Vickery Coal Project

Environmental Impact Statement

APPENDIX H

VISUAL ASSESSMENT

Resource Strategies

WHITEHAVEN COAL

Vickery Coal Project

Visual Assessment

Final Report

October 2012

urbis

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FIGURES:

PLATES:

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1 Introduction

1.1 SUMMARY DESCRIPTION OF THE PROJECT

Whitehaven Coal Limited (Whitehaven) proposes to develop an open cut mining operation known as the Vickery Coal Project (the Project) approximately 25 kilometres (km) north of Gunnedah in New South Wales (NSW) (***Figure 1***).

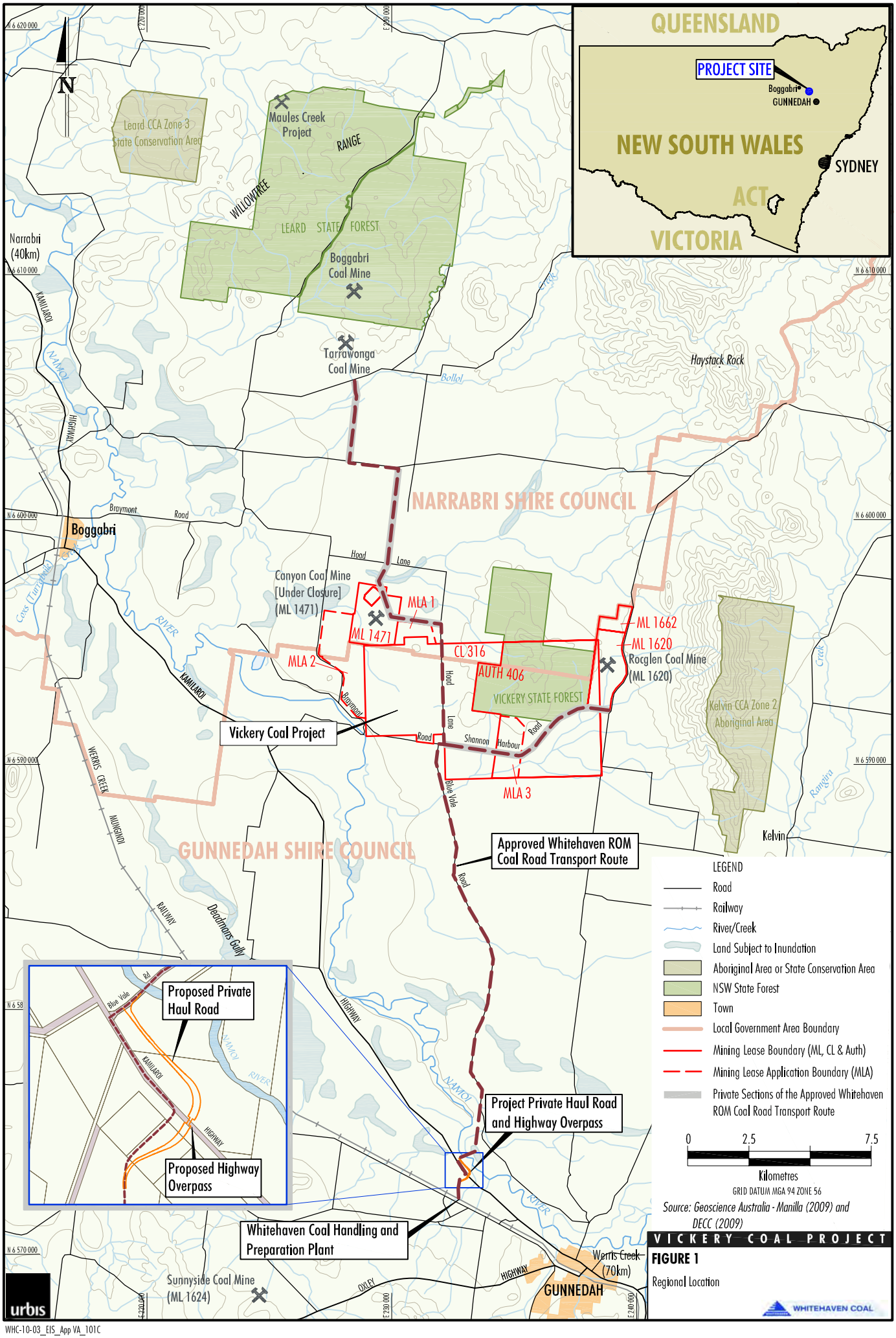
The Project is located at the site of the previous Vickery Coal Mine which was operated during the 1980s and 1990s, and has subsequently been closed and rehabilitated. The site is currently in care and maintenance.

The Project would involve the development of an open cut coal mine and associated infrastructure, producing up to approximately 4.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for a period of approximately 30 years.

Whitehaven is seeking approval for the Project under Division 4.1, Part 4 of the NSW *Environmental Planning and Assessment Act, 1979*.

The main activities associated with the development of the Project are shown on ***Figures 2*** to ***7*** and listed below:

- Development and operation of an open cut mine within Coal Lease 316, Authorisation 406, Mining Lease (ML) 1471, Mining Lease Application (MLA) 1, MLA 2 and MLA 3.
- Use of conventional mining equipment, haul trucks and excavators to remove up to 4.5 Mtpa of ROM coal and approximately 48 million bank cubic metres of waste rock per annum from the planned open cut.
- Placement of waste rock (i.e. overburden and interburden/partings) within external emplacements to the west and east of the planned open cut (i.e. Western Emplacement and Eastern Emplacement) and within mined-out voids.
- Construction and use of a Mine Infrastructure Area (MIA), including on-site coal crushing, screening and handling facilities to produce sized ROM coal, workshops, offices and services.
- Transport of ROM coal by haulage trucks to the Whitehaven coal handling and processing plant (CHPP) on the outskirts of Gunnedah (approximately 20 km to the south of the Project open cut) for processing.
- Use of an on-site mobile crusher for coal crushing and screening of up to 150,000 tonnes (t) of domestic specification coal per annum for direct collection by customers at the Project site.
- Use an on-site mobile crusher to produce up to approximately 90,000 cubic metres of gravel materials per annum for direct collection by customers at the Project site.
- Construction and use of water supply bores, and a surface water extraction point on the bank of the Namoi River and associated pump and pipeline systems.
- Construction and use of new dams, sediment basins, channels, dewatering bores and other water management infrastructure required to operate the mine.
- Construction and use of new soil stockpile areas, laydown areas and gravel/borrow areas.
- Construction of a 66 kilovolt (kV)/11 kV electricity substation and 11 kV electricity transmission line.



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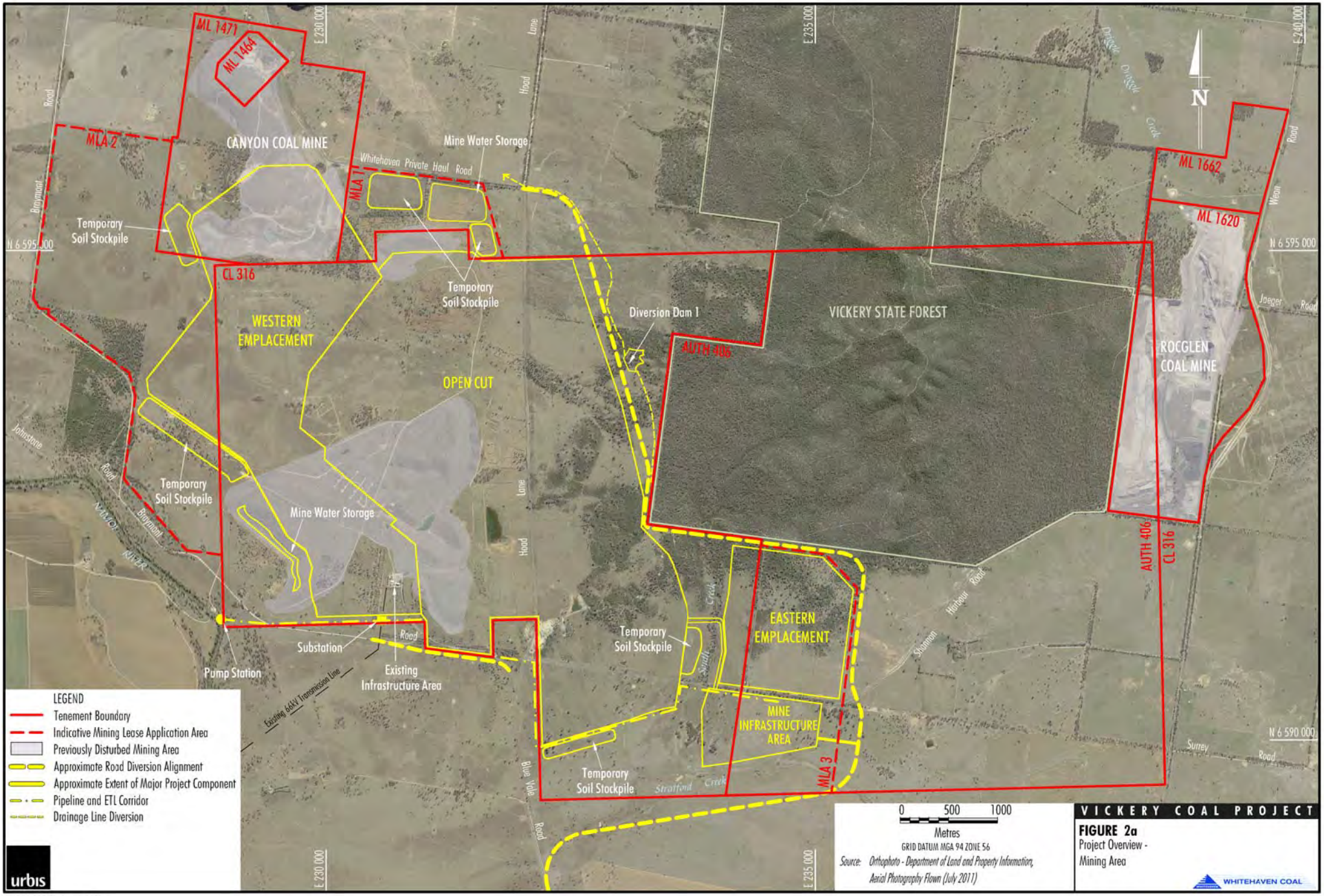

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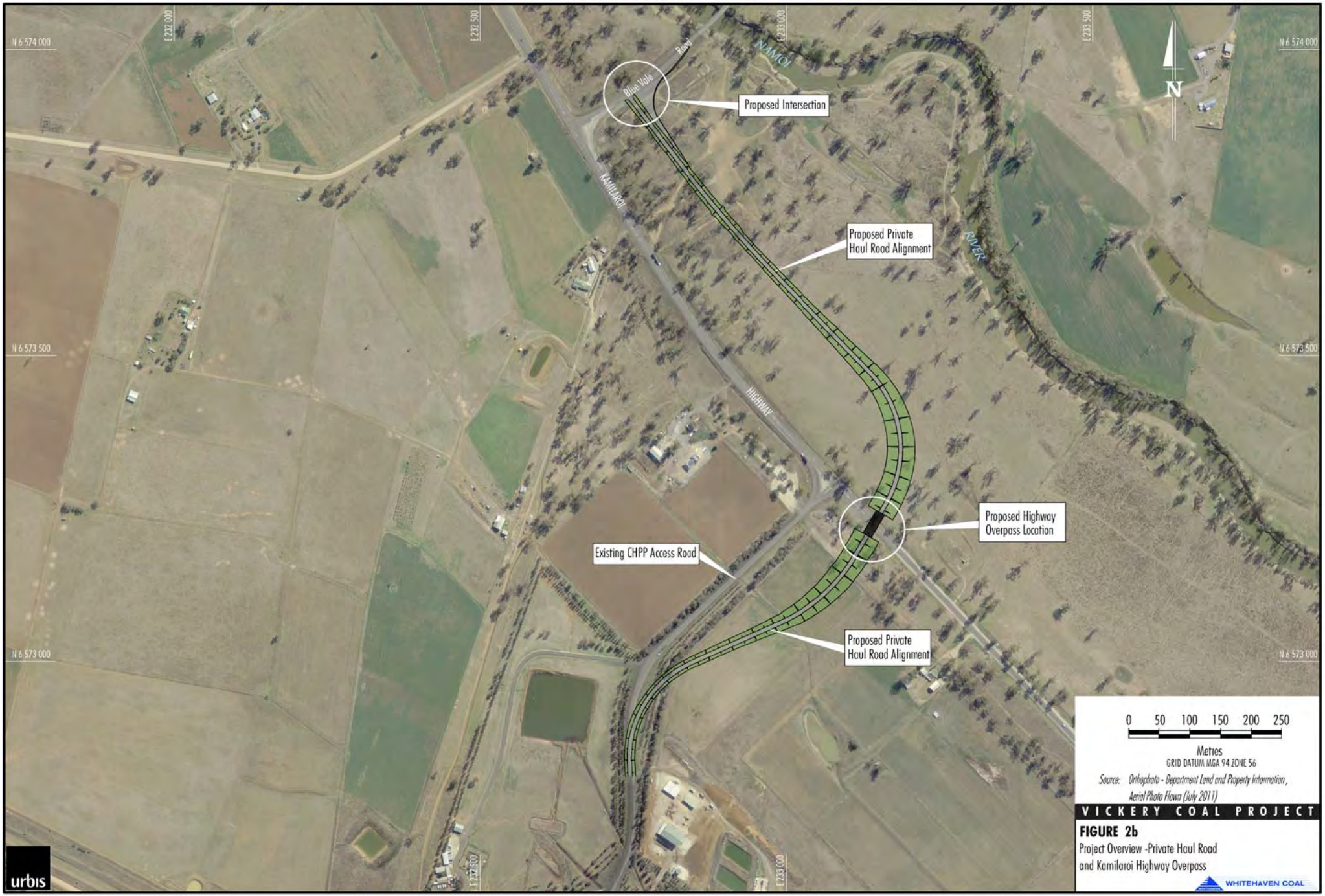

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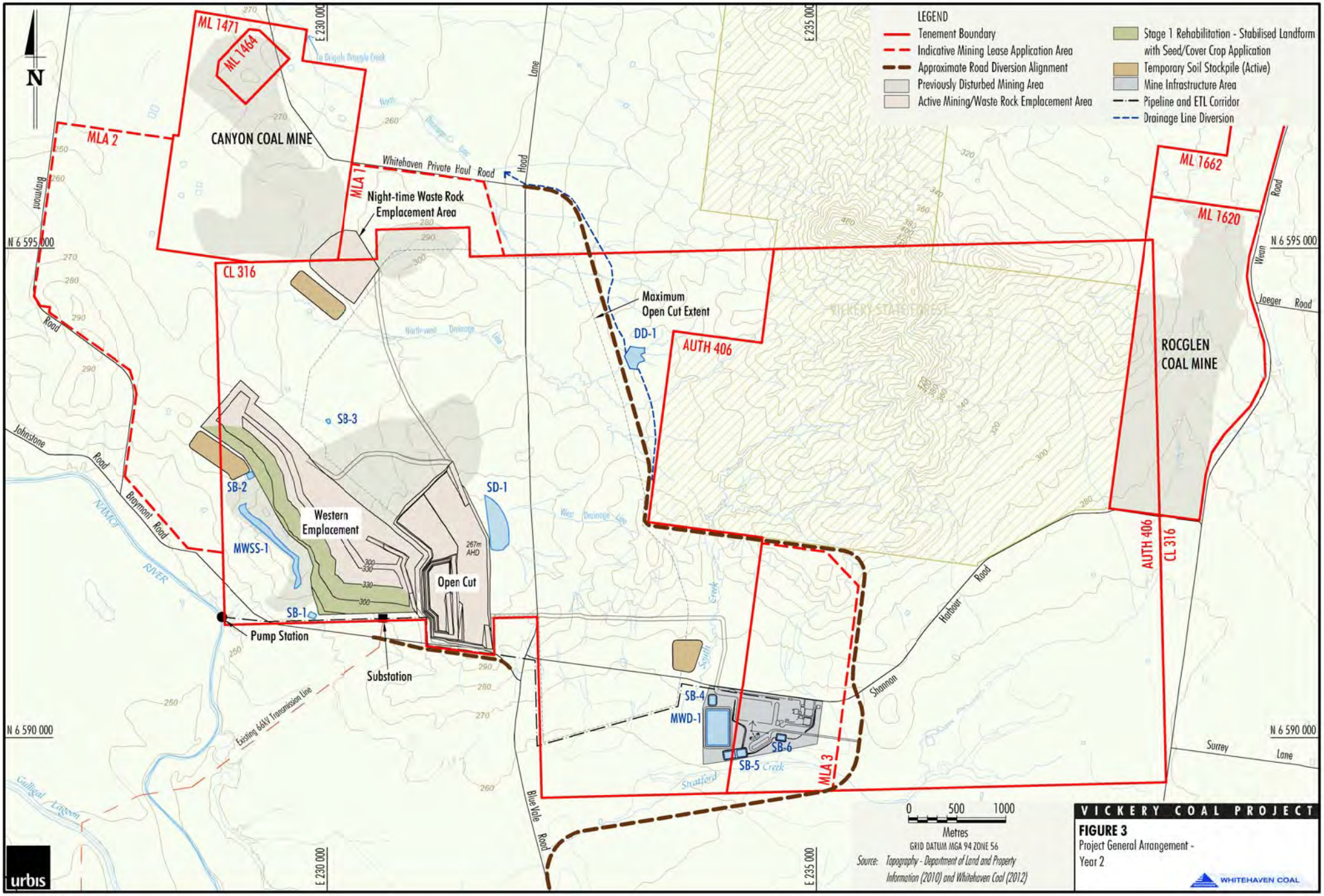

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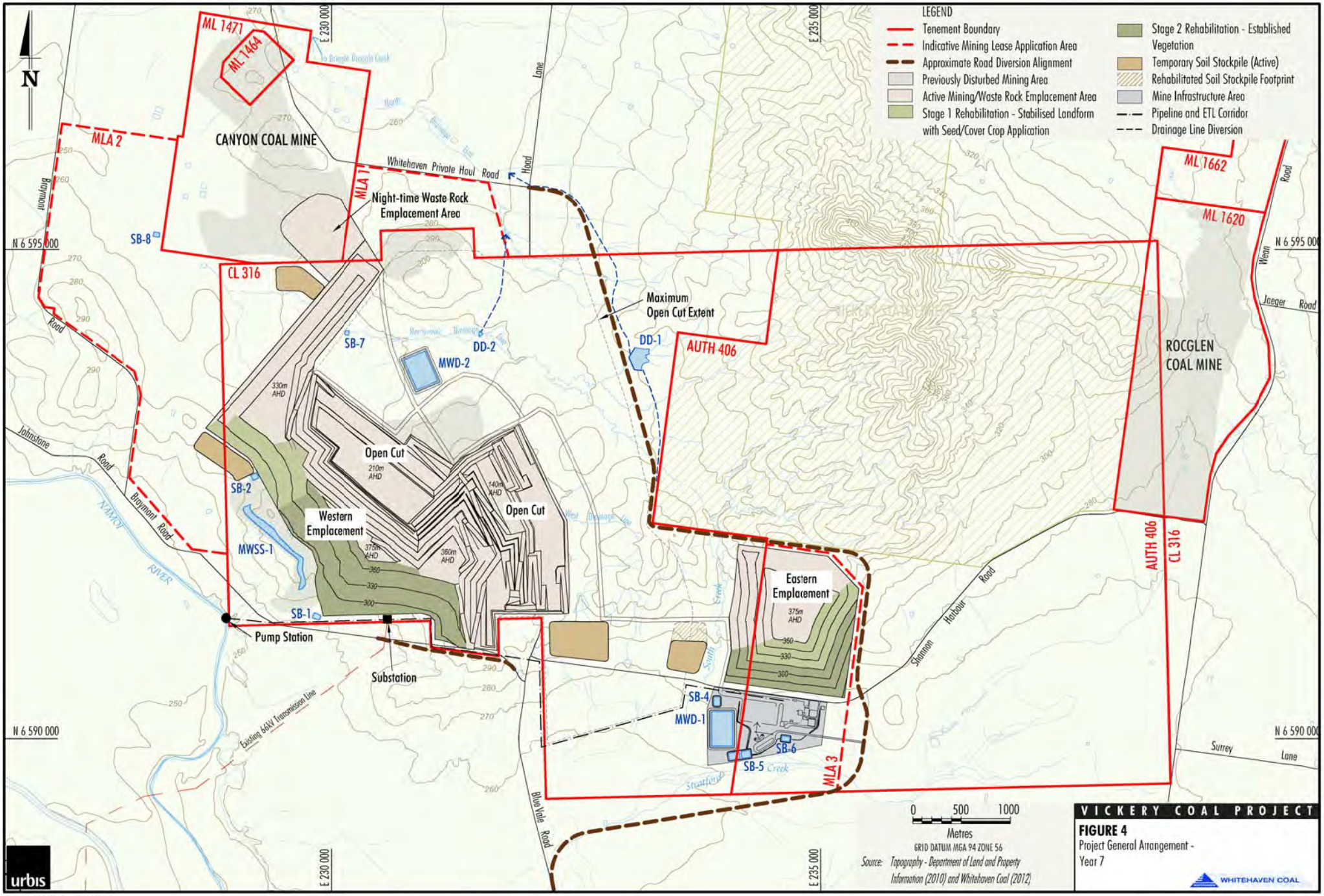

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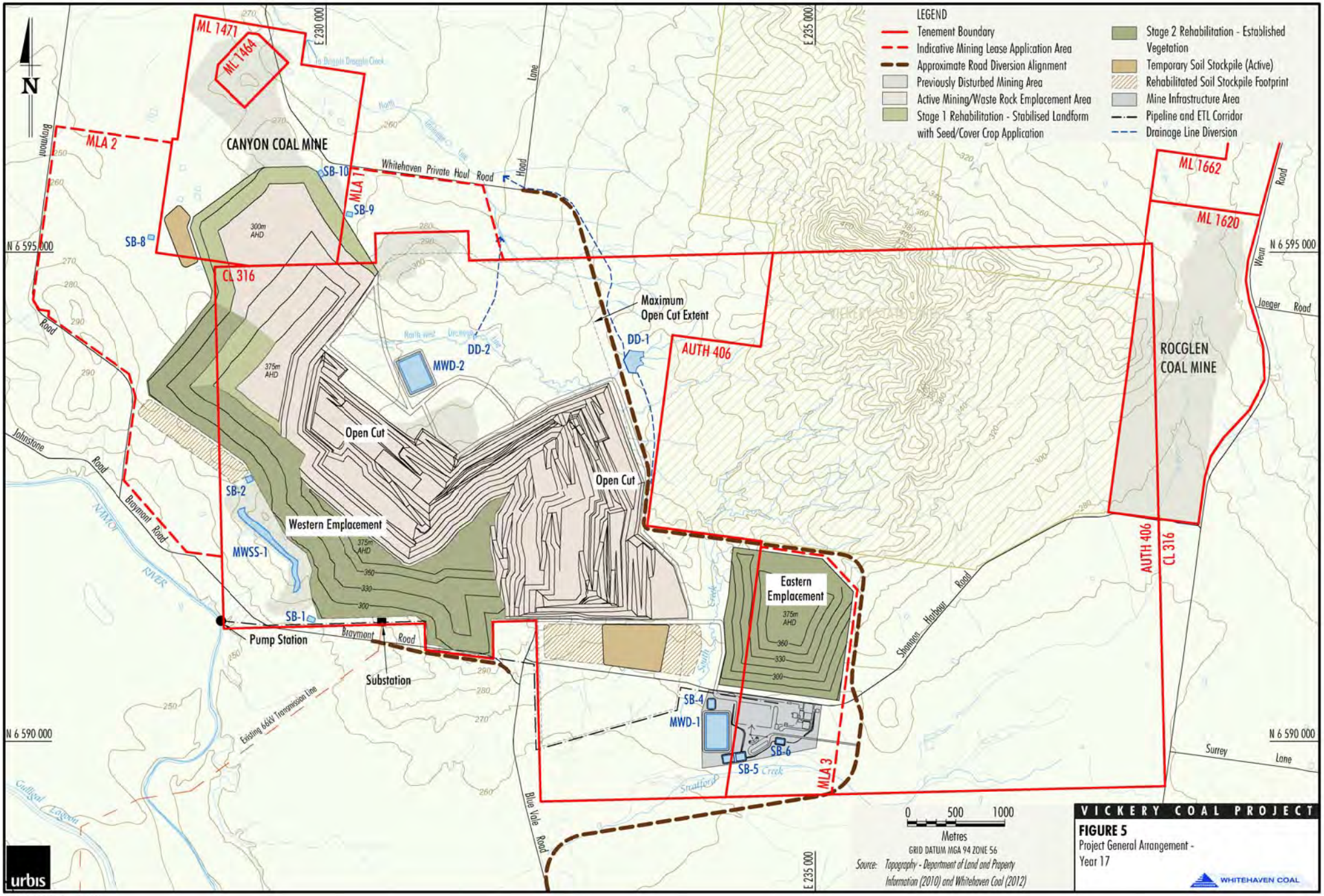

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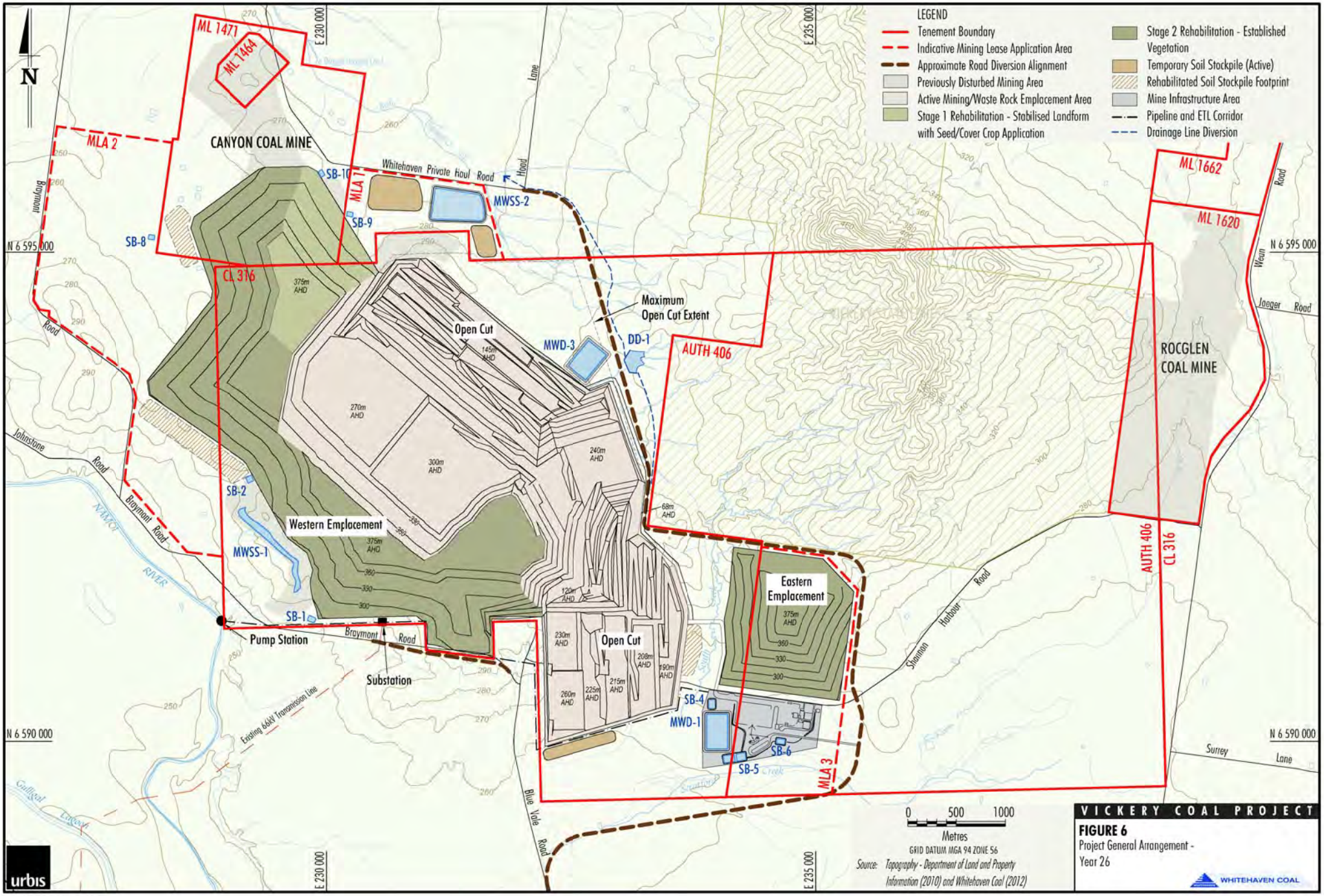

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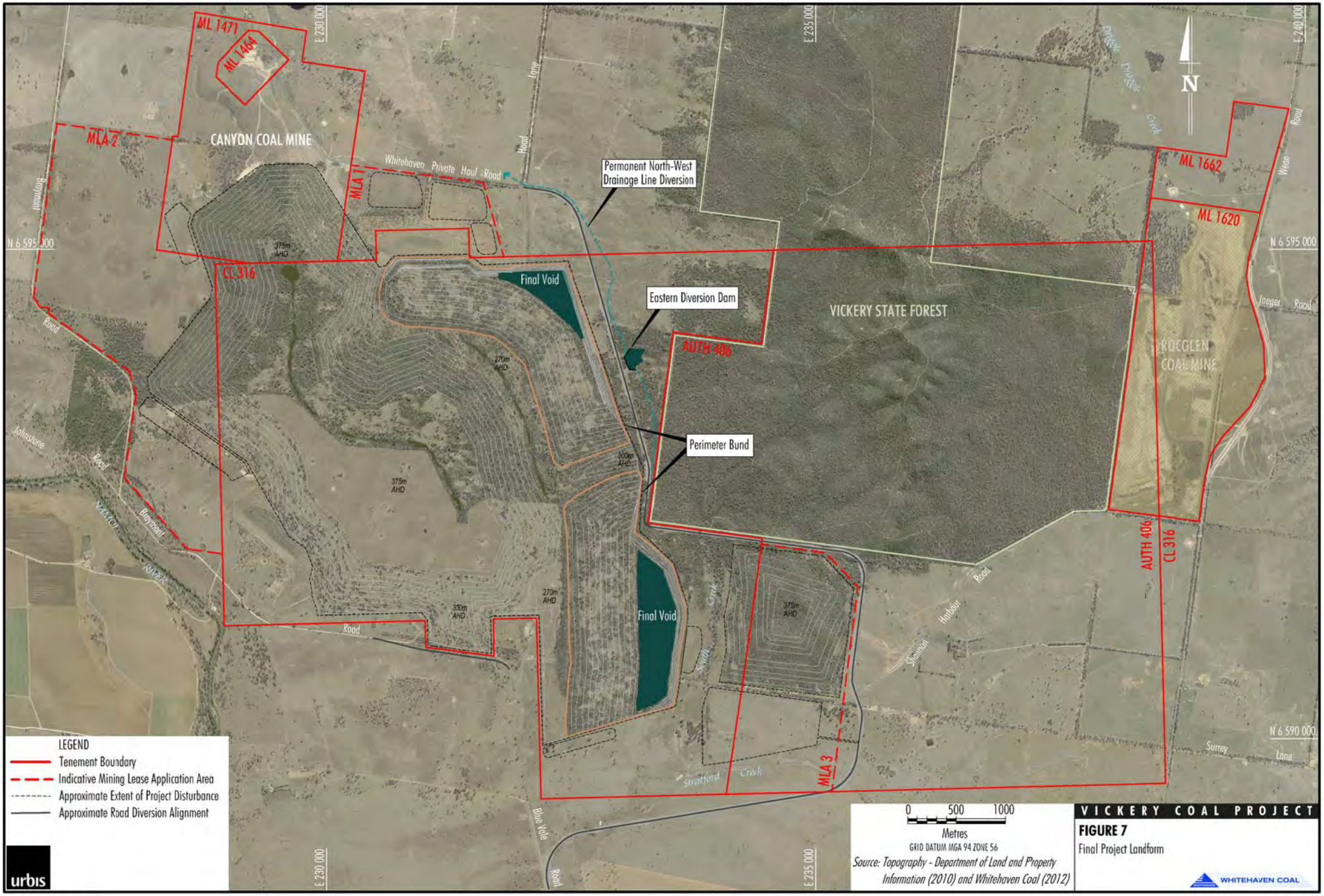

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- Transport of coarse rejects generated within the Whitehaven CHPP via truck to the Project for emplacement within an in-pit emplacement area.

- Transport of tailings (i.e. fine rejects) generated within the Whitehaven CHPP via truck to the Project for emplacement within co-disposal storage areas in the open cut and/or disposal in existing off-site licensed facilities (e.g. the Brickworks Pit).

- Realignment of sections of Blue Vale Road, Shannon Harbour Road and Hoad Lane to the east and south of the open cut.

- Realignment of the southern extent of Braymont Road to the south of the open cut.

- Construction of an approximately 1 km long section of private haul road (including an overpass over the Kamilaroi Highway) between Blue Vale Road and the Whitehaven CHPP.

- Ongoing exploration, monitoring and rehabilitation activities.

- Construction and use of other associated infrastructure, equipment and mine service facilities.

Urbis has been commissioned to undertake specialist landscape and visual impact assessment services for the Project.

1.2 OBJECTIVES OF THE STUDY

Key components of the assessment are to:

- Define the criteria relevant to the study including legislation, standards and methodology (***Section 1.3***).

- Prepare a characterisation of the existing landscape features and of landscape character and scenic quality within the regional setting (***Section 2***).

- Review the main aspects of the Project in regard to potential visual impacts (***Section 3***).

- Preparation of a Zone of Visual Influence (ZVI) analysis which compares the viewsheds of the existing environment and the Project to identify potential viewpoints (***Section 5.1.2***).

- Assess the potential visual impacts of the Project on identified sensitive receptors, including potential night lighting impacts (***Section 5***).

- Identify and propose design responses and measures for the reduction, mitigation and management of potential visual impacts (***Section 6***).

1.3 STUDY METHOD

The study approach has been based on an analysis of the visual setting and assessment of the potential impacts of the development of the Project. The methodology is comprised of a number of components. These are:

- **Quantitative Assessment (*Appendix A*):**

  - How much of the proposed development is visible from particular viewpoints?

- **Qualitative Assessment:**

  - Visual modification – How does the proposed development contrast with the landscape character of the surrounding setting?

  - What is the quality of the landscape setting?

  - Sensitivity – How sensitive would viewers be to the proposed development?

1.3.1 APPROACH TO ASSESSMENT

The methodology employed by Urbis is based on the Visual Management System (VMS) (United States Department of Agriculture Forest Service, 1974) methodology. The basis of this methodology is that the visual impact of a proposed development is determined by evaluating the degree of visual modification/fit of the development in the context of the visual sensitivity of surrounding land use areas from which a proposed development may be visible. The visual impact resulting from the combination of visual modification and visual sensitivity, or viewer sensitivity, is illustrated in ***Table 1*** and ***Figure 8***.

Level of Visual Impact VL = Very Low, L = Low, M = Moderate, H = High		**Viewer Sensitivity**		
		H	M	L
Level of Visual Modification	H	H	H	M
	M	H	M	L
	L	M	L	L
	VL	L	VL	VL

Table 1 – Visual Impact Matrix

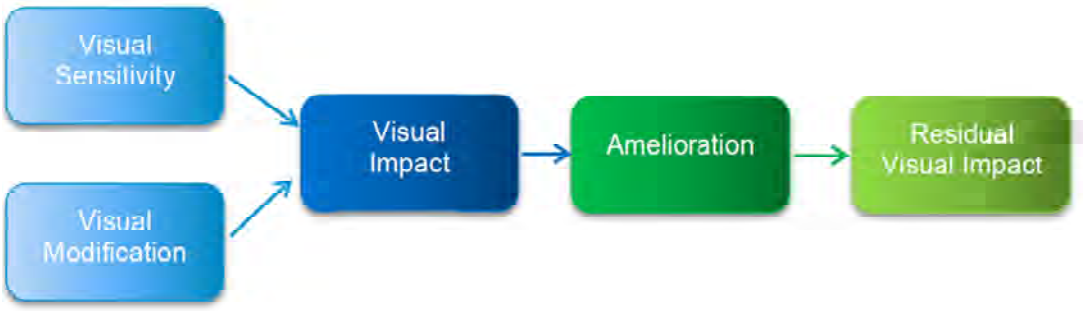


Figure 8 – Visual Assessment Process

VISUAL MODIFICATION

The visual modification level of a proposed development can be best measured as an expression of the visual interaction, or the level of visual contrast between the development and the existing visual environment (Zube *et al.,* 1976). Throughout the visual catchment, the level of visual modification generally decreases as the distance from the development to various viewpoint locations increases, and is categorised as follows:

- Negligible (or very low) level of visual modification – where the development is distant and/or relates to a small proportion of the overall viewscape.

- Low level of visual modification – where there is minimal visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the development and the landscape. In this situation the development may be noticeable, but does not markedly contrast with the existing modified landscape.

- Moderate level of visual modification – where a component of the development is visible and contrasts with the landscape, while at the same time achieving a level of integration. This occurs where surrounding topography, vegetation or existing modified landscape provide some measure of visual integration or screening.

- High level of visual modification – where the major components of the development contrast strongly with the existing landscape.

VISUAL SENSITIVITY

Visual sensitivity is a measure of how critically a change to the existing landscape will be viewed from various use areas (Brush and Shafer, 1975). Different activities undertaken within the landscape setting have different sensitivity levels. For example, tourists who are using the surrounding landscape as a part of the holiday experience will generally view changes to the landscape more critically than agricultural or industrial workers in the same setting. Similarly, individuals will view changes to the visual setting of their residence more critically than changes to the visual setting of the broader setting in which they travel or work.

The visual sensitivity of the development depends on a range of viewer characteristics. The primary characteristics used in this study are:

- Land use.

- Distance of the development from viewers.

- Its visibility from critical viewing areas.

- View angle.

The visual sensitivity of land uses was assessed to assist in determining the visual impact of the development. As distance from the viewer to the proposed development increases, the level of sensitivity reduces.

Typical levels of viewer sensitivity for the study area are based on levels of visual significance as described in the VMS methodology, and are outlined in ***Table 2***.

VISUAL PROMINENCE – RELATIONSHIP WITH VIEWSHEDS

This report defines a number of viewsheds based on distance from the Project for the purposes of assessment. The methodology is based on the reduction of impact with an increase in distance between a given viewpoint and the Project. The potential visual impact of the Project would also, to a large extent, depend on how much of the central field of vision it occupies (***Table 3***, ***Table 4***, ***Table 5*** and ***Appendix A***).

Throughout the visual catchment (or ZVI) the degree of visual prominence will generally decrease as the distance from the development site to various viewing locations increases.

The quantitative assessment of visibility, i.e., how much is potentially visible, is intertwined with the distribution, height and density of vegetation throughout the visual catchment as well as topography.

VISUAL USE AREA	FOREGROUND		MIDDLEGROUND		BACKGROUND
	Local Setting		Sub- Regional Setting		Regional Setting
	0 - 0.5 km	0.5 – 1 km	1 - 2 .5 km	2.5 - 5 km	> 5 km
Residences/Townships	H	H	H	M	L
Highways/Tourist Routes	H	M	M	L	L
State Forest (Timber production)	M	M	L	L	VL
Local Roads	L	L	L	VL	VL
Agricultural Areas	L	L	L	VL	VL
Mining Areas	VL	VL	VL	VL	VL
H = High, M = Moderate, L = Low, VL = Very Low					

Source: United States Department of Agriculture Forest Service (1974)

Table 2 – Typical Visual (Viewer) Sensitivity

Degrees of Field of View Occupied	Potential Visual Prominence – Horizontal Field of View
Less than 5^{o}	***Insignificant – Low Visual Prominence*** The development may not be highly visible in the view unless it contrasts strongly with the background.
5^{o} – 30^{o}	***Potentially Noticeable – Moderate Visual Prominence*** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 30^{o}	***Potentially Dominant – High Visual Prominence*** The development will be highly noticeable.

Table 3 – Horizontal Line of Sight – Visual Impact/Visual Prominence

Degrees of Field of View Occupied	Potential Visual Prominence – Vertical Field of View
Less than 0.5^{o}	***Insignificant – Low Visual Prominence*** A small thin line in the landscape.
0.5^{o} – 2.5^{o}	***Potentially Noticeable – Moderate Visual Prominence*** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 2.5^{o}	***Potentially Dominant – High Visual Prominence*** The development will be highly noticeable, although the degree of visual intrusion will depend on the landscape setting and the width/spread of the object.

Table 4 – Vertical Line of Sight – Visual Impact/Visual Prominence

Distance from Object	Potential Visual Prominence
5,000 m (Regional viewshed)	***Visibility Diminishing*** The visual prominence of the element progressively diminishes over distance.
1,000 – 5,000 m (Sub-regional viewshed)	***Potentially Noticeable*** The development will be noticeable. The degree that it intrudes on the view will increase as distance reduces.
Less than 1,000 m – (Local viewshed)	***Potentially Dominant*** The development may be highly noticeable.

m = metre

Table 5 – Visual Prominence in Relation to Distance and Viewshed Settings

IMPACTS OF NIGHT-LIGHTING

Given the lack of Australian standards for the assessment of lighting impacts, the assessment of the impacts of lighting at night-time has been based on the United Kingdom's *Guidance Notes for the Reduction of Obtrusive Light* (***Appendix B***).

2 The Existing Landscape

This assessment has been undertaken for the following settings:

- ***Regional*** – more than 5 km from the Project.
- ***Sub–regional*** – between 1 km and 5 km from the Project:
  - *Distant Sub–regional* – between 2.5 km and 5 km from the Project.
  - *Near Sub–regional* – between 1 km and 2.5 km from the Project.
- ***Local*** – within 1 km of the Project.

2.1 SITE CONTEXT AND SUMMARY

The Project is located approximately 25 km north of the town of Gunnedah and 15 km south-east of Boggabri within the Gunnedah Basin in northern NSW. The Namoi River is located in close proximity to the south-western corner of the Project.

The region contains a number of existing coal mines as well as rehabilitated mines (***Section 2.2***).

2.2 LAND USE

2.2.1 REGIONAL SETTING (> 5 KM)

The regional setting is primarily comprised of broad scale agriculture, predominately grazing and crop production. The Namoi River Valley extends roughly north to south, to the west of the Project.

The infrastructure associated with the region includes roads, the most significant being the Kamilaroi Highway, rail lines and power lines of varying voltages and scales.

The town of Boggabri is located approximately 15 km to the north-west and Gunnedah, the major regional centre, approximately 25 km to the south.

A number of coal mines exist within the regional setting. These are the Tarrawonga Coal Mine and Idemitsu Boggabri Coal Mine, which are located 10 km and 15 km respectively to the north (***Figure 1***).

2.2.2 LOCAL (< 1 KM) AND SUB–REGIONAL SETTING (1 TO 5 KM)

As for the regional setting, broad scale agriculture is the main land use activity within the local and sub-regional setting.

The Rocglen Coal Mine is located 5 km to the east, and the north-western part of the Project area (ML 1471) incorporates the rehabilitated landform (including final void) of the former Canyon Coal Mine (***Figure 2***).

The Kamilaroi Highway traverses the sub-regional setting to the south-west of the Project. Local roads, both sealed and unsealed, including Blue Vale Road, which forms a component of the haul route from the Tarrawonga Coal Mine to the Whitehaven CHPP, are located throughout the sub-regional and local settings.

The Vickery State Forest immediately abuts the eastern boundary of the Project.

2.3 VEGETATION AND LANDSCAPE FORM AND CHARACTER

The patterning created by broad scale agriculture is the dominant human influence on the landscape in the region***. Figure 2*** and ***Plate 1*** illustrate the broad landscape character, patterns, vegetation cover and landform within the region.

The landscape is subjected to seasonal change, with the stages of agricultural production creating a cycling transition from the colour of raw soils resulting from tilling and cultivation, to the bright greens of emerging and growing crops, to the straw brown colour of mature crops awaiting harvest.

2.3.1 REGIONAL SETTING (> 5 KM)

The Namoi River and its broad valley are the dominant elements of the physical landscape, although their flat topographic form, combined with scatted vegetation makes them recessive elements from a visual perspective.

A number of reserved areas are also located in the regional setting of the Project (in addition to the Vickery State Forest [Section 2.3.2]) including Leard Coordinated Conservation Area (CCA) Zone 3 State Conservation Area (located approximately 12 km to the north), Kelvin CCA Zone 2 Aboriginal Area (located approximately 9 km to the east), and Mount Kaputar National Park (located approximately 25 km to the north) (***Figure 1***).

2.3.2 LOCAL SETTING (< 1 KM) AND SUB–REGIONAL SETTING (1 TO 5 KM)

Within the local and sub-regional setting the Vickery State Forest is a heavily vegetated high point, attaining a maximum elevation of approximately 479 m Australian height datum (AHD), abutting the eastern edge of the Project. Scattered vegetation extends from the forest into the Project area. However, the remainder of the local and sub-regional setting is generally free of vegetation apart from remnants along waterways and road reserves.

The rural residences throughout the landscape are generally located within a surrounding band of vegetation.

Plate 1 – Typical Landscape Character

2.4 LANDSCAPE SCENIC QUALITY

It has been established through previous studies that scenic quality increases as topographic ruggedness and relative relief increase (Leonard and Hammond, 1984; Burns and Rundell, 1969; Anderson *et al*., 1976). Scenic quality, particularly in modified landscapes, can also increase as the patterning of vegetation increases.

The area surrounding the Project comprises a number of distinct land use types and landscape units of varying levels of landscape quality. These have been defined as follows:

- Agricultural Areas – the Project is abutted to the north and south by heavily cleared dryland agriculture areas. The irrigated crop production area of the Namoi Valley is located to the south and west.

- Existing Coal Mines – the Rocglen Coal Mine, located to the east of the Project, and the Tarrawonga and Boggabri Coal Mines, located in the regional setting to the north, are open cut coal mining operations.

- Historic Coal Mines – the final void of the Canyon Coal Mine forms part of the Project area in the north, and historic mining activities associated with the former Vickery Coal Mine form part of the existing landscape within the Project area (e.g. final voids and rehabilitated waste emplacements).

- Vickery State Forest – located to the immediate east of the Project, is a wooded area of higher elevation in the local area.

- Residential Dwellings – detached private dwellings located to the north, south and west of the Project.

- An unnamed wooded range (incorporating the Kelvin CCA Zone 2 Aboriginal Area) – running north to south, approximately 9 km to the east of the Project with a number of peaks to a maximum elevation of 823 m AHD.

- Namoi River and Namoi River Valley – a major regional river that abuts the Project area to the south-west.

Major topographic features in the vicinity of the Project are shown on ***Figure 1***. A description of landscape character and scenic quality for each of these settings is provided below.

2.4.1 REGIONAL SETTING (>5 KM)

The regional setting has attributes of moderate scenic quality due to the presence of the unnamed wooded range 9 km to the east of the Project. The contrast between the vegetation and topography of the ranges and agricultural areas of the valley adds to visual interest. The regional setting also has many attributes of low scenic quality due to the generally flat, cleared dryland agricultural areas that dominate the landscape.

2.4.2 SUB-REGIONAL SETTING (1-5 KM)

The sub-regional setting has attributes of low scenic quality due to the presence of flat, cleared dryland agricultural areas, but has attributes of moderate scenic quality due to the presence of Vickery State Forest and the meandering form of the Namoi River with its associated riparian remnant vegetation. The patterning created by the irrigated crops of the Namoi Valley provides some visual interest and results in a moderate scenic quality.

Areas of cleared agricultural land are interspersed with vegetation generally associated with local roads and dwellings and other farm buildings.

2.4.3 LOCAL SETTING (<1 KM)

The local setting has been heavily modified over time with the majority of vegetation, apart from the Vickery State Forest, disturbed by historic agricultural clearing and past mining operations. The overall visual character of the local setting is considered to be of low scenic quality.

Notwithstanding, to the immediate east of the Project, is the Vickery State Forest (***Figure 2***) which predominantly comprises native woodland and forest vegetation and is of moderate scenic quality. The Vickery State Forest is zoned for the purposes of forestry, recreation and mineral extraction.

2.5 ABSORPTIVE CAPABILITY

The definition of landscape absorptive capability is closely related to that of visual modification levels. It is generally applied at a broader scale than visual modification and is an assessment of how well a landscape setting is able to accommodate change or a development.

The key factors considered in determining absorptive capability are topography and vegetation. In areas of flatter topography, overlooking is not possible and a low and thin band of vegetation is able to screen views to a development from a given viewpoint. In areas of undulating or elevated topography, overlooking can occur and vegetation needs to be higher and denser to achieve effective screening. Intervening undulating topography also has the potential to block views in certain landscapes.

The landscape settings of the Project and its sub-regional and regional surroundings (the primary areas subject to visual impact) have absorptive capabilities as described in ***Section 2.5.1***.

2.5.1 LOCAL, SUB-REGIONAL AND REGIONAL SETTING

As previously described, apart from the localised highpoint of the Vickery State Forest to the east, which is not readily accessible by the public, and the un-named range further to the east, the landscape of the setting is generally flat with vegetation confined to a rectilinear pattern reflecting property boundaries and roads. Within this landscape, overlooking is not possible and even relatively low vegetation (up to eye-height) is effective at screening views.

Topography – High absorptive capability due to flat topography and minimal potential for overlooking.

Existing Vegetation – Generally low for cleared agricultural areas. Moderate to high absorptive capability where vegetation exists.

3 Description of Project Form

3.1 BROAD DESCRIPTION OF THE PROJECT

The proposed mining method would involve mining of coal and overburden using conventional drill, blast, load and haul mining methods. Following drilling and blasting, coal and overburden would be loaded by hydraulic excavators or front-end loaders to dump trucks and the coal would be transported for primary crushing. As discussed above, overburden would be moved within the open cut as in-fill or transported to out-of-pit waste rock emplacements.

ROM coal would be processed at primary crushers within the MIA (***Figure 2***) before being transferred to trucks and transported via Blue Vale Road to the Whitehaven CHPP.

The Project is described in detail in Section 2 in the Main Report of the EIS.

3.2 COMPONENTS OF THE PROJECT

The Project would involve the development of major components that will modify the landscape setting. From a visual impact perspective, the most dominant elements of the Project are the waste rock emplacements and the open cut and MIA. The components of the Project most relevant to visual assessment are outlined in ***Table 6***. The dimensions of the spatial elements represent the upper range to ensure a conservative approach to visual impact assessment.

NON-SPATIAL ELEMENTS	
Project Life	30 years.
Open Cut	Up to two active mining areas.
Vegetation Rehabilitation	All areas to be rehabilitated when they are no longer required.
Overburden	Two waste rock emplacements – Western and Eastern – located either side of the open cut.
Coal Handling Infrastructure	ROM coal would be hauled to the primary crushing facilities at the MIA, before being loaded onto trucks for transport to Whitehaven CHPP. A grade separation of the haul road and Kamilaroi Highway is proposed access the Whitehaven CHPP.
SPATIAL ELEMENTS	
Surface Area of Final Voids	Southern void approximately 145 ha, northern void approximately 185 ha (at surface level).
Depth of Open Cut	Up to approximately 250 m below existing ground level.
Height of Waste Rock Emplacements	375 m AHD (up to approximately 100 m above existing ground level).
Combined Surface Area of External Waste Rock Emplacements	Approximately 775 ha.

Table 6 – Summary of Project Components Relevant to the Visual Assessment

4 Potential Visual Impacts

This assessment has been prepared to define areas of highest visual impact and to assist in the mitigation of impacts of the proposed works from sensitive viewpoints.

4.1 DEVELOPMENT COMPONENTS

From a visual impact perspective, the most dominant elements of the Project are the waste rock emplacements, the open cut and the MIA. The disturbance areas of the components of the Project most relevant to visual assessment are outlined below.

4.1.1 OPEN CUT

Typical open cuts are large scale features within the landscape setting (***Plate 2***). Due to the nature of an open cut being excavated into the earth, large areas of disturbance are often not visible due to the disturbance being below view. However, in some locations, cuts into hill sides can result in highly visible activity. In the case of the Project, the open cut is set in a relatively flat area of topography and will generally not be visible.

The open cut would be selectively mined in benches to a depth of up to approximately 250 m below ground level.

Plate 2 – Typical Open Cut

4.1.2 WASTE ROCK EMPLACEMENTS

The out-of-pit waste rock emplacements are the most visible elements of the Project that, unlike the open cut, protrude above ground level (***Plate 3***). The waste emplacements are proposed to have a maximum height of 375 m AHD. The Western Emplacement, arranged roughly north to south, is approximately 4.8 km in length and in 1.5 km in width. The Eastern Emplacement is roughly 1.3 km square (***Figure 2***).

Some overburden would be directly returned into the mining void. However, backfilling would only commence when sufficient space is available within the open cut to enable direct backfilling.

Stockpiles for topsoil and subsoil would be located adjacent to the mining void and emplacements. Stockpiles would generally be less than 3 m high and temporary and they would be removed and used as part of progressive rehabilitation during the Project life.

The visual impact of emplacements would be reduced by progressive rehabilitation.

Plate 3 – Rocglen Coal Mine Waste Rock Emplacement prior to Profiling and Rehabilitation

4.1.3 OTHER ASSOCIATED INFRASTRUCTURE

Other infrastructure associated with the planned mining of the Project is discussed below.

COAL HANDLING INFRASTRUCTURE

Components of the coal handling infrastructure include elements within and outside the mining area include:

- development of MIA and associated ROM coal handling infrastructure;
- construction of road diversions for sections of Blue Vale Road and Shannon Harbour Road to the east and south of the Project respectively; and
- construction and use of a private haul road between Blue Vale Road and the Whitehaven CHPP including a grade separation of the haul road and Kamilaroi Highway in proximity to the Whitehaven CHPP.

SIGNAGE

Identification, directional, advisory and warning signage would be located throughout the Project area and surrounds.

INTERNAL ROADS

A system of internal roads would be located within the mining area and would be used by both light and heavy vehicles.

Visitor and employee parking areas would be located adjacent to the site administration building. Roads and parking areas would generally be natural aggregate surfaces.

NON-PROCESS INFRASTRUCTURE

Non-process infrastructure, such as administration facilities, maintenance workshops, waste treatment facilities and fuel storage buildings etc., would be typically low profile and unlikely to be visually prominent.

LIGHTING

Mining operations would occur 24 hours a day. Lighting emissions would be of two types:

- *Fixed* – administration and ancillary support buildings.
- *Mobile* – mining fleet headlights. Mobile lighting plants would also be used to provide lighting on loading and dumping areas.

4.2 DURATION OF OPERATION

Mining activity would be undertaken up to 24 hours per day, seven days per week.

5 Assessment of Potential Impact

This assessment has been prepared to define areas of highest visual impact and to assist in the mitigation of impacts of the proposed works from sensitive viewpoints.

5.1 QUANTITATIVE VISUAL IMPACT – PRIMARY VIEWPOINTS

The critical issues to consider in the assessment of visual impact are:

- The number of sensitive viewing locations.
- Degree to which the proposed works are visible.

The method assumes that if the works are not seen, then there is no resulting impact. It has been assumed that the disturbance visible during the mining process will primarily relate to the waste rock emplacements and the open cut.

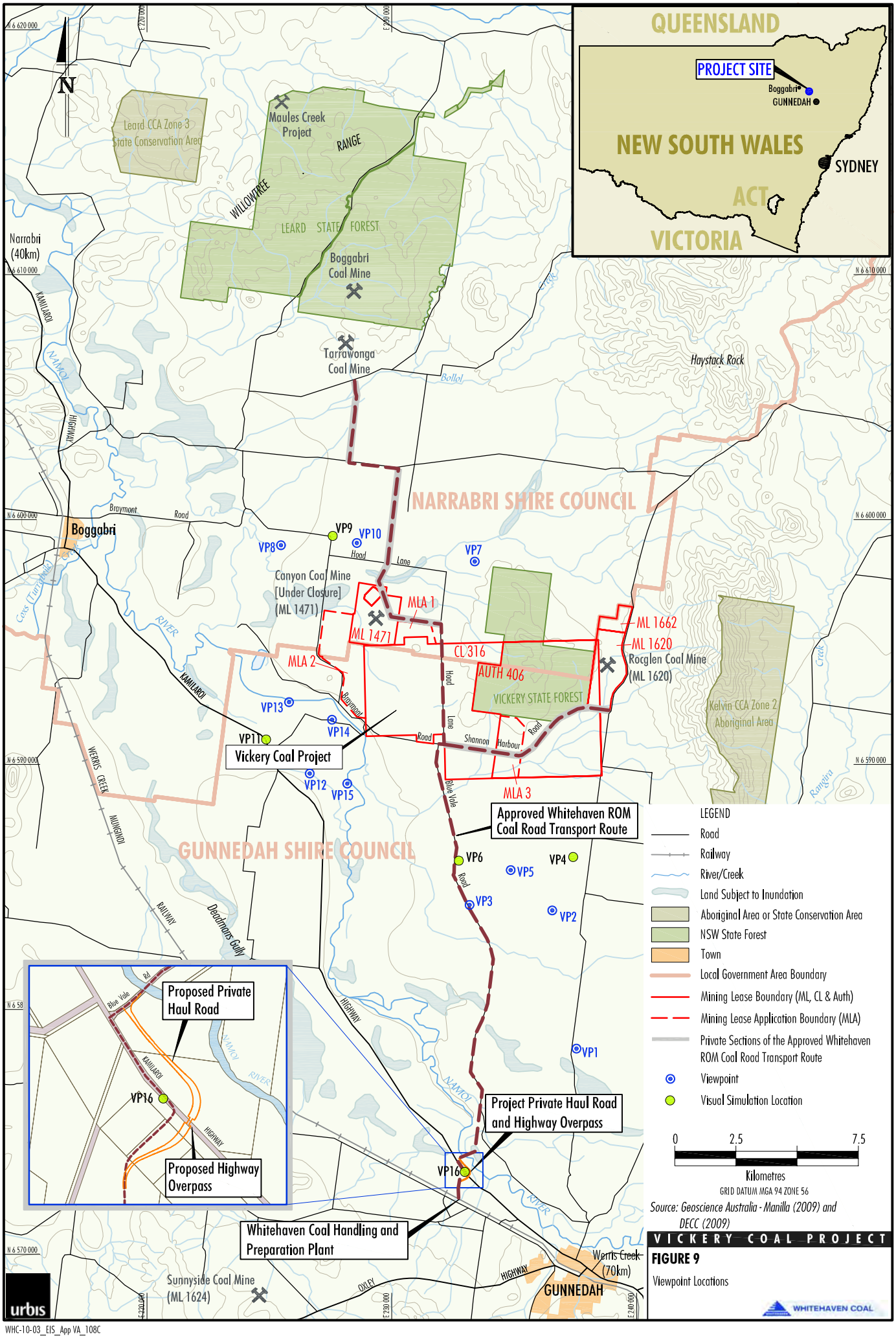
Analysis was undertaken to identify sensitive viewpoints in the vicinity of the Project. Viewpoints, located within the local, sub-regional and regional settings of the Project, were chosen for detailed assessment during a site inspection based on their higher levels of viewer sensitivity (***Figure 9***):

- Rural residences and settlements. It should be noted that there are no residences within the local setting.
- Transport and tourist routes, e.g. Kamilaroi Highway.

The quantitative assessment process has focussed on the visual modification that may result on views for the most sensitive visual settings/land uses, applying the visibility method as described in ***Section 1.3.1*** and ***Appendix A***. Low sensitivity visual settings, such as agricultural production land have not been considered. The quantification of vertical angle is based on the height of the tallest elements of the Project (e.g. waste rock emplacements). The quantification of vertical and horizontal prominence assists with the determination of visual modification. However, it does not take into account aspects such as visual contrast or visual integration which are assessed as part of the qualitative assessment process.

Distances expressed in the quantitative assessment are based on those from the viewpoint to the most visible components of the Project, either the waste rock emplacements or the open cut.

A quantitative assessment of these viewpoints is given in ***Table 7*** and the locations of viewpoints are shown in ***Figure 9***.



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VIEWPOINT *(REFER FIGURE 14)*	VIEWSHED	HORIZONTAL DISTANCE FROM VIEWER (TO CLOSEST COMPONENT)	HORIZONTAL ANGLE	*HORIZONTAL POTENTIAL VISUAL PROMINENCE*	VERTICAL ANGLE	*VERTICAL POTENTIAL VISUAL PROMINENCE*	*VISUAL MODIFICATION LEVEL*
Viewpoint 1 Bengalala (Wean Road)	Regional	12 km (Eastern Emplacement)	24°	Potentially Noticeable	0.45°	Insignificant	Low - partially screened by vegetation
Viewpoint 2 Coulston (Primary Residence)	Regional	6.1 km (Eastern Emplacement)	35°	Potentially Dominant	0.95°	Potentially Noticeable	Low – heavily screened by vegetation
Viewpoint 3 Blue Vale Road (to the south of the Project)	Regional	5 km (Eastern Emplacement)	55°	Potentially Dominant	1.1°	Potentially Noticeable	Low to Moderate - partially screened by vegetation
Viewpoint 4 Brolga	Sub-Regional	4.5 km (Eastern Emplacement)	39°	Potentially Dominant	1.3°	Potentially Noticeable	Low to Moderate - partially screened by vegetation
Viewpoint 5 Coulston (2nd Residence)	Sub-Regional	3.9 km (Eastern Emplacement)	47°	Potentially Dominant	1.5°	Potentially Noticeable	Low to Moderate - partially to heavily screened by vegetation
Viewpoint 6 Blue Vale Road (to the south of the Project)	Sub-Regional	3.3 km (Eastern Emplacement)	58°	Potentially Dominant	1.7°	Potentially Noticeable	Moderate to High
Viewpoint 7 Silkdale	Sub-Regional	3.2 km (Western Emplacement)	57°	Potentially Dominant	1.8°	Potentially Noticeable	Moderate - partially screened by vegetation
Viewpoint 8 Braymont	Sub-Regional	4.8 km (Western Emplacement)	28°	Potentially Noticeable	1.2°	Potentially Noticeable	Low to Moderate - partially screened by vegetation and buildings

Table 7 – Quantitative Assessment

VIEWPOINT *(REFER FIGURE 14)*	VIEWSHED	HORIZONTAL DISTANCE FROM VIEWER (TO CLOSEST COMPONENT)	HORIZONTAL ANGLE	*HORIZONTAL POTENTIAL VISUAL PROMINENCE*	VERTICAL ANGLE	*VERTICAL POTENTIAL VISUAL PROMINENCE*	*VISUAL MODIFICATION LEVEL*
Viewpoint 9 Braymont Road (to the north-west of the Project)	Sub-Regional	3.9 km (Western Emplacement)	34°	Potentially Dominant	1.5°	Potentially Noticeable	Moderate to High
Viewpoint 10 Bungalow	Sub-Regional	3.0 km (Western Emplacement)	39°	Potentially Dominant	1.9°	Potentially Noticeable	Moderate to High
Viewpoint 11 Kamilaroi Highway	Sub-Regional	4.2 km (Western Emplacement)	47°	Potentially Dominant	1.3°	Potentially Noticeable	Moderate to High – partially screened by vegetation
Viewpoint 12 Clinton	Sub-Regional	3.8 km (Western Emplacement)	52°	Potentially Dominant	1.5°	Potentially Noticeable	Moderate - partially screened by vegetation
Viewpoint 13 Mirrabinda (Residence No:1)	Sub-Regional	2.6 km (Western Emplacement)	70°	Potentially Dominant	2.2°	Potentially Noticeable	Moderate to High - partially screened by vegetation
Viewpoint 14 Mirrabinda (Residence No:2)	Sub-Regional	1.6 km (Western Emplacement)	86°	Potentially Dominant	3.6°	Potentially Dominant	Moderate to High - partially screened by mid-ground vegetation
Viewpoint 15 Mirrabinda (Residence No:3)	Sub-Regional	2.6 km (Western Emplacement)	57°	Potentially Dominant	2.2°	Potentially Noticeable	Moderate to High - partially screened by vegetation
Viewpoint 16 Kamilaroi Highway	Local	0.2 km (Overpass)	45°	Potentially Dominant	2.4°	Potentially Noticeable	Moderate to High – approach ramps partially screened by vegetation

Table 7 (Cont.) – Quantitative Assessment

5.1.1 VISUAL SIMULATIONS

Visual simulations, or photosimulations, (based on a computer generated 3D model) have been created for the locations identified in ***Table 8*** and shown on ***Figure 9*** for Year 7 or 17 and Year 26 mining landforms, and for the proposed Kamilaroi Highway overpass.

Visual simulations were prepared using Project landforms for Years 7 or 17 (depending on the viewpoint) as the waste emplacements would have reached maximum height representing the greatest potential for visual impact as the progressive rehabilitation would have commenced but not be fully established. Visual simulations for Year 27 were also developed to represent a stage when rehabilitation of the waste emplacements was largely established (as viewed from most locations) and the landforms would be all but constructed. The rehabilitated landforms take into account the rehabilitation and final land use objectives as described in Section 5 in the Main Report of the EIS (Rehabilitation and Mine Closure).

Visual Simulation Location	Potential View of Project Landforms	Visual Simulation Figure
Adjacent to the "Brolga" Dwelling (privately-owned)	View towards Western and Eastern Emplacements.	Figure 14
Blue Vale Road, 3.3 km south of the Project	View towards Western and Eastern Emplacements.	Figure 17
Braymont Road, 3.9 km north-west of the Project	View towards Western Emplacement.	Figure 20
Kamilaroi Highway, 4.2 km west of the Project	View towards Western Emplacement.	Figure 22
Kamilaroi Highway, 200 m west of the highway overpass	View east towards Kamilaroi Highway overpass.	Figure 27

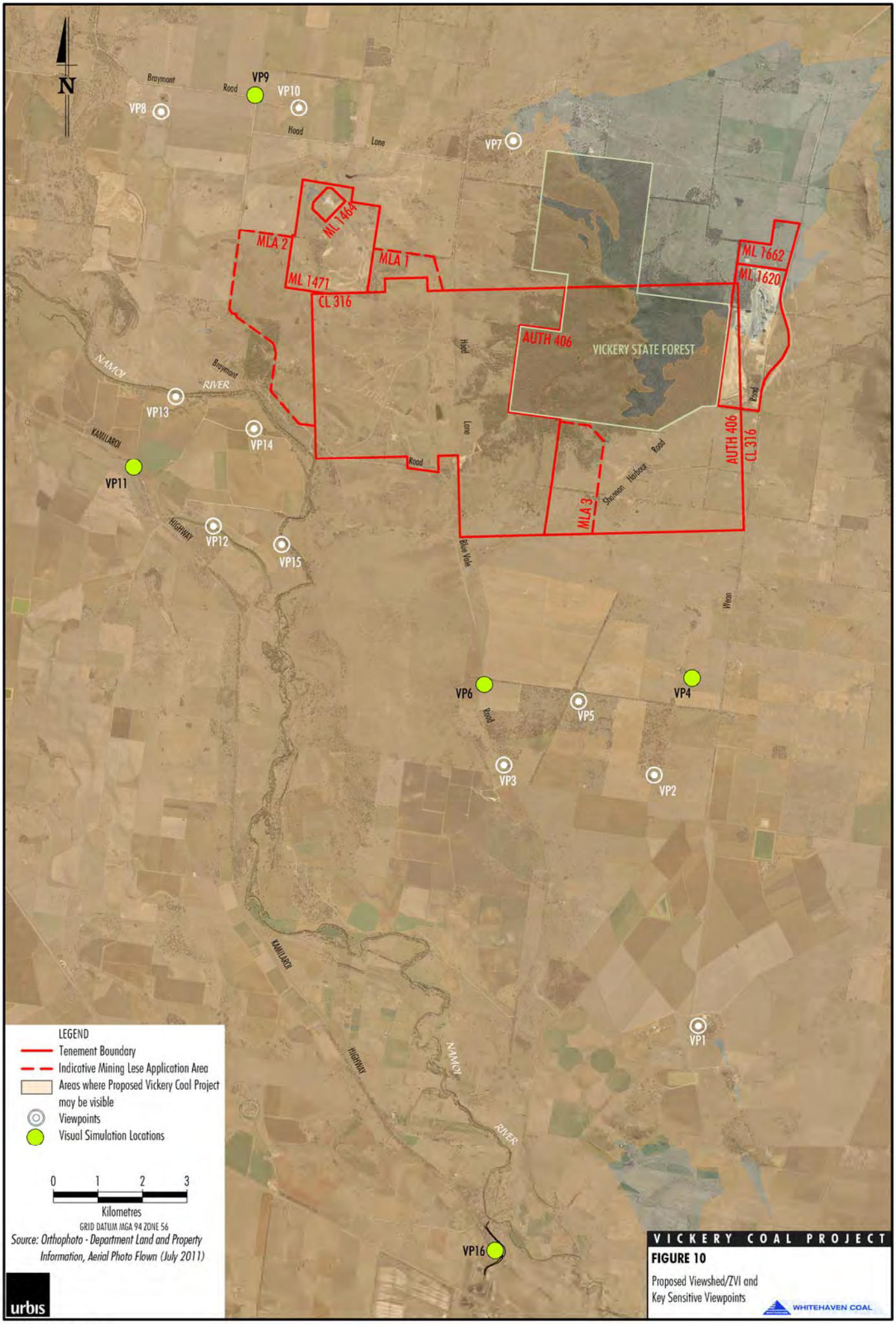
Table 8 – Locations of Visual Simulations

5.1.2 VIEWSHED

The viewshed or ZVI is the area from which views of a particular proposed development may be possible. The viewshed of the Project is shown on ***Figure 10***. The extent of coverage of the ZVI analysis is based on the availability of reliable digital topographic data. The contour interval of the digital terrain model was 10 m for the broader context and 1 m for the Project area.

The ZVI has been generated for the surfaces of the waste rock dumps and the open cut and assume a viewing height for surrounding areas of 1.5 m above ground level.

The ZVI could be considered to be a worst case (i.e. conservative) scenario, with a greater extent of viewshed identified than would actually exist, as it does not take into account the effects of screening of views by vegetation. Its primary purpose is to identify locations from which a proposed development may be visible.



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5.2 QUALITATIVE ASSESSMENT

The following section assesses the potential visual impact of the Project on the sensitive viewpoints described in ***Section 4.1***. Distances expressed in the qualitative assessment are based on those from the viewpoints to the most visible components of the Project, the waste rock emplacements or the open cut.

The assessment has been undertaken for a range of individual viewpoints which are representative of other similar viewpoints within the setting with a similar aspect to the Project.

5.2.1 REGIONAL SETTING

The visual impact of the Project on the regional setting is generally very low to negligible. The level of apparent visual modification from this distance would be low due to the reduction in clarity of viewing that occurs over distance and the presence of intervening scattered vegetation between the Project and the viewpoint.

VIEWPOINT 1 – BENGALALA – WEAN ROAD	
Viewing Location	Wean Road adjacent to the property driveway (***Figure 10***).
Viewing Distance	12 km to the Project (Eastern Emplacement).
Visual Setting	Regional.
Landscape Setting	The residence is located on a well vegetated localised highpoint surrounded by flatter topography (***Figure 11***). In the surrounding area, vegetation is primarily confined to some roadsides and property boundaries (***Figure 12***).
Visual Modification	Existing vegetation would partially screen views out to the surrounding area and the Project. Given the distance from the Project, the relatively minimal topographic variation and the presence of vegetation immediately around the residence, views to the Project may be possible but it would not be visible in its entirety. As a result, the overall visual modification level is considered to be low.
Land Use	Residential, agricultural and local road.
Visual Sensitivity	Low due to distance.
Duration of View	Static (for residence). Dynamic (for road).
Potential Visual Impact	The low visual sensitivity, due to distance from the Project, combined with a low visual modification level, would result in a low visual impact. This would reduce to very low once rehabilitation of the waste emplacements has established.

Figure 11 – Character of Setting – View towards Bengalala Residence from Wean Road

Figure 12 – View North towards the Project from Wean Road adjacent to Bengalala

VIEWPOINT 2 – COULSTON PRIMARY RESIDENCE	
Viewing Location	Edge of “home yard” around primary residence (***Figure 10***).
Viewing Distance	6.1 km to the Project (Eastern Emplacement).
Visual Setting	Regional.
Landscape Setting	The landscape of the regional setting is generally flat with vegetation limited to along roadsides and property or paddock boundaries. Residences are generally contained within a “home yard” surrounded by vegetation, and often work sheds, which partially to fully block views out to the surrounding area (***Figure 13***).
Visual Modification	The established vegetation and sheds partially screens views out to the surrounding area. Given the distance from the Project, the relatively minimal topographic variation, which prevents overlooking, and the presence of intervening vegetation, views to the upper surfaces of the emplacements would be possible but they would not be visible in their entirety. As a result, the overall visual modification level is considered to be low.
Land Use	Residential/agricultural.
Visual Sensitivity	Low due to distance.
Duration of View	Static.
Potential Visual Impact	The low visual sensitivity, due to distance from the Project, combined with a low visual modification level, would result in a low visual impact for the Coulston primary residence as well as for the majority of residences within the regional setting. This would reduce to very low once rehabilitation of the waste emplacements has established.

Figure 13 – View North towards the Project from Coulston Homestead

VIEWPOINT 3 – BLUE VALE ROAD	
Viewing Location	Roadway (***Figure 10***).
Viewing Distance	5 km to the Project (Eastern Emplacement).
Visual Setting	Regional.
Landscape Setting	Blue Vale Road traverses the regional visual catchment of the study area roughly north to south. The landscape is generally flat with intermittent bands of vegetation present along the edges of the road and along local roads and property or paddock boundaries.
Visual Modification	From Blue Vale Road within the regional setting the active, un-rehabilitated operations of the Project would be generally screened by intervening roadside and paddock boundary vegetation. Given the distance from the Project, the relatively minimal topographic variation that prevents overlooking and the presence of vegetation that provides screening, views to the Project from Blue Vale Road in the regional setting may be possible but limited. As a result, the visual modification level is considered to be low.
Land Use	Local road and designated haul road.
Visual Sensitivity	Very low due to distance.
Duration of View	Dynamic/moving.
Potential Visual Impact	The low visual sensitivity, due to distance from the Project, combined with a low visual modification level, would result in a low visual impact for users of Blue Vale Road within the regional setting. This would reduce to very low once rehabilitation of the waste emplacements has established.

5.2.2 SUB-REGIONAL SETTING

The visual impacts on viewing locations within the sub-regional setting would vary according to the visual screening provided by intervening vegetation. The impacts of the proposed development on individual areas are described below.

VIEWPOINT 4 – BROLGA	
Viewing Location	Adjacent to the sheds/yards approximately 100 m north-west of the property house, and at the northern edge of the home yard around house (***Figure 10***).
Viewing Distance	4.5 km to the Project (Eastern Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	The landscape is generally flat and concentrations of denser vegetation occur along roadsides and property or paddock boundaries (***Figure 14***). This residence, like most in the sub-regional setting, is contained with a "home yard" surrounded by vegetation and farm sheds (***Figure 15***).
Visual Modification	Visual simulations from adjacent to the sheds approximately 100 m north-west of the house has been developed (***Figure 14***). The established vegetation and sheds partially screens views out to the surrounding area from the house. Given the distance from the Project, the relatively minimal topographic variation that prevents overlooking and the presence of intervening vegetation, views to the upper surfaces of the emplacements would be possible from a location adjacent to the sheds on the property but they would not be visible in their entirety from the house due to screening effects from the vegetation and sheds. The open cut would not be visible from this location. As a result, the overall visual modification level is considered to be low to moderate.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a low to moderate visual modification level, would result in a low to moderate visual impact for most residences in the distant sub-regional setting. This would reduce to low, to very low, once rehabilitation of the waste emplacements has established.

Existing View

Year 7 Simulation

Year 26 Simulation

Source: Urbis (2012)

VICKERY COAL PROJECT

FIGURE 14

Existing View and Visual Simulations - Brolga (VP4)

urbis

WHITEHAVEN COAL

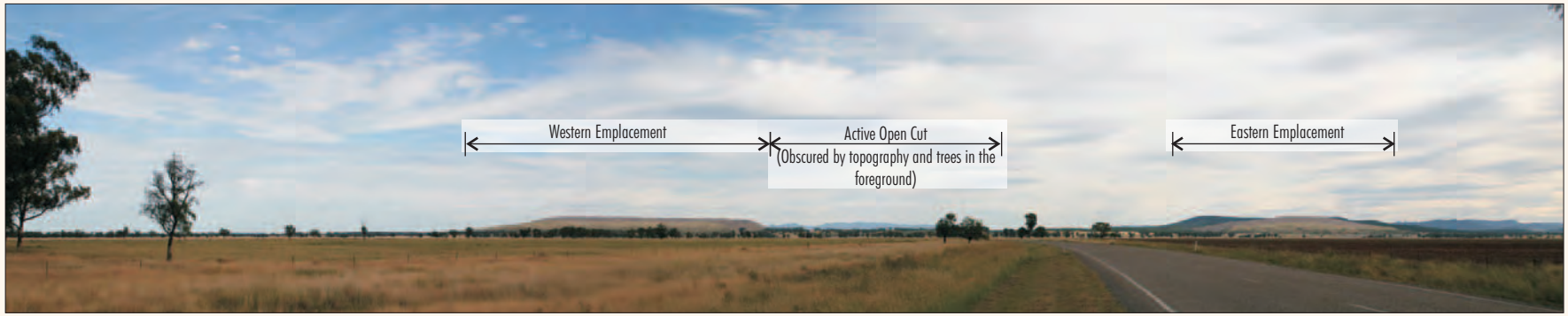
Figure 15 – View North towards the Project from Brolga Homestead

VIEWPOINT 5 – COULSTON (SECOND RESIDENCE)	
Viewing Location	Within the home yard around run-down second house on Coulston (***Figure 10***).
Viewing Distance	3.9 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	The landscape is generally flat and concentrations of denser vegetation occur along roadsides and property or paddock boundaries. The “home yard” of the residence is surrounded by relatively tall and dense vegetation and farm sheds (***Figure 16***).
Visual Modification	The vegetation and farm sheds heavily screen views out to the surrounding area. Given the distance from the Project, the relatively minimal topographic variation and the presence of intervening vegetation, views to the Project would be possible but it would not be visible in its entirety. As a result, the overall visual modification level is considered to be low to moderate.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a low to moderate visual modification level, would result in a low to moderate visual impact for the distant sub-regional setting. This would reduce to low, to very low, once rehabilitation of the waste emplacements has established.

Figure 16 – View North towards the Project from Coulston Second Residence

VIEWPOINT 6 – BLUE VALE ROAD	
Viewing Location	Roadway (***Figure 10***).
Viewing Distance	3.3 km to the Project (Eastern Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	Blue Vale Road traverses the regional visual catchment of the study area roughly north to south. The landscape is generally flat, and often quite open, with intermittent bands of vegetation present along the edges of the road and along local roads and property or paddock boundaries (***Figure 17***).
Visual Modification	Visual simulations from Blue Vale Road 3.3 km south of the Project have been developed (***Figure 17***). From Blue Vale Road within the sub-regional setting, the active, un-rehabilitated upper surfaces of the Eastern and Western Emplacements would be visible to road users travelling north. However, the lower parts and the open cut would be generally screened by intervening roadside and paddock boundary vegetation. As a result, the visual modification level is considered to be moderate to high due to the expanse of mining operations visible.
Land Use	Local road and designated haul road.
Visual Sensitivity	Very low (distant sub-regional).
Duration of View	Dynamic/moving.
Potential Visual Impact	The very low visual sensitivity, due to distance from the Project, combined with a moderate to high visual modification level, would result in a very low to low visual impact for road users of Blue Vale Road within the sub-regional setting. This would reduce to very low, as landform rehabilitation measures are established.

Existing View



Year 7 Simulation

Year 26 Simulation

Source: Urbis (2012)

VICKERY COAL PROJECT

FIGURE 17

Existing View and Visual Simulations - Blue Vale Road (VP 6)

urbis

WHITEHAVEN COAL

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VIEWPOINT 7 – SILKDALE	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	3.2 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	Silkdale is located on a slight rise to the north of the Project. The landscape is gently undulating with scattered groups of taller trees (***Figure 18***).
Visual Modification	The slight elevation of the viewpoint would allow for a degree of overlooking of the open cut. However, existing vegetation would partially screen views out to the surrounding area and to the Western Emplacement. The vegetated rising topography of Vickery State Forest would prevent views to the Eastern Emplacement. As a result, the overall visual modification level is considered to be moderate during operation.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a moderate visual modification level, would result in a moderate visual impact for the distant sub-regional setting. This would reduce to low, to very low, once rehabilitation of the waste emplacements has established.

Figure 18 – View South towards the Project from Silkdale Homestead

VIEWPOINT 8 – BRAYMONT	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	4.8 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	The landscape is generally flat and concentrations of denser vegetation occur along roadsides and property or paddock boundaries. This residence, like most in the sub-regional setting, is contained with a “home yard” surrounded by vegetation and farm sheds.
Visual Modification	The established vegetation and sheds partially to heavily screen views out to the surrounding area (***Figure 19***). Given the distance from the Project, the relatively minimal topographic variation and the presence of intervening vegetation, views to the Project would be possible but it would not be visible in its entirety. As a result, the overall visual modification level is considered to be low to moderate.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a low to moderate visual modification level, would result in a low visual impact for the distant sub-regional setting. This would reduce to low, to very low, once rehabilitation of the Western Emplacement has established.

Figure 19 – View South-east towards the Project from Braymont Homestead

VIEWPOINT 9 – BRAYMONT ROAD	
Viewing Location	Braymont Road adjacent to entrance to Bungalow (***Figure 10***).
Viewing Distance	3.9 km to the Project (Western Emplacement).
Visual Setting	Sub-regional.
Landscape Setting	Braymont Road traverses the regional visual catchment of the study area roughly north to south and, at this location, it turns 90^{o} towards the west. As a result, the view line from the road is directed towards the Project. Visual simulations from Braymont Road north-west of the Project have been developed (***Figure 20***). The landscape is generally flat, and often quite open, with intermittent bands of vegetation present along the edges of the road and along other local roads and property or paddock boundaries. The landform of the rehabilitated Canyon Coal Mine is visible in the distance (***Figure 20***).
Visual Modification	From Braymont Road within the sub-regional setting, the active, un-rehabilitated outer surface of the Western Emplacement would be visible to road users, particularly those heading south. As a result of the expanse of mining operations visible, the visual modification level is considered to be moderate to high.
Land Use	Local road.
Visual Sensitivity	Very low (distant sub-regional).
Duration of View	Dynamic/moving.
Potential Visual Impact	The very low visual sensitivity combined with a moderate to high visual modification level, would result in a low visual impact for the distant sub-regional setting. This would reduce to very low, once rehabilitation of the Western Emplacement has established.

Existing View

Year 17 Simulation

Year 26 Simulation

urbis

VICKERY COAL PROJECT

FIGURE 20

Existing View and Visual Simulations - Braymont Road (VP 9)

WHITEHAVEN COAL

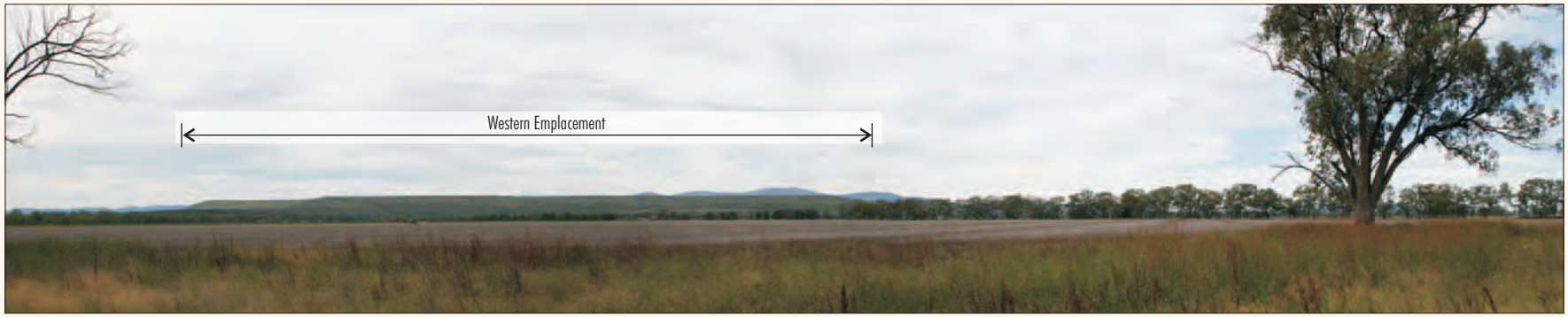
VIEWPOINT 10 – BUNGALOW	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	3.0 km to the Project (Western Emplacement).
Visual Setting	Sub-regional.
Landscape Setting	The residence and home yard is oriented to the south towards the Project. There is little surrounding vegetation present that contributes to visual screening. The landscape between the viewpoint and the Project is generally flat and concentrations of denser vegetation occur in the distance along Hoad Lane and property or paddock boundaries. The landform of the rehabilitated Canyon Coal Mine is visible in the distance (***Figure 21***).
Visual Modification	From this viewpoint within the sub-regional setting, the active, un-rehabilitated upper surface of the Western Emplacement would be visible. However, the lower parts would be generally screened by intervening paddock boundary vegetation. As a result, the visual modification level is considered to be moderate to high due to the expanse of mining operations visible.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a moderate to high visual modification level would result in a moderate to high visual impact for the distant sub-regional setting. This would reduce to low once rehabilitation of the Western Emplacement has established.

Figure 21 – View South towards the Project from Bungalow Homestead

VIEWPOINT 11 – KAMILAROI HIGHWAY	
Viewing Location	Eastern edge of roadway (***Figure 10***).
Viewing Distance	4.2 km to the Project (Western Emplacement).
Visual Setting	Sub-regional.
Landscape Setting	The Kamilaroi Highway diagonally traverses the sub-regional visual catchment to the west of the Project. The landscape is generally flat with bands of vegetation present along the edge of the highway and along local roads and property or paddock boundaries (***Figure 22***).
Visual Modification	Visual simulations from the Kamilaroi Highway west of the Project have been developed (***Figure 22***). From the Kamilaroi Highway within the distant sub-regional setting, the active un-rehabilitated outer and upper surfaces of the Western Emplacement would be visible to road users where breaks in roadside vegetation allow for views out to the Project. Where views to the Project are possible, the lower parts of the emplacement would generally be screened by intervening vegetation, particularly the tall trees along the Namoi River (***Figure 22***). As views out are typically screened, the visual modification level is considered to be moderate.
Land Use	Highway/tourist route.
Visual Sensitivity	Low (distant sub-regional).
Duration of View	Dynamic/moving.
Potential Visual Impact	The low sensitivity combined with a moderate visual modification level, would result in a low visual impact for the distant sub-regional setting. This would reduce to very low, once rehabilitation of the Western Emplacement has established.

Existing View

Year 17 Simulation



Year 26 Simulation

VICKERY COAL PROJECT

FIGURE 22

Existing View and Visual Simulations - Kamilaroi Highway (VP 11)

urbis

WHITEHAVEN COAL

VIEWPOINT 12 – CLINTON	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	3.8 km to the Project (Western Emplacement).
Visual Setting	Sub-regional.
Landscape Setting	The landscape is generally flat and concentrations of denser vegetation occur along property or paddock boundaries as well as taller trees along the Namoi River. This residence, like most in the sub-regional setting, is contained within a "home yard" surrounded by vegetation and farm sheds (***Figure 23***).
Visual Modification	Views to the Project would be partially screened by existing vegetation, the majority of which are establishing trees which would eventually develop clean trunks with an upper canopy that would in the future allow less obscured views to the Project. Where views are possible, the existing views to the distant unnamed range to the east would be partially obscured by the Western Emplacement. The lower parts of the emplacement would be partially screened by intervening vegetation, particularly the tall trees along the Namoi River. As a result of the expanse of mining operations visible, the visual modification level is considered to be moderate while the existing trees provide partial visual screening.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity, due to distance from the Project, combined with a moderate visual modification level, would result in a moderate visual impact. This would reduce to low, to very low, once rehabilitation of the Western Emplacement has established.

Figure 23 – View North-east towards Project from Clinton Homestead

VIEWPOINT 13 – MIRRABINDA RESIDENCE NO. 1	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	2.6 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	The residence is located in close proximity to the banks of the Namoi River which is lined with tall riparian vegetation which becomes progressively thinner away from the river (***Figure 24***). Apart from the lightly incised river channel, the landscape is generally flat and concentrations of denser vegetation occur along property or paddock boundaries and local roads. This residence, like most in the sub-regional setting, is contained within a "home yard" surrounded by vegetation and farm sheds.
Visual Modification	The established vegetation along the Namoi River partially to heavily screen views out to the Project. Where views are possible, the existing views to the high point within the Vickery State Forest to the east would be obscured by the Western Emplacement. As a result of the expanse of mining operations visible and the proximity, the visual modification level is considered to be moderate to high.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a moderate to high visual modification level, would result in a moderate to high visual impact for this residence at the edge of the near and distant sub-regional setting. This would reduce to low once rehabilitation of the Western Emplacement has established.

Figure 24 – View East to the Project from Mirrabinda Residence No. 1

VIEWPOINT 14 – MIRRABINDA RESIDENCE NO:2	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	1.6 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (near).
Landscape Setting	The landscape is generally flat and concentrations of denser vegetation occur along property or paddock boundaries as well as taller trees along the Namoi River. This residence is contained within a “home yard” surrounded by vegetation and farm sheds. Additionally, a flood protection levee bank to approximately 2 m in height is located around the residence (***Figure 25***).
Visual Modification	The established vegetation, sheds and levee bank combine to partially to heavily, screen views out from the residence to the Project. Where views are possible, the existing glimpses to the high point within the Vickery State Forest to the east would be obscured by the Western Emplacement. The lower parts of the emplacement would be partially screened by the tall trees along the Namoi River. Although an expanse of mining operations is potentially visible, the visual modification level is considered to be moderate given the degree of visual screening afforded around the residence.
Land Use	Residential/agricultural.
Visual Sensitivity	High (near sub-regional).
Duration of View	Static.
Potential Visual Impact	The high visual sensitivity combined with a moderate visual modification level, would result in a high visual impact for the near sub-regional setting. This would reduce to low once rehabilitation of the Western Emplacement has established.

Figure 25 – View East to the Project from Levee Bank adjacent to Mirrabinda Residence No. 2

VIEWPOINT 15 – MIRRABINDA RESIDENCE NO:3	
Viewing Location	Within the home yard around house (***Figure 10***).
Viewing Distance	2.6 km to the Project (Western Emplacement).
Visual Setting	Sub-regional (distant).
Landscape Setting	The residence is located in close proximity to the banks of the Namoi River which is lined with riparian vegetation which becomes progressively thinner away from the river (***Figure 26***). Apart from the lightly incised river channel, the landscape is generally flat and concentrations of denser vegetation occur along property or paddock boundaries and local roads. This residence, like most in the sub-regional setting, is contained within a "home yard" surrounded by vegetation.
Visual Modification	The established vegetation along the Namoi River partially screens views out to the Project. Where views are possible, the existing views to the unnamed range to the east would be obscured by the Western Emplacement. As a result of the expanse of mining operations visible through breaks in vegetation, the visual modification level is considered to be moderate to high.
Land Use	Residential/agricultural.
Visual Sensitivity	Moderate (distant sub-regional).
Duration of View	Static.
Potential Visual Impact	The moderate visual sensitivity combined with a moderate to high visual modification level, would result in a moderate to high visual impact for this residence at the edge of the near and distant sub-regional setting. This would reduce to low once rehabilitation of the Western Emplacement has established.

Figure 26 – View North-east to the Project from Mirrabinda Residence No. 3

5.2.3 LOCAL SETTING

The proposed private haul road and Kamilaroi Highway overpass is located approximately 5 km north-west of Gunnedah, adjacent to the Whitehaven CHPP.

The visual impact of this component of the Project on a typical viewpoint within the local setting is described following.

VIEWPOINT 16 – KAMILAROI HIGHWAY	
Viewing Location	Kamilaroi Highway intersection with Whitehaven CHPP access road (***Figure 10***).
Viewing Distance	0.2 km to the Kamilaroi Highway overpass.
Visual Setting	Local.
Landscape Setting	The Kamilaroi Highway is located within a landscape that is generally flat with bands of vegetation present along the edge of the highway and along local roads and property or paddock boundaries (***Figure 27***). The existing Whitehaven CHPP facilities are visible to the south of the Highway. The highway landscape includes signage, road intersections, rail crossings and, occasionally, road or stock overpasses/grade separations.
Visual Modification	A visual simulation of the Kamilaroi Highway overpass has been developed (***Figure 27***). The highway overpass, although being highly visible, is an element that one would typically expect to find within a highway setting. In this regard it is considered to have a high degree of visual compatibility or fit. The approach ramps are partially screened from view by vegetation adjacent to the road. The top of the bridge structure sits below the upper canopy line of the existing vegetation (***Figure 27***). As a result, the visual modification level is considered to be very low.
Land Use	Highway/tourist route.
Visual Sensitivity	High.
Duration of View	Dynamic/moving.
Potential Visual Impact	The high visual sensitivity combined with a very low visual modification level, would result in a low visual impact.

Existing View

Simulation

urbis

VICKERY COAL PROJECT

FIGURE 27

Existing View and Visual Simulations -
Kamilaroi Highway Overpass
(VP 16)

WHITEHAVEN COAL

5.3 IMPACTS OF NIGHT-LIGHTING

Mining operations for the Project would be undertaken 24 hours a day. The methodology applied in this study is drawn from the Institute of Lighting Engineers' (ILE) *Guidance Notes for the Reduction of Obtrusive Light* (ILE, 2005), and includes a range of categories with which to describe the lit situation of the landscape. These environmental zones are supported by design guidance for the reduction of light pollution which can then inform proposed mitigation techniques (***Appendix B***).

5.3.1 THE EXISTING SETTING

The surrounding lighting environmental zones of the Project include the following settings as identified in the *Guidance Notes for the Reduction of Obtrusive Light* (ILE, 2005):

- All sectors - local and sub-regional settings: Environmental Zone E1 – Intrinsically Dark Landscapes.
- Existing mining operations – Rocglen Coal Mine - Environmental Zone E2 – Low district brightness area.

The notes recommend that lighting for developments in Environmental Zone E1 – Intrinsically Dark Landscapes should have minimal illumination into the sky as well as to adjacent viewpoints in order to maintain the night-time setting.

5.3.2 LIGHTING SOURCES

The lighting proposed to be employed on the proposed facility would be emitted from three sources, discussed below.

FIXED/PERMANENT LIGHTS

This is lighting that is installed as part of the permanent infrastructure of the development, for example the main administration complex, equipment storage compounds and processing facilities.

STATIONARY WORK LIGHTS

These are primarily trailer mounted lights comprised of a number of directional, shielded lights mounted on a post above a small generator. These would be widely spaced, illuminating locations where night operations occur and moved to suit changing operational requirements. In many cases they would be obscured from view within the open cut.

VEHICLE MOUNTED LIGHTS

Headlights mounted on mining fleet. Vehicles operating within the development area would have headlights and hazard lights operating at all times due to occupational health and safety requirements. Light emitted from vehicles working on overburden stockpiles would be the most visible.

5.3.3 EFFECTS OF LIGHTING

The exact impact or acceptability of night-lighting is difficult to define as it is dependent on individual perceptions and sensitivities as well as the presence of existing light.

From most locations in the sub–regional and regional setting, direct views to the lighting sources would be obscured from view by vegetation within the landscape and around residences.

The management of night-time operations, such as not operating on outer waste rock emplacement faces at night, would reduce impacts on adjacent sensitive viewpoints, particularly those within the local and near subregional setting. However, even with these measures in place, a certain amount of light spill from vehicles and stationary work lights may still occur and cloud cover at night may result in some reflection off the cloud base. Therefore, some impacts from lighting are possible for sensitive viewpoints within the local setting. Any impacts are likely to reduce further within the distant sub-regional setting.

The glow produced by night-lighting at the Rocglen Coal Mine is visible primarily at nearby dwellings and local roads. The night glow is similar to that associated with existing towns in the region. Direct views of mobile machinery lights and operational lighting are also available from some exposed positions and nearby dwellings.

In addition, the Project would result in the number of vehicles using the existing Blue Vale Road haul road. Consequently there would be an increase in night-lighting impacts associated with vehicle headlights.

Notwithstanding the above, the nature of the night-lighting for the Project would be similar to the existing night-lighting at the Rocglen Coal Mine and the change in potential night-lighting impacts would be relatively minor for most viewpoints. The highest impact would result for sensitive viewpoints to the west of the Project.

The Siding Springs Observatory is located approximately 115 km to the south-west of the Project. It is considered night-lighting produced by the Project would not be visible from the Siding Springs Observatory.

Mitigation measures to reduce the potential impacts of night-lighting from the Project are described in ***Section 6.3***.

5.4 CUMULATIVE ASSESSMENT

The assessment of cumulative visual impacts has considered the combined effects of the Project with the effects of the existing Rocglen Coal Mine. The combined disturbance areas of the Project and the Rocglen Coal Mine represent a very small proportion of the Namoi Valley and cumulatively would not detract from the region's essentially rural nature.

It is expected that views of both the Project and the Rocglen Coal Mine landforms would generally be only available from viewpoints from the southern side of the Project. As with views of the Project, these viewpoints would typically be associated with elevated areas where no vegetation screening is present (e.g. from paddocks, private roads).

Few residences have views to the Tarrawonga and Boggabri Coal Mines to the north, the Rocglen Coal Mine to east or the Project. Silkdale, situated in an area of more elevated topography, is located within the regional viewshed of the Tarrawonga Coal Mine to the north and within the sub-regional viewshed of the Project. Views from Silkdale to the Rocglen Coal Mine are blocked by the rising topography of the Vickery State Forest.

The night-time setting is currently subject to the effects of lighting from the Rocglen Coal Mine. However, the Rocglen Coal Mine is contained to some extent between the rising topography of the Vickery State Forest and the unnamed range to the east.

It is expected that the cumulative visual impacts as a result of the Project and the Rocglen Coal Mine are considered to be low to moderate and confined to sensitive viewpoints to the south of the Project.

6 Amelioration of Visual Impacts

A Vickery Coal Mine Rehabilitation Management Plan would be prepared for the Project, subject to the conditions of any Development Consent.

6.1 PROGRESSIVE REHABILITATION

Progressive rehabilitation of the Western Emplacement, Eastern Emplacement, open cut and other infrastructure would be undertaken in order to reduce the contrast between the Project landforms and the surrounding environment. The design of the mine waste rock emplacements assist with the visual shielding of the active open cut operations from viewpoints in the west and south-east.

Rehabilitation would be conducted in accordance with Section 5 in the Main Report of the EIS (Rehabilitation and Mine Closure).

6.2 VISUAL SCREENING

Visual screening (e.g. a vegetation screen consisting of endemic plants that are compatible with the existing surrounding vegetation) could be considered to mitigate potential visual impacts from sensitive viewpoints. Vegetated screens could be developed along the realigned sections of Blue Vale Road.

In addition, upon receiving a request from an owner of any privately-owned dwelling which has significant direct views of the Project, Whitehaven would implement reasonable and feasible visual mitigation measures (e.g. vegetation screening) in consultation with the owner to minimise the visibility of the Project from the dwelling.

6.3 MANAGEMENT OF POTENTIAL LIGHTING IMPACTS

Whitehaven would seek to minimise light emissions from the Project by carefully selecting the sites where lights would be placed, and by use of physical barriers and/or operational measures to reduce light 'spill' without compromising operational safety. Measures that would be employed to mitigate potential impacts from night-lighting would include one or more of the following, where practicable:

- All external lighting associated with the Project would comply with Australian Standard AS 4282: 1997 – *Control of the Obtrusive Effects of Outdoor Lighting*.
- Restriction of night-lighting to the minimum required for operations and safety requirements.
- Use of directional lighting techniques.
- Use of light shrouds and reflectors to limit the spill of lighting.
- In consultation with the landholder, planting of trees at nearby private dwellings to help screen any potential visual impacts (***Section 6.2***).
- In consultation with the landholder, provision of curtains, cladding and/or screens at nearby private dwellings to help screen any potential night-time lighting impacts, in consultation with the landholder.

In addition, mining operations on the external faces of the Western Emplacement would be restricted during night-time. This would limit the night-lighting impacts from mobile fleet.

7 References

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8 Glossary of Terms

Amelioration – The ability to reduce the visual impact of a development through siting, design, colour or screening.

Sensitivity – The degree to which various user groups will respond to change based on their expectation of a particular experience in a given setting, i.e., the expectation of a high level of visual amenity in a national park.

Modification Level – The degree to which a development contrasts or blends with its setting.

Visual Impact – The result of assessing the sensitivity level of a viewer and the modification level of a development.

Viewshed – The area visible from a particular viewing location.

Zone of Visual Influence (ZVI) – The area over which an object can be seen within the landscape

Visual Amenity – The qualities of a landscape setting that are appreciated and valued by a viewer.

Viewer Perception – The way in which people respond to what they are seeing as influenced by things other than purely visual, – i.e., noise and economic benefits.

Appendix A Visibility Rationale

VISIBILITY – RELATIONSHIP WITH VIEWSHEDS

The report defines a number of viewsheds based on distance from the development for the purposes of assessment. The methodology is based on the reduction of impact with an increase in distance between a given viewpoint and the development. These viewsheds or settings are:

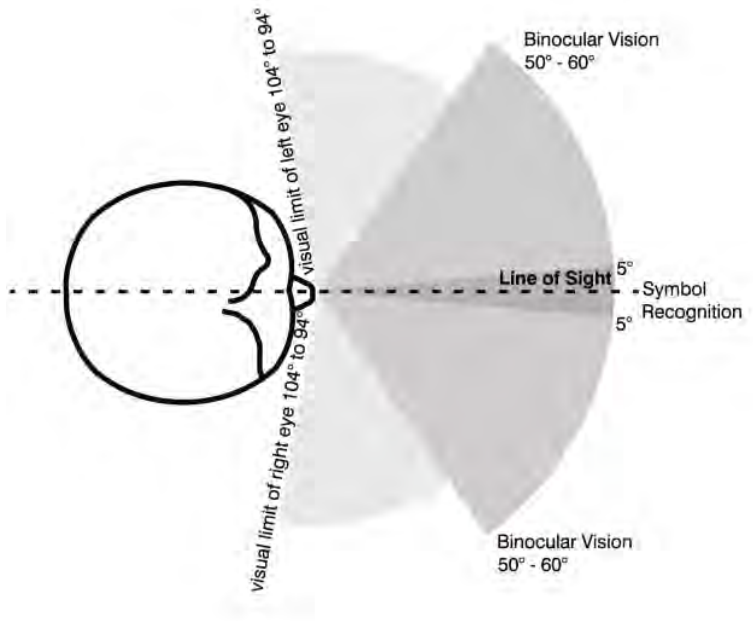
- **Local Setting** – up to 1 km from the development.
- **Sub-regional Setting** – between 1 km and 5 km from the development.
- **Regional Setting** – beyond 5 km of the development.

These distances have been established based on previous studies undertaken by URBIS. They are based on the reduction of visibility of objects in the distance as the field of view reduces.

HORIZONTAL LINE OF SIGHT

It is generally accepted that the central field of vision for the human eye covers a horizontal angle of approximately 50 degrees to 60 degrees. Given both eyes see simultaneously and that there is a degree of overlap, a central field of view results in a person looking straight ahead ***(Figure A.1).***

HORIZONTAL LINE OF SIGHT FIGURE A.1



In the production of visual simulations, a 50 mm lens on a 35 mm film format is most widely used as it captures a field of view of approximately 46 degrees, similar to that of the view from one eye. Two photos taken with a 50 mm lens produced as a panorama, with a degree of central overlap, capture the central field of view in a similar way to that of the human binocular view (binocular field).

Within the central field of vision, the viewed image is sharp, colours are separately defined and depth perception occurs.

VISUAL IMPACT/VISUAL PROMINENCE

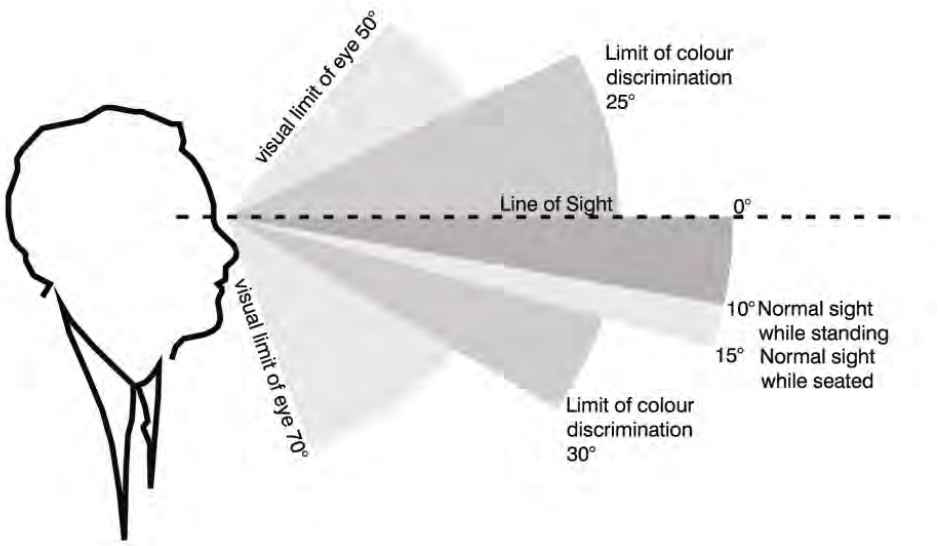
The potential visual impact of a development will, to a large extent, depend on how much of the central field of vision that it occupies. In relation to the assessment of mining sites that often extend across the landscape, the calculation of horizontal view angle is not the only factor to be considered.

DEGREES OF FIELD OF VIEW OCCUPIED	POTENTIAL VISUAL PROMINENCE – HORIZONTAL FIELD OF VIEW
Less than 5^o	**Insignificant** The development will not be highly visible in the view, unless it contrasts strongly with the background.
5^o – 30^o	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will be dependant on how well it integrates with the landscape setting.
Greater than 30^o	**Potentially Dominant** The development will be highly noticeable.

VERTICAL LINE OF SIGHT

As for the horizontal line of sight, there is also a vertical central field of view. If we assume that the horizon is 0^o then the eye clearly defines colour, field of view and has image sharpness for an angle of approximately 25^o upwards and 30^o downwards. However, in reality, the typical line of sight for a standing person at ground level is approximately 10^o below the horizon line ***(Figure A.2).***

VERTICAL LINE OF SIGHT FIGURE A.2



VISUAL IMPACT / VISUAL PROMINENCE

Objects that occupy a small proportion of the vertical field of view are visible but not dominant, particularly when they occur within landscapes that have been modified by human activity.

DEGREES OF FIELD OF VIEW OCCUPIED	POTENTIAL VISUAL PROMINENCE – HORIZONTAL FIELD OF VIEW
Less than 0.5°	**Insignificant** A small thin line in the landscape.
0.5° – 2.5°	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 2.5°	**Potentially Dominant** The development will be highly noticeable, although the degree of visual intrusion will depend on the landscape setting and the width / thickness of the object.

VISUAL PROMINENCE IN RELATION TO DISTANCE AND VIEWSHED SETTINGS

The following distances relating to visual prominence are based on the previous field of view exercises. The distances also relate to the distances for the setting types in the visual assessment methodology.

DEGREES OF FIELD OF VIEW OCCUPIED	POTENTIAL VISUAL PROMINENCE – HORIZONTAL FIELD OF VIEW
5000 metres	**Insignificant** Visually insignificant.
1000 – 5000 metres	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will increase as distance reduces.
Less than 1000 metres	**Potentially Dominant** The development will be highly noticeable.

Appendix B

Guidance Notes for the Reduction of Obtrusive Light

GUIDELINES PREPARED BY THE INSTITUTION OF LIGHTING ENGINEERS, UK.

The Institution of Lighting Engineers

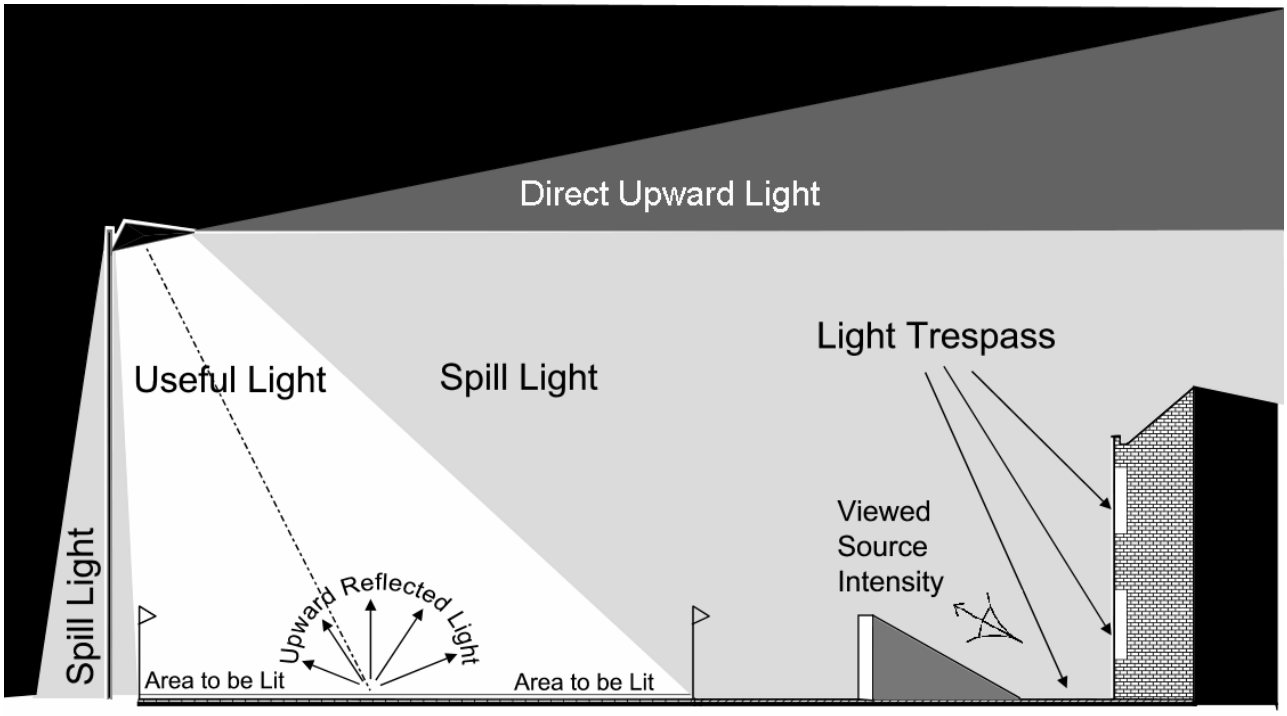
E-mail ile@ile.org.uk Website www.ile.org.uk

GUIDANCE NOTES FOR THE REDUCTION OF OBTRUSIVE LIGHT

ALL LIVING THINGS adjust their behaviour according to natural light. Man's invention of artificial light has done much to enhance our night-time environment but, if not properly controlled, **obtrusive light** (commonly referred to as light pollution) can present serious physiological and ecological problems.

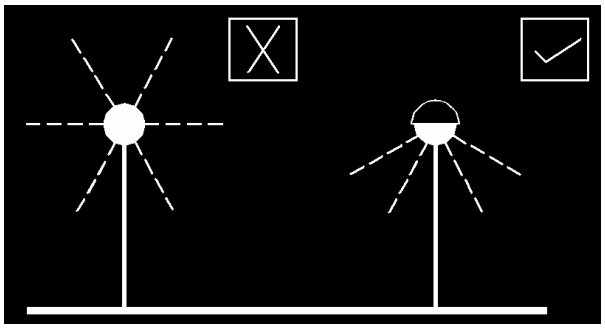
Obtrusive Light, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution and can be substantially reduced without detriment to the lighting task.

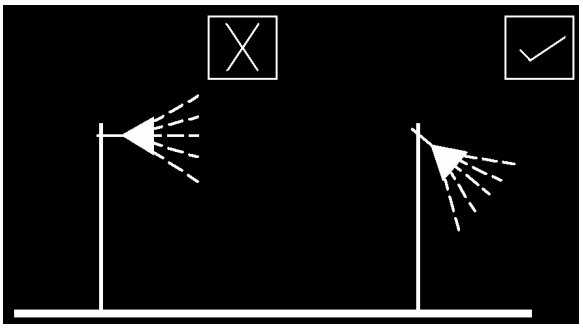
Sky glow, the brightening of the night sky above our towns, cities and countryside, **Glare** the uncomfortable brightness of a light source when viewed against a dark background, and **Light Trespass**, the spilling of light beyond the boundary of the property or area being lit, are all forms of obtrusive light which may cause nuisance to others, waste money and electricity and result in the unnecessary emissions of greenhouse gases. Think before you light. Is it necessary? What effect will it have on others? Will it cause a nuisance? How can I minimise the problem?



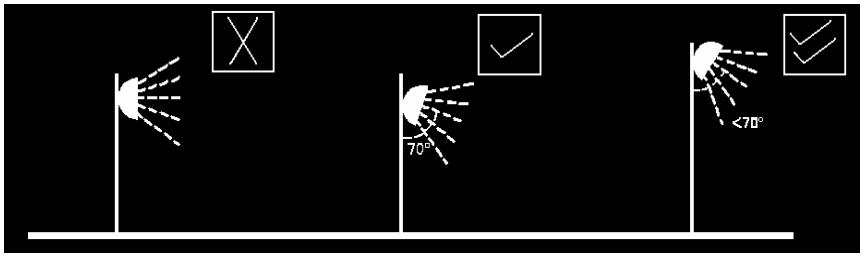
Do not "over" light. This is a major cause of obtrusive light and is a waste of energy. There are published standards for most lighting tasks, adherence to which will help minimise upward reflected light. Organisations from which full details of these standards can be obtained are given on the last page of this leaflet.

Dim or switch off lights when the task is finished. Generally a lower level of lighting will suffice to enhance the night time scene than that required for safety and security.



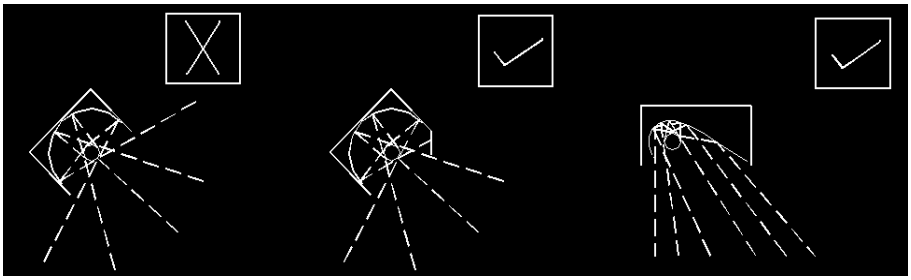


Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaires to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. Remember that lamp light output in LUMENS is not the same as lamp wattage and that it is the former that is important in combating the problems of obtrusive light

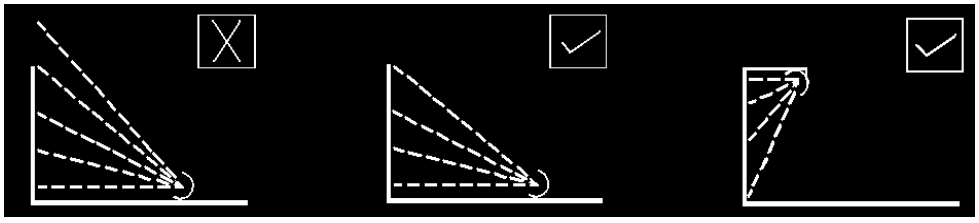


Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting the ILE produces an information leaflet GN02 that is freely available from its web site.

The UK Government will be providing an annex to PPS23 Planning and Pollution Control, specifically on obtrusive light. However many Local Planning Authorities (LPA's) have already produced, or are producing, policies that within the new planning system will become part of the local development framework. For new developments there is an opportunity for LPA's to impose planning conditions related to external lighting, including curfew hours.



For sports lighting installations (see also design standards listed on Page 4) the use of luminaires with double-asymmetric beams designed so that the front glazing is kept at or near parallel to the surface being lit should, if correctly aimed, ensure minimum obtrusive light. In most cases it will also be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation. The requirements to control glare for the safety of road users are given in Table 2.



When lighting vertical structures such as advertising signs direct light downwards, wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of shields, baffles and louvres will help reduce spill light around and over the structure to a minimum.

For road and amenity lighting installations, (see also design standards listed on Page 4) light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note ULRs in Table 1). In sensitive rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However in many urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

ENVIRONMENTAL ZONES:

It is recommended that Local Planning Authorities specify the following environmental zones for exterior lighting control within their Development Plans.

Category	Examples	
E1:	**Intrinsically dark landscapes**	National Parks, Areas of Outstanding Natural Beauty, etc
E2:	**Low district brightness areas**	Rural, small village, or relatively dark urban locations
E3:	**Medium district brightness areas**	Small town centres or urban locations
E4:	**High district brightness areas**	Town/city centres with high levels of night-time activity

Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.

DESIGN GUIDANCE

The following limitations may be supplemented or replaced by a LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a professional lighting designer before installing any exterior lighting.

Table 1 – Obtrusive Light Limitations for Exterior Lighting Installations

Environmental Zone	Sky Glow ULR [Max %] (1)	Light Trespass (into Windows) Ev [Lux] (2)		Source Intensity I [kcd] (3)		Building Luminance Pre-curfew (4)
		Pre- curfew	Post- curfew	Pre- curfew	Post- curfew	Average, L [cd/m2]
E1	0	2	1*	2.5	0	0
E2	2.5	5	1	7.5	0.5	5
E3	5.0	10	2	10	1.0	10
E4	15.0	25	5	25	2.5	25

ULR = **Upward Light Ratio of the Installation** is the maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky.

Ev = **Vertical Illuminance in Lux** and is measured flat on the glazing at the centre of the window

I = **Light Intensity in Cd**

L = **Luminance in Cd/m2**

Curfew = **The time after which stricter requirements (for the control of obtrusive light) will apply**; often a condition of use of lighting applied by the local planning authority. If not otherwise stated - 23.00hrs is suggested.

***** = From Public road lighting installations only

(1) **Upward Light Ratio** – Some lighting schemes will require the deliberate and careful use of upward light – e.g. ground recessed luminaires, ground mounted floodlights, festive lighting – to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

(2) **Light Trespass (into Windows)** – These values are suggested maxima and need to take account of existing light trespass at the point of measurement. In the case of road lighting on public highways where building facades are adjacent to the lit highway, these levels may not be obtainable. In such cases where a specific complaint has been received, the Highway Authority should endeavour to reduce the light trespass into the window down to the after curfew value by fitting a shield, replacing the luminaire, or by varying the lighting level.

(3) **Source Intensity** – This applies to each source in the potentially obtrusive direction, outside of the area being lit. The figures given are for general guidance only and for some sports lighting applications with limited mounting heights, may be difficult to achieve.

(4) **Building Luminance** – This should be limited to avoid over lighting, and related to the general district brightness. In this reference building luminance is applicable to buildings directly illuminated as a night-time feature as against the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area.

Table 2 – Maximum Values of Threshold Increment from Non-Road Lighting Installations				
Light Technical Parameter TI	**Road Classification** [5]			
	No road lighting	ME5	ME4/ ME3	ME2 / ME1
	15% based on adaptation luminance of 0.1cd/m^2	15% based on adaptation luminance of 1cd/m^2	15% based on adaptation luminance of 2 cd/m^2	15% based on adaptation luminance of 5 cd/m^2

TI = **Threshold Increment** is a measure of the loss of visibility caused by the disability glare from the obtrusive light installation

(5) **Road Classifications** as given in BS EN 13201 - 2: 2003 Road lighting Performance requirements
Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in path of travel. See CIE Publication 150:2003, Section 5.4 for methods of determination. For a more detailed description and methods for calculating and measuring the above parameters see CIE Publication 150:2003.

RELEVANT PUBLICATIONS AND STANDARDS:

British Standards: www.bsi.org.uk	BS 5489-1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas BS EN 13201-2:2003 Road lighting – Part 2: Performance requirements BS EN 13201-3:2003 Road lighting – Part 3: Calculation of performance BS EN 13201-4:2003 Road lighting – Part 4: Methods of measuring lighting performance. BS EN 12193: 2003 Light and lighting – Sports lighting	
Countryside Commission/DOE www.odpm.gov.uk	Lighting in the Countryside: Towards good practice (1997) *(Out of Print)*	
CIBSE/SLL Publications: www.cibse.org	CoL LG1 LG4 LG6 FF7	Code for Lighting (2002) The Industrial Environment (1989) Sports (1990+Addendum 2000) The Exterior Environment (1992) Environmental Considerations for Exterior Lighting (2003)
CIE Publications: www.cie.co.at	01 83 92 115 126 129 136 150 154	Guide lines for minimizing Urban Sky Glow near Astronomical Observatories (1980) Guide for the lighting of sports events for colour television and film systems (1989) Guide for floodlighting (1992) Recommendations for the lighting of roads for motor and pedestrian traffic (1995) Guidelines for minimizing Sky glow (1997) Guide for lighting exterior work areas (1998) Guide to the lighting of urban areas (2000) Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003) The Maintenance of outdoor lighting systems (2003)
Department of Transport www.defra.gov.uk		Road Lighting and the Environment (1993) (Out of Print)
ILE Publications: www.ile.org	TR 5 TR24 GN02	Brightness of Illuminated Advertisements (2001) A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999) Domestic Security Lighting, Friend or Foe
ILE/CIBSE Joint Publications ILE/CSS Joint Publications		Lighting the Environment - A guide to good urban lighting (1995) Seasonal Decorations – Code of Practice (2005)
Campaign for Dark Skies (CfDS) www.dark-skies.org		

NB: These notes are intended as guidance only and the application of the values given in Tables 1 & 2 should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.

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