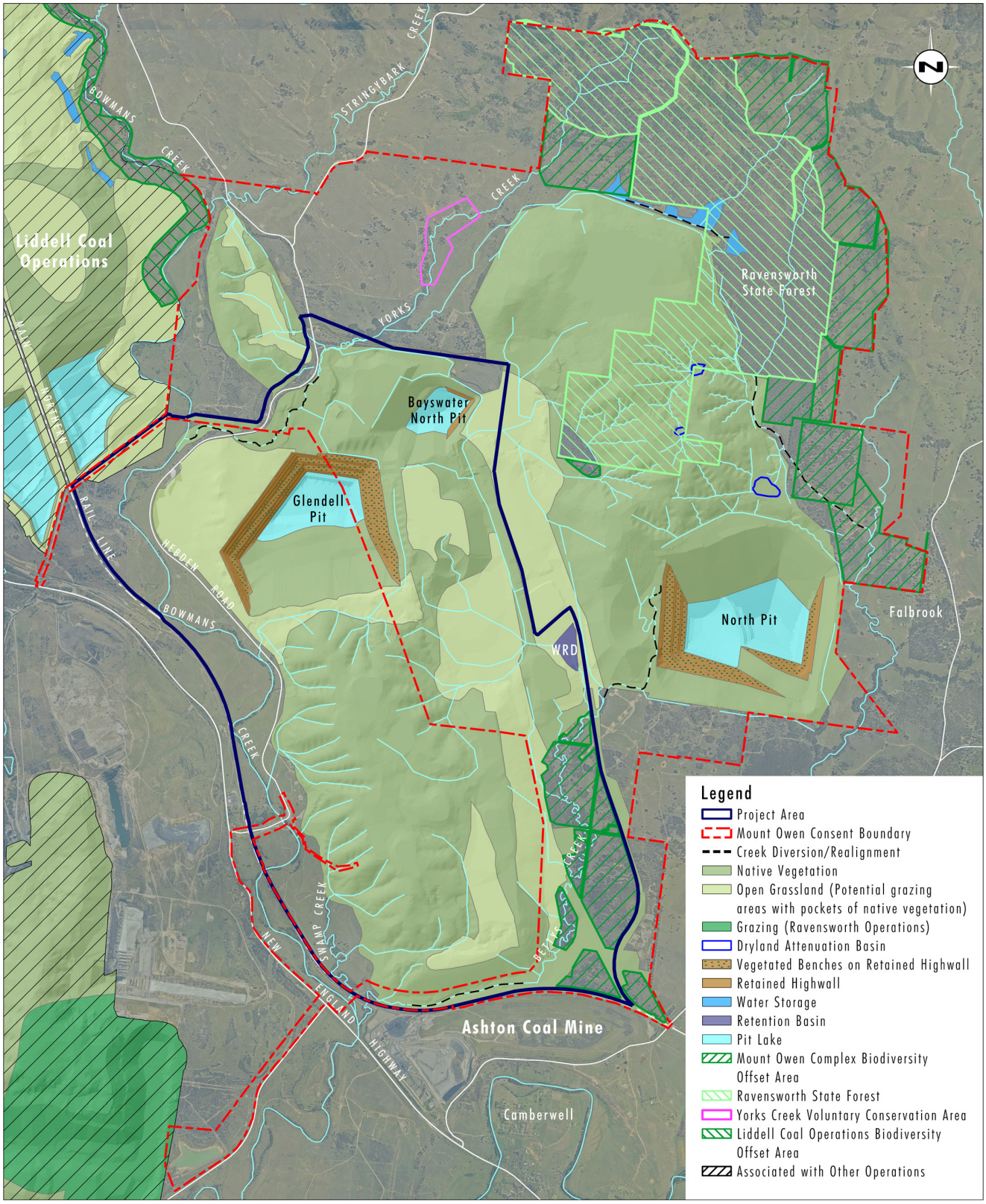

Figure 23: Final Landform Concept

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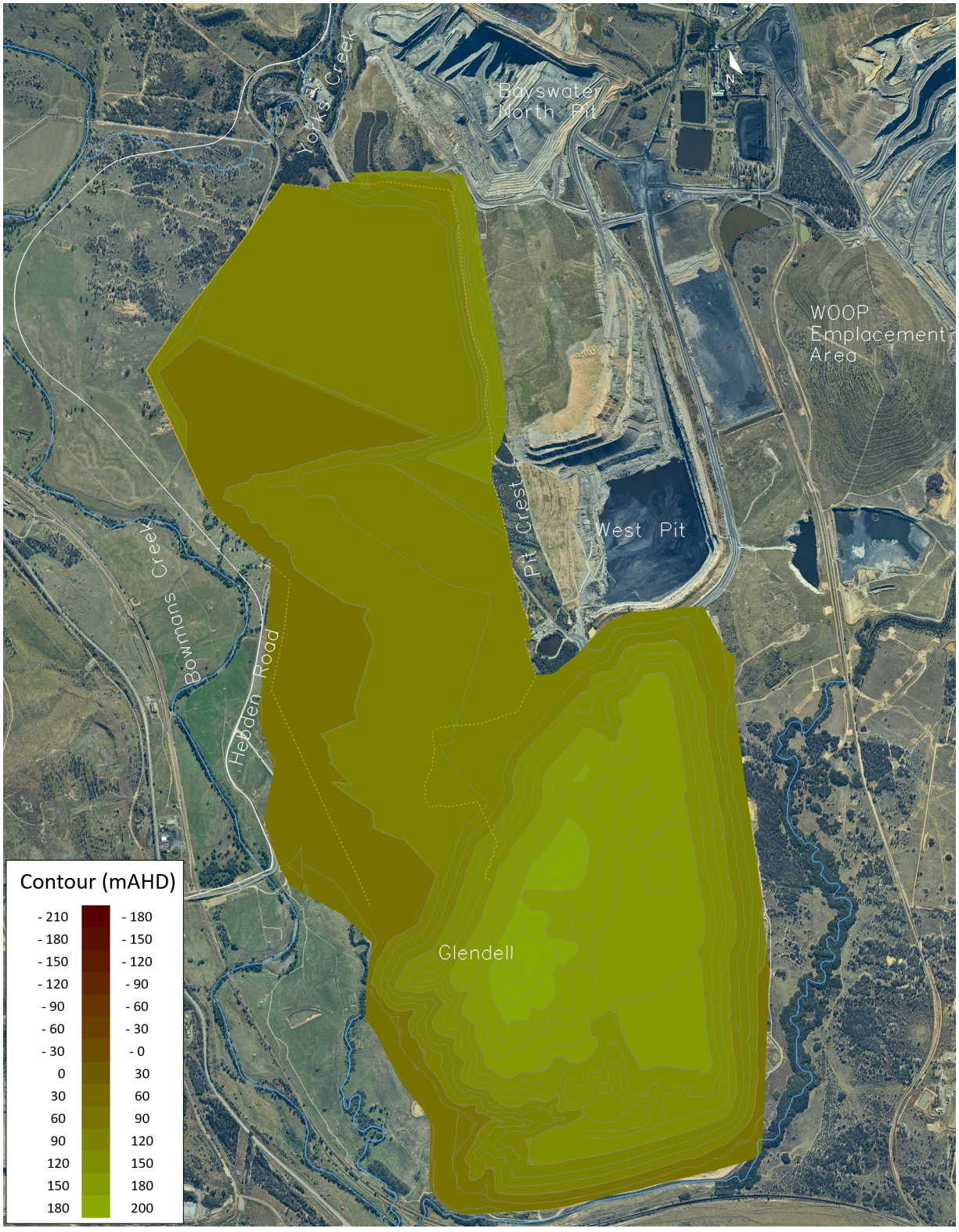

Figure 24: No Void Final landform concept

5.5 Final Void Options Assessment Outcome

Overburden from the Glendell Pit Extension will be used to fill the approved Glendell Pit void as the proposed mining operation progresses northwards. The final landform for the Preferred Mine Plan will include a void at the northern end of the Glendell Pit Extension. The net outcome from the filling of the approved Glendell Pit void and provision of a final void at the northern end of the proposed mining area will be no change in the number of approved final voids at Glendell Mine.

The proposed final landform for the Preferred Mine Plan incorporates natural landform design elements and has been integrated into the approved Glendell Mine final landform. At the completion of mining treatment protocols would include battering weathered strata to improve the long term stability of high walls and the battering of internal backfill slopes to maximise post-mining habitat areas down to the predicted pit lake level.

The area and volume of the final landform has been influenced largely by the geometry of the Preferred Mine Plan including dipping seams, a narrow pit in the early years of the project, and a progressively deepening pit floor.

The proposed final landform:

- Provides a balanced outcome that both achieves economic expectations whilst reducing where practicable the size of the final void
- Improves the visual appearance of the void by removing and softening the sharper traditional engineered profiles
- Void acts as a long-term groundwater sink, capturing salt and avoiding impacts on surrounding water quality

A no void final landform option was considered in acknowledgement of stakeholder expectations and government direction including the “Improving Mine Rehabilitation in NSW Discussion Paper” (DPE 2017). As stated within this report it is not possible to reinstate the topography to pre mining levels across all previously mined areas, as following the extraction of coal there is a net deficit of overall material available.

For the no void option the mining operation would need to continue following completion of coal mining and move approximately 255Mbcm from existing rehabilitated mining areas, including material from the existing approved mine, to fill the void to a self-draining surface as shown in **Figure 24**. This would require the disturbance of approximately 355 hectares of rehabilitated mine overburden area that would have been progressively stabilised and revegetated during mining.

The requirement to reclaim approximately 255Mbcm for the purpose of backfilling the void to a free-draining landform would continue the operation for approximately 12 years using a mining fleet size comparable to that currently in place for the approved Glendell mining operation. Additionally, filling of the void will extend noise and air quality impacts, require the removal of established mine rehabilitation and delay the establishment of the final landform and land use. Further, the indicative cost of filling the void would be in excess of $1.6B spent from the end of mining until the void is filled or $522M Net Present Cost calculated at a 4% discount rate assuming void filling works would commence in 2045. This analysis shows that filling the void is not economically viable.

Based on the above, the preferred conceptual final landform includes the filling of the approved Glendell Pit void and creation of a new void at the northern end of the Preferred Mine Plan. The filling of the final void is not considered practical or economically viable. Further details regarding the key features of the final landform and rehabilitation strategy is discussed in the GCO Project EIS.

6 Conclusion

Mine planning investigations have been ongoing since 2010 and have included exploration and geotechnical drilling, and assessment of alternate mine plan options with consideration of technical constraints and risks, economic viability, and potential environmental and social impacts. The outcome of these investigations has been the selection of the Preferred Mine Plan, which forms the basis of the Project, and will provide in excess of $960M (undiscounted, almost $400M in NPV terms) in direct economic benefits (company tax, royalties and payroll tax) to the State of NSW and substantial economic flow on effects in the form of spending with suppliers and contractors and associated employment. The Preferred Mine Plan mines through:

- The location of the existing Glendell MIA;
- A section of Swamp Creek;
- The location of the Ravensworth Homestead; and
- Sections of Hebden Road and Yorks Creek.

Infrastructure works required to support the Preferred Mine Plan include construction of a new MIA, relocation of the Ravensworth Homestead to a new recipient site, and relocation of sections of Hebden Road and Yorks Creek around the proposed mining footprint.

Alternate final landform options have been examined for the Preferred Mine Plan with consideration of technical, economic, environmental and social factors. The preferred final landform option will include a void at the northern end of the Glendell Pit Extension with filling of the approved Glendell Pit void with overburden to occur as mining progresses to the north. This will result in no change in the number of approved voids in the final landform. The majority of overburden from the Glendell Pit Extension will be emplaced in-pit and the landform will incorporate natural landform design elements.

The option of backfilling the proposed void to achieve a free-draining landform was assessed and was not considered practical or economically viable due to:

- The need to disturb areas of mine rehabilitation in order to access the material needed to fill the void;
- High cost associated with moving the large volume of material needed to fill the void to a free-draining surface;
- A prolongation of noise and air quality impacts well beyond the life of the mining operation; and
- Delay in final rehabilitation and mine closure in excess of 12 years.

The Preferred Mine Plan and final landform as proposed in the EIS is considered to achieve an appropriate balance between mine planning, economic, environmental and social outcomes.

7 References

- AGE, 2019, Groundwater Impact Assessment (Appendix 16 of GCO Project EIS)
- Department of Planning and Environment (DPE 2017). Improving Mine Rehabilitation in NSW Discussion Paper November 2017.
- Ernst & Young, 2019, Economic Impact Assessment (Appendix 30 of GCO Project EIS)
- GHD, 2019, Surface Water Impact Assessment (Appendix 17 of GCO Project EIS)