



Orebody 31

Landscape and
Visual Impact
Assessment (LVIA)

Prepared for:
BHP Billiton Iron Ore

July 2014

● people ● planet ● professional

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Executive Summary

360 Environmental Pty Ltd was commissioned by BHP Billiton Iron Ore to undertake a Landscape and Visual Impact Assessment (LVIA) for the proposed Orebody 31 (OB31; the Project) development. OB31 is located approximately 40 kilometers (km) east of the Newman Township, in the Shire of East Pilbara. Being situated directly east of the existing Orebody 17 and 18 operations at Shovellana Hill, OB31 is intended as a long term replacement for these projects.

The LVIA consisted of three assessment phases, a desktop, field and impact assessment. The desktop assessment identified 11 potential sensitive receptor sites based on a risk -of-impact and site significance matrix, which were then visited and surveyed during the field assessment. The field assessment identified seven sites out of the 11 in the Newman region that were of high socio-cultural value that may potentially be impacted by the Project. These seven sites were then further assessed in the impact assessment phase. An additional eighth 'site', a 103 km length of the Great Northern Highway and Marble Bar Road was also analysed in an effort to understand a larger extent of potential impacts from the Project.

Viewshed and photomontage analysis conducted on these sites based on information collected during the field study showed that direct impacts on landscape character and visual amenity were relatively low (the maximum impact to a site's viewshed peaked at 1.11%). This is likely due to a combination of various factors. Similarly, impacts to landscape character from clearing activities (both at the local and regional level was extremely low (0.05% – 0.11%), as was impacts to local Land Systems (0.01% – 0.37%). Impacts to important transport networks were also very low, with the impact on the total viewshed of the 103 km section of road peaking at only 0.65%.

The low impact level of the project is thought to be due to a combination of factors. The topographical location of the Project naturally mitigates impact in that it is screened from impacts to the south by Ophthalmia Range and to the north by the dense screens of vegetation along the numerous creeks in the region (including the Fortescue River). In addition to this, most sensitive receptors are located to the east of the Fortescue River, which contains dense stands of tall vegetation (especially in areas along the Marble Bar Road), which effectively act to screen out views of the Project Area.

The findings of this study also suggest that impacts are likely to stem from the surrounding developments rather than from OB31, however indirect impacts in the form of dust may be slightly intensified which in turn may result in impacts to visual amenity.

Table of Contents

1	Introduction	1
1.1	Background	1
1.2	Legislative Context	1
1.3	Scope and Objectives	3
2	The Existing Environment	6
2.1	Environmental Setting	6
2.2	Socio-economic Setting	9
3	Methodology	12
3.1	Desktop Assessment	12
3.2	Field Assessment	16
3.3	Visual Impact Assessment	20
4	Results	25
4.1	Field Assessment	25
4.2	Visual Impact Assessment	41
5	Discussion	50
5.1	Direct Impacts on Visual Amenity	50
5.2	Cumulative Impacts on Visual Impact	51
6	Conclusion	52
6.1	Summary of Impacts	52
7	Limitations	53
8	References	54

List of Tables

Table 1. WAPC Criteria for Site Significance	13
Table 2. Vulnerability of Sites: Potential Impact Versus Likelihood	15
Table 3. Field Assessment Criteria	17
Table 4. Surveyed Sites	25
Table 5. K1 – Radio Tower Hill lookout site characteristics.....	26
Table 6. K2 – Ophthalmia Dam picnic area site characteristics	29
Table 7. K3 – Ophthalmia Dam wall site characteristics	30
Table 8. K4 – Marble Bar Road rest stop 1 site characteristics.....	32
Table 9. K5 – Marble Bar Road rest stop 2 site characteristics.....	34
Table 10. K6 – Kalgan Pool site characteristics	36
Table 11. K7 – Round Hill site characteristics	38
Table 12. K6 – Round Hill site characteristics	40
Table 13. Impacts to LCTs and Land Systems.....	41

List of Figures

Figure 1. Project Location	4
Figure 2. Conceptual Project Layout.....	5
Figure 3. Landscape Character Types	10
Figure 4. Land Systems	11
Figure 5. 3D Site Model.....	20
Figure 6. Pre and Post Development Terrain Models	21
Figure 7. Example of Viewshed Analysis Output from a Hypothetical Viewpoint.....	22
Figure 8. Surveyed Sites.....	24
Figure 9. K1 – Radio Tower Hill, Newman.....	42
Figure 10. K2 – Ophthalmia Dam Picnic Area.....	43
Figure 11. K3 – Ophthalmia Dam Wall.....	44
Figure 12. K4 – Marble Bar Road Rest Stop 1	45
Figure 13. K5 – Marble Bar Road Rest Stop 2.....	46
Figure 14. K6 – Kalgan Pool.....	47

Figure 15. K7 – Round Hill.....	48
Figure 16. Regional Roads Viewshed Analysis.....	49

List of Plates

Plate 1. View experiences from different landform combinations	19
Plate 2. K1 - Radio Tower Hill lookout.....	26
Plate 3. K2 – Ophthalmia Dam picnic area.....	28
Plate 4. K3 – Ophthalmia Dam wall	30
Plate 5. K4 – Marble Bar Road rest stop 1	32
Plate 6. K5 – Marble Bar Road rest stop 2	33
Plate 7. K6 – Kalgan Pool.....	35
Plate 8. K7 – Round Hill	37
Plate 9. K8 – Great Northern Hwy and Marble Bar Road (aerial image: Landgate 2013)	39

List of Appendices

Appendix A: Other Sites Surveyed	56
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Definitions of Terms, Acronyms and Abbreviations

TERM	DEFINITION
Background	Five to ten kilometres from the viewer.
Foreground	From the viewer to one kilometre away.
Georeferenced	The attribution of a coordinate system to data which corresponds to real life.
Landscape	A spatially heterogeneous area, scaled relative to the process of interest. Within landscapes it is usually possible to define a series of different ecosystems, landforms, habitats and natural or man-made features.
Landscape Character Type/ Unit	A large scale geographic area with broad similarities in landform types, soils, and vegetation.
Land system	A fine scale geographic area with a specific combination of landforms, soils, vegetation and drainage patterns
Midground	One to five kilometres away from the viewer.
Valued Landscape Characteristic	The resulting landscape characteristic that results from a combination of natural features. E.g. panoramic, coastal.
View Experience	The relative levels of appreciation a viewer experiences for a particular view relative to the landscape. E.g. negative, neutral, positive.
Viewshed	The theoretical area of visibility from a given point.
Visual Amenity	The values and services that result from a view on a receptor, usually an individual or community.
Visual Impact	The changes to visual amenity as a result of a development.
Visual Plane	The theoretical straight line of sight from a viewer to an object.
Visual Risk	The likelihood and consequence of positive and negative visual impact.
Mitigation Strategy	A strategy to minimise visual impact.
ACRONYM	DEFINITION
DMP	Department of Mines and Petroleum, Western Australia
DPI	Department of Planning and Infrastructure, Western Australia
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now the Department of the Environment)
EPA	Environmental Protection Authority
GDA 1994	Geodetic Datum of Australia 1994
LCT	Landscape Character Type
LVIA	Landscape and Visual Impact Assessment
MGA 1994	Map Grid of Australia – based on the GDA 1994 datum
OSA	Overburden Storage Area
TIN	Triangulated Irregular Network
UTM	Universal Transverse Mercator
WAPC	Western Australian Planning Commission
ABBREVIATION	DEFINITION

ha	Hectare
Hwy	Highway
m	Metre
km	Kilometre
km ²	Square kilometre
Mtpa	Million tonnes per annum

1 Introduction

1.1 Background

Orebody 31 (OB31; the Project) is located approximately 40 kilometers (km) east of the Newman Township, in the Shire of East Pilbara (Figure 1). Being situated directly east of the existing Orebody 17 and 18 operations at Wheelara Hill, OB31 is currently intended as a long term replacement for these projects. The Project is situated between the Newman and Jimblebar Iron Ore Hubs. The location of OB31 in relation to surrounding operations is shown in Figure 1.

At present, the project is envisaged to involve the mining of one open cut pit that is largely below the water table (through conventional drill and blast techniques) as well as the construction of two Overburden Storage Areas (OSAs), a primary crusher and conveyor infrastructure. Ore is proposed to be produced at an initial rate of approximately 15 million tonnes per annum (Mtpa) with a potential full throughput of 30 Mtpa. It is anticipated that the Project will house one primary crusher, with ore most likely being initially transported via overland conveyors to existing the Ore Handling Plant (OHP), ore stockpile and Train Load Out (TLO) facility at OB17/18. Should throughput be increased to 30 Mtpa, a secondary conveyor may be constructed to convey ore to the Jimblebar OHP, stockpile and TLO facility at Shovellana Hill (Figure 2).

360 Environmental was commissioned by BHP Billiton Iron Ore (BHPBIO) to conduct a Landscape and Visual Impact Assessment (LVIA) to support the environmental impact assessment and approvals required for the project.

1.2 Legislative Context

Legislative instruments exist at the Federal, State and Local government levels which directly or indirectly support the protection of landscapes and their resulting visual amenity. These are outlined below.

1.2.1 Federal Legislation and Positions

Under Section 528 of the *Environment Protection and Biodiversity Conservation Act 1999*, the term 'Environment' is defined as (DSEWPaC 2012):

- (a) *Ecosystems and their constituent parts, including people and communities; and*
- (b) *Natural and physical resources; and*
- (c) *The qualities and characteristics of locations, places and areas; and*
- (d) *Heritage values of places; and*
- (e) *The social economic and cultural aspects of a thing mentioned in paragraph (a), (b) or (c).*

Under this definition, impacts to visual amenity can be considered an ‘environmental’ impact, as it falls under the definition in (c).

1.2.2 State Legislation and Positions

When a proposal is assessed under the *Environmental Protection Act 1986* the Environmental Protection Authority (EPA) may consider a proposal’s impacts to visual amenity under its guidance framework for environmental factors based on a number of environmental factors and protection objectives listed in *Environmental Assessment Guideline for Environmental factors and objectives* (EPA 2013a). The objectives relevant to landscape and visual impacts are:

- Landforms: “To maintain the variety, integrity, ecological functions and environmental values of landforms and soils”;
- Air Quality: “To maintain air quality for the protection of the environment and human health and amenity”; and
- Amenity: “To ensure that impacts to amenity are reduced as low as reasonably practicable”.

Although the Landforms factor does not contain mention of visual impact or amenity, it is considered relevant as intact landforms often make up intact landscapes (as assessed by this study) which can reflect higher levels of ecological function and biodiversity (The Landscape Institute 2002; Ludwig et al. 1996).

There are also a number of State policies that highlight the need for visual impact assessment to be considered during the planning phase of developments. These include the Western Australian State Planning Framework and the Pilbara Planning and Infrastructure Framework.

The Western Australian Planning Commission’s (WAPC) *State Planning Policy No. 2: Environment and Natural Resource Policy* for Western Australia (WAPC 2003) states that the objective for planning is to:

- “identify and protect landscapes with high natural resource values (such as ecological, aesthetic or geological)”;
- “consider the capacity of the landscape to absorb new activities and incorporate building design and siting criteria to ensure that new developments are consistent and sensitive to the character and quality of the landscape”; and
- “consider the need for a landscape or visual impact assessment for development proposals that may impact upon sensitive landscapes”.

The WAPC also encourages proponents to develop appropriate management strategies that can contribute to the maintenance and enhancement of high value landscapes. The WAPC's Pilbara Planning and Infrastructure Framework (WAPC 2012) highlights the need to:

- “safeguard and enhance significant natural landscape assets and cultural heritage values”; and
- “protect and manage the region’s cultural heritage, arts including indigenous significant places, and landscapes of significance”.

1.3 Scope and Objectives

The broad objectives of the OB31 LVIA are to:

- Identify key landscape values within and surrounding the proposed development;
- Identify vantage points and corridors where these key sites may be viewed / accessed / experienced;
- Evaluate the visual amenity associated with these landscape values – the way the landscape is viewed, experienced and valued;
- Assess the potential impacts on visual amenity resulting from the proposed development, including cumulative impacts from other existing and proposed projects;
- Assess the significance of these impacts; and
- Describe management and mitigation measures that will reduce impacts to landscape and visual amenity (presented in a separate document).

These objectives are considered in line with LVIA assessment methodology guidelines, as set out in the Department of Planning and Infrastructure’s (DPI) Visual Landscape Planning in Western Australia: a Manual for Evaluation, Assessment, Siting and Design (DPI 2007), and in the Guidelines for Landscape and Visual Impact Assessment (3rd Edition, 2013), from the Landscape Institute and Institute of Environmental Management and Assessment (UK).

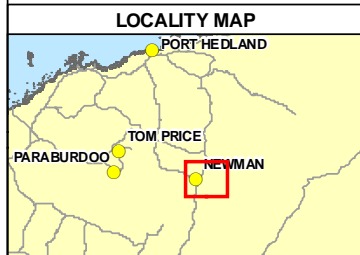
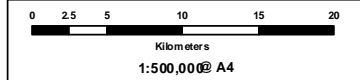


- Legend**
- Localities
 - Watercourses
 - Orebody 31 Project Areas**
 - OSA
 - Pit
 - Roads**
 - Great Northern Highway
 - Other Roads
 - Existing Major Iron Ore Mines**
 - BHP Billiton Iron Ore Operated
 - Other Operators
 - Rail Infrastructure**
 - BHP Billiton Iron Ore Rail Lines
 - Other Operator Rail Lines

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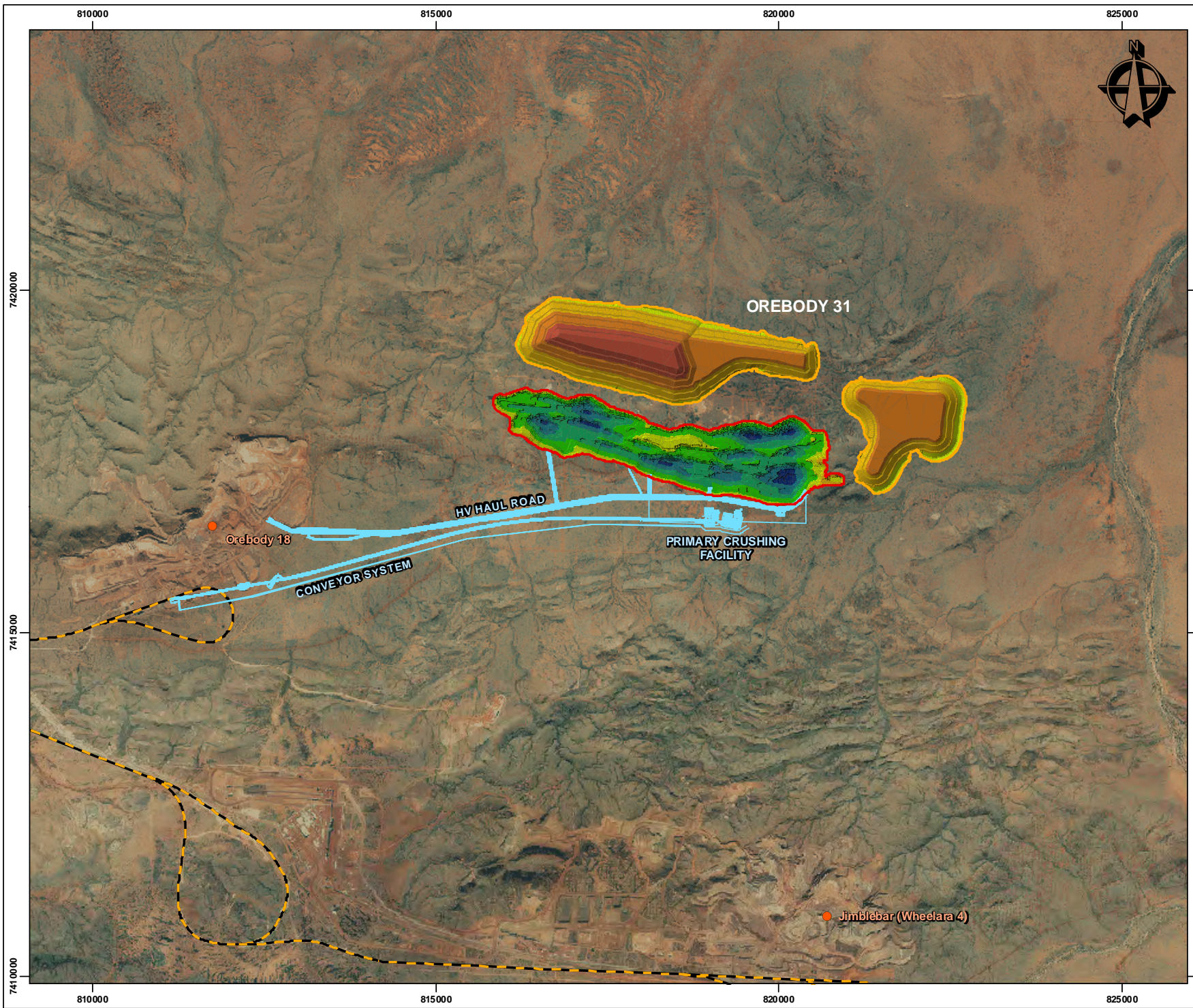


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BHP Billiton Iron Ore
Orebody 31

Landscape and Visual Impact Assessment (LVIA)

Figure 1 - Site Location

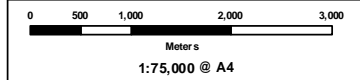


- ### Legend
- Orebody 31 Project Areas**
 - OSA
 - Pit
 - Haul Roads & Overland Conveyors
 - Existing Major Iron Ore Mines**
 - BHP Billiton Iron Ore Operated
 - Other Operators
 - Rail Infrastructure**
 - BHP Billiton Iron Ore Rail Lines
 - Site Model Elevation (mAHD)**
 - 605m - 640m
 - 570m - 605m
 - 535m - 570m
 - 500m - 535m
 - 465m - 500m
 - 430m - 465m
 - 395m - 430m
 - 360m - 395m

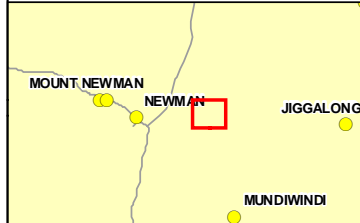
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LOCALITY MAP



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BHP Billiton Iron Ore
Orebody 31

Landscape and Visual Impact Assessment (LVIA)

Figure 2 - Site Layout

2 The Existing Environment

2.1 Environmental Setting

2.1.1 Landscape Character

The Project falls primarily within the Hamersley Plateaux Landscape Zone within the Pilbara Bioregion, which forms the large part of the Landscape Character Type (LCT) of the Newman region (Figure 3). Landscape Character is a broad grouping of similar landforms, soils and vegetation. The Hamersley Plateaux LCT can broadly be described as (adapted from Tille 2006):

“Hills and dissected plateaux (with some stony plains and hardpan wash plains) on sedimentary and volcanic rocks of the Hamersley Basin (Ophthalmia Fold Belt). Stony soils with Red shallow loams and some Red/brown non-cracking clays and Red loamy earths. Spinifex grasslands with snappy gum and kanji (and some mulga shrublands).”

A smaller area falls within the Fortescue Valley LCT, described as:

“Alluvial plains, hardpan wash plains and sandplains (with stony plains, floodplains and some salt lakes) on alluvial deposits over sedimentary rocks of the Hamersley Basin. Red deep sands, Red loamy earths and Red/brown non-cracking clays with some Red shallow loams and Hard cracking clays. Mulga shrublands and spinifex grasslands (with some tussock grasslands and halophytic shrublands).”

A more specific and level of detail, the OB31 Project area falls within several land systems as described by Van Vreeswyk et al (2004) in *An inventory and condition survey of the Pilbara Region, Western Australia* (Tille 2006; Figure 4). These systems are described as:

- Newman System: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands (49.13%);
- Boolgeeda System: Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands (41.58%);
- McKay: Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands (0.86%); and
- Washplain System: Hardpan plains supporting groved and hard spinifex grasslands (8.43%).

2.1.2 Newman Land System

The Newman system is a large land system in the central Pilbara and is characteristic of Pilbara landscapes. The geomorphology of the Newman System is described as:

“Erosional surfaces; plateaux and mountains - extensive high plateaux, mountains and strike ridges with vertical escarpments and steep scree slopes and more gently inclined lower slopes; moderately spaced dendritic and rectangular tributary drainage patterns of narrow valleys and gorges with narrow drainage floors and channels. Relief up to 450 m.”

It is estimated that approximately 70% of this land system consists of plateaux, ridges, mountains and hills. Twenty percent of the land system consists of lower slopes with the remaining 10% split evenly between stony plains and narrow drainage floors with channels (Van Vreeswyk et al 2004). The majority of vegetation in this land system is described as:

“Hummock grasslands of *Triodia wiseana*, *T. brizoides*, *T. plurinervata* (hard spinifex) with very scattered to scattered shrubs and trees including *Acacia* and *Senna spp.*, *Grevillea wickhamii* (Wickham’s grevillea), *Eucalyptus leucophloia* (snappy gum) and other eucalypts. Occasionally hummock grass is *Triodia biflora* (soft spinifex).”

The Newman System is of high socioeconomic importance due to the large number of iron ore resources in the form of banded iron formations being found in it.

2.1.3 Boolgeeda Land System

The Boolgeeda Land system is commonly associated with the Newman Land System, being downslope of it. The geomorphology of this System is described as:

“Predominantly depositional surfaces; very gently inclined stony slopes and plains below hill systems becoming almost level further downslope; closely spaced, dendritic and sub-parallel drainage lines. Relief up to about 20 m.”

It is estimated that 65% of this land system consists of stony lower plains, with 20% of stony slopes and upper plains, 10% of narrow drainage floors and channels, 4% of low hills and rises and the remaining 1% being made up of groves.

Vegetation largely consists of a mixture of that found in the Washplain and Newman Systems and is described as:

“Hummock grasslands *T. wiseana*, *T. lanigera* (hard spinifex) or *T. pungens* (soft spinifex) (PHSG, PSSG). Also scattered to moderately close tall shrublands of *A. aneura* and other acacias with hard and soft spinifex ground layer.”

The proximity of the Boolgeeda Land System to the Newman System, as well as its generally low relief and gentle slope has made it ideal for the setting up of processing

infrastructure. The processing facilities and TLOs for BHPBIO's Jimblebar, Shovellana, OB24 and Area C operations, as well as Rio Tinto's Marandoo and Yandi operations are largely set within this Land System.

2.1.4 McKay Land System

The geomorphology of this land system is described as:

“Erosional surfaces; hill tracts, ridges, plateaux remnants and breakaways with steep upper slopes and more gently inclined lower footslopes, restricted stony plains and interfluves; moderately spaced tributary drainage patterns incised in narrow valleys in upper parts becoming broader and more widely spaced downstream. Relief up to 100 m.”

It is estimated that 60% of this land system consists of hills, ridges and plateaux remnants, 20% of stony plains, 10% of lower footslopes to hills, ridges and plateaux, 8% of drainage floors and 2% of breakaways (indurated mesa caps of ironstone or laterite).

Vegetation within this land system is most commonly described as:

“Hummock grasslands of *Triodia lanigera*, *T. wiseana* (hard spinifex) with isolated to scattered *Acacia spp.* shrubs or *Eucalyptus leucophloia* (snappy gum) trees.”

2.1.5 Washplain Land System

The geomorphology of the Washplain System is described as:

“Depositional surfaces; level alluvial hardpan plains subject to overland sheet flow, discrete drainage foci(groves) arranged with long axes at right angles to direction of sheet flow and drainage tracts receiving more concentrated flow,occasional channels; minor stony plains and sandplains. Relief up to 10 m.”

Approximately 60% of this system consists of alluvial hardpan plains, 15% of groves, 14% of drainage tracts, 6% of stony plains and the 3% is made up of sandplains (Van Vreeswyk et al. 2004).

The most abundant vegetation association of the Washplain System's is described as:

“Herbfields with isolated shrubs or very scattered to scattered shrublands of *Acacia aneura*, *Eremophila cuneifolia* (royal poverty bush) other eremophilas, *Senna spp.* and small *Maireana spp.*”

2.2 Socio-economic Setting

2.2.1 Land uses

Mining is considered the main land use in the Newman area. BHP Billiton Iron Ore owns and operates a number of mining operations around the Newman area which are known as the Whaleback Hub, the Eastern Ridge Hub and the Jimblebar Hub. The hubs consist of the following grouped deposits/mines:

- Whaleback Hub (current operations - Whaleback, OB18, OB29, OB30, OB35 and the proposed OB31);
- Eastern Ridge Hub (current operations OB23, OB24 and OB25); and
- Jimblebar Hub (current operations Jimblebar and Wheelarra 4).

2.2.2 Overview of the Newman Township and Surrounding Areas

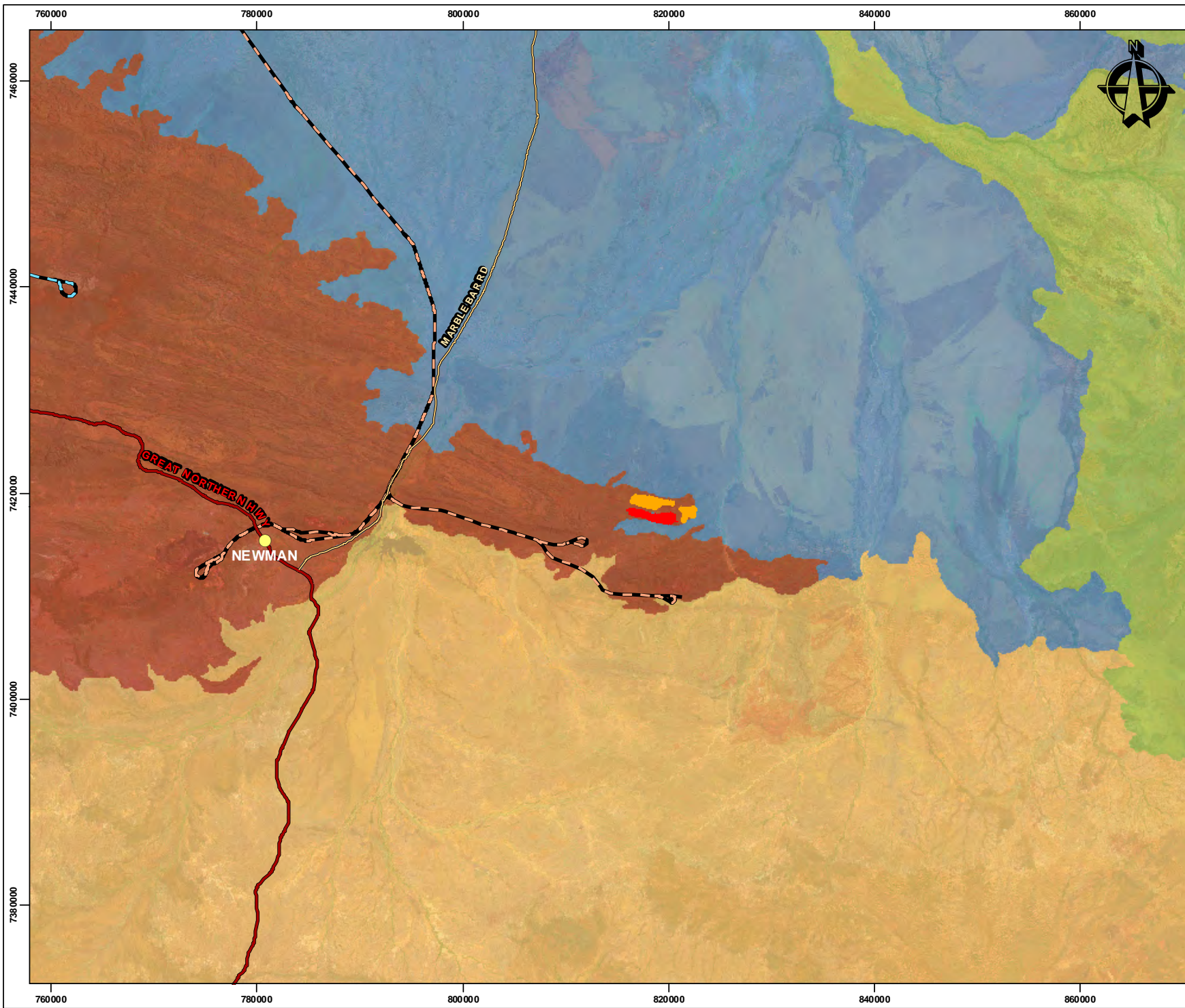
The Project is located approximately 40 km east of the Newman Township, Newman is the largest town in the East Pilbara with the population of the township growing exponentially since 2003. In 2012 the residential population of Newman was 5,478 (Australian Bureau of Statistics 2012). Adding to the permanent population is the fly in fly out workforce averaging around 4,000 people.

The Orebody 31 project area lies within the traditional lands of the Nyiyaparli People. The Nyiyaparli People are the Traditional Owners of approximately 36,684 km² of land and waters in the east Pilbara region, including the township of Newman.

Newman is also an access point for a number of sites with environmental or social values including:

- Karijini National Park (approximately 200 km west of Newman);
- Karlamilyi (Rudall River) National Park (approximately 300 km north east of Newman);
- Ophthalmia Dam, a popular swimming and recreation spot (fishing and sailing) (approximately 20 km out of Newman);
- Kalgan Pool/Creek (approximately 20 km out of Newman);
- Wanna Munna rock are and pool site (approximately 30 km out of Newman);
- Silent Gorge (approximately 12 km out of Newman); and
- Weeli Wolli Springs (approximately 100 km out of Newman).

The area surrounding the Newman Township is also valued for its unique flora and fauna. Between July to September each year a number of tourists visit the area to witness the flowering of Spinifex grass (Newman Visitor Centre 2013).

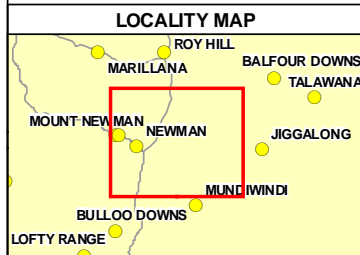
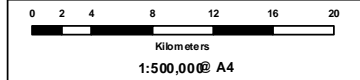


- ### Legend
- Orebody 31 Project Areas**
- OSA
 - Pit
- Roads**
- Great Northern Highway
 - Other Roads
- Rail Infrastructure**
- BHP Billiton Iron Ore Rail Lines
 - Other Operator Rail Lines
- Landscape Character Types (LCT)**
- Fortescue Valley
 - Hamersley Plateaux
 - Jigalong Plains
 - Bulloo Plains and Hills

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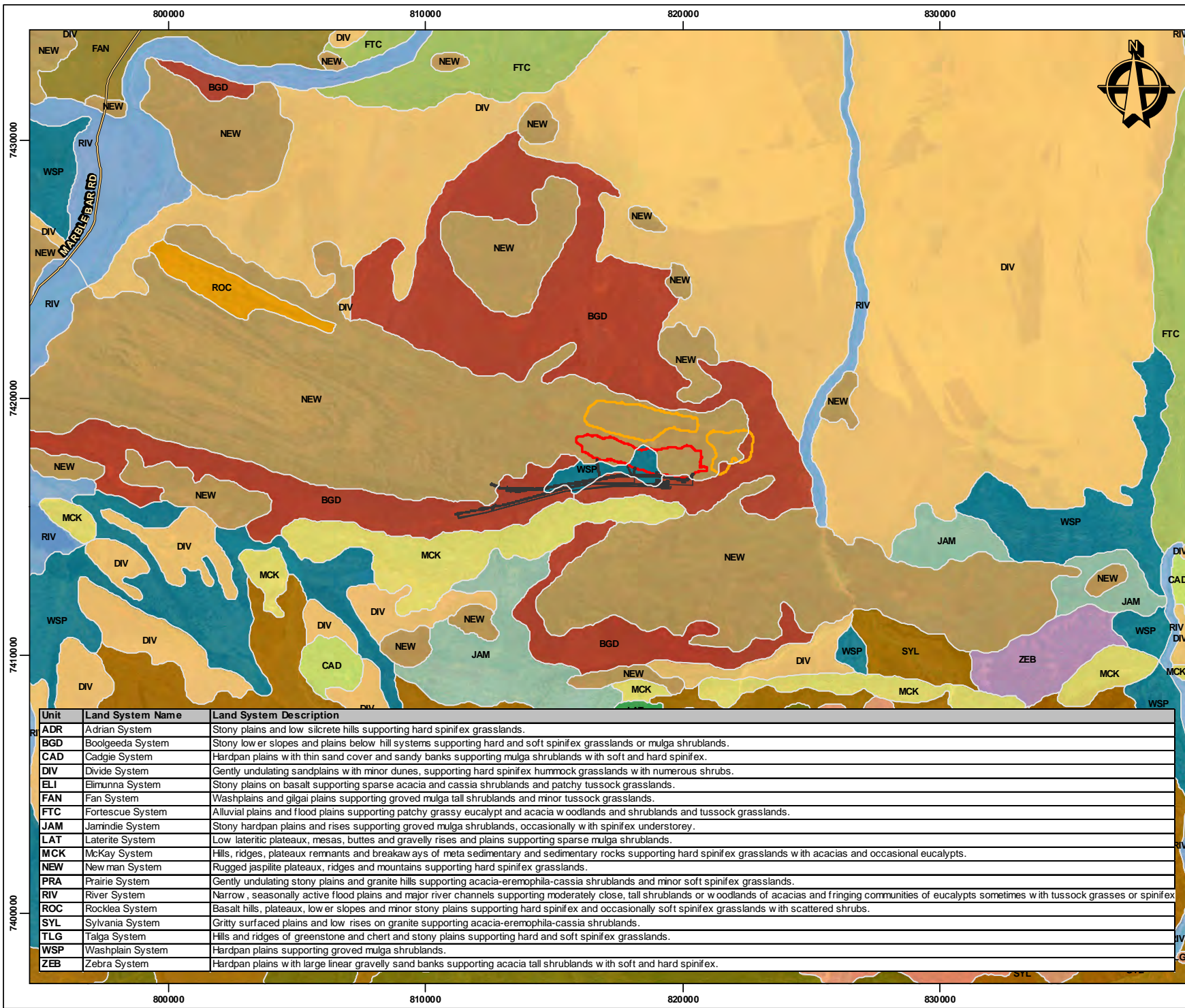


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BHP Billiton Iron Ore Orebody 31

Landscape and Visual Impact Assessment (LVIA)

Figure 3 - Landscape Character Types



Legend

Orebody 31 Project Areas

- OSA
- Pit
- Infrastructure

Land Systems

- ADR - Adrian System
- BGD - Boolgeeda System
- CAD - Cadgie System
- DIV - Divide System
- ELI - Elimunna System
- FAN - Fan System
- FTC - Fortescue System
- JAM - Jamindie System
- LAT - Laterite System
- MCK - McKay System
- NEW - Newman System
- PRA - Prairie System
- RIV - River System
- ROC - Rocklea System
- SYL - Sylvania System
- TLG - Talga System
- WSP - Washplain System
- Zebra System

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0 1 2 4 6 8
 Kilometers
 1:200,000 @ A4

LOCALITY MAP

DRAWING ID: 317
 DATE: 22/05/2014

HORIZONTAL DATUM AND PROJECTION
 GDA 1994 MGA Zone 50

CREATED JJ	CHECKED FJ	APPROVED TS	REVISION 0
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BHP Billiton Iron Ore Orebody 31

Landscapes and Visual Impact Assessment (LVIA)

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Unit	Land System Name	Land System Description
ADR	Adrian System	Stony plains and low silcrete hills supporting hard spinifex grasslands.
BGD	Boolgeeda System	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.
CAD	Cadgie System	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.
DIV	Divide System	Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.
ELI	Elimunna System	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.
FAN	Fan System	Washplains and gilgai plains supporting groved mulga tall shrublands and minor tussock grasslands.
FTC	Fortescue System	Alluvial plains and flood plains supporting patchy grassy eucalypt and acacia woodlands and shrublands and tussock grasslands.
JAM	Jamindie System	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.
LAT	Laterite System	Low lateritic plateaux, mesas, buttes and gravelly rises and plains supporting sparse mulga shrublands.
MCK	McKay System	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.
NEW	Newman System	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.
PRA	Prairie System	Gently undulating stony plains and granite hills supporting acacia-eremophila-cassia shrublands and minor soft spinifex grasslands.
RIV	River System	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.
ROC	Rocklea System	Basalt hills, plateaux, low er slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.
SYL	Sylvania System	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands.
TLG	Talga System	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.
WSP	Washplain System	Hardpan plains supporting groved mulga shrublands.
ZEB	Zebra System	Hardpan plains with large linear gravelly sand banks supporting acacia tall shrublands with soft and hard spinifex.

Figure 4 - Land Systems

3 Methodology

3.1 Desktop Assessment

3.1.1 Viewpoint Selection

In order to determine potential viewpoints for the Field survey, several types of target sites were identified where the proposed development may be visible. These target sites were then prioritised using both qualitative and quantitative selection criteria.

3.1.1.1 Desktop Sources

A number of sources were used to identify target sites including:

- BHP Billiton Iron Ore's Places dataset – contains a list of regionally significant features such as pools, hills, towns, streams, rock-holes and gorges, as well as culturally significant sites;
- Tourist maps – contain sites of recreational and regional interest likely to be accessed by tourists, generally with good levels of accessibility;
- 4WD Forums and Clubs – contains site of significance to the local 4WD community with varying levels of accessibility;
- Newman Visitors Centre – several locally important and popular sites were identified through this source as well as advice on accessibility and popularity; and
- Other sources – This included public websites and social network sites which contain geo-tagged place marks of interesting sites. These sites were recorded by various members of the public, including tourists and local residents and have varying levels of accessibility.

As sites are valued differently by different individuals, the use of public forums presented a useful way of identifying sites of importance to the public. A number of sites were also sourced from the findings of BHP Billiton Iron Ore's Pilbara Expansion Strategic Environmental Assessment LVIA (360 Environmental/GHD, in prep).

3.1.1.2 Qualitative Criteria

The significance of target sites was prioritised giving consideration to the WAPC *Criteria for Site Significance* as shown in Table 1.

Table 1. WAPC Criteria for Site Significance

WAPC (2007) CRITERIA FOR SIGNIFICANCE	METHODOLOGY
Rarity of a view based on natural beauty and/or cultural significance.	Site selection based on various sources (BHP Dataset, tourist maps, visitor centres, public forums).
The background of viewers i.e. tourists or local residents.	Site selection based on various sources (tourist maps, local 4WD clubs, public forums).
The degree of use i.e. the amount of traffic a view location receives.	Proximity to transport corridors; also assessed on site.
The relative significance of a viewpoint to the area, for instance a viewpoint on a major highway as opposed to a viewpoint located on a remote observation platform.	Relationship between accessibility, risk of impact and visitor traffic. Assessed by a site significance criteria (Section 3.1.2) as well as in the field.
The duration and clarity of a view, for instance a sudden glimpse of the operation area through dense vegetation while travelling along a highway from close proximity, as opposed to a sustained view of the operation area from further away.	Similar to above, site significance criteria gives a higher level of significance to major road networks which are likely to provide high view duration and clarity. Also assessed in the field.

The desktop assessment considered the following site types when compiling a list of potentially significant sites:

- Water features;
- Hills and mountains;
- Towns and homesteads;
- Lookouts; and
- Public roads.

The rationale for identifying these site types are listed below.

3.1.1.3 Water Features

Arguably the most high value attraction for potential viewers in the Newman region are the creeks, rivers, pools and gorges. As these sites are often located within gorges and areas of the landscape that are relatively recessed and sheltered, it is unlikely that their visual amenity will be directly impacted by the Project. However, in many cases, access to these sites requires travel over elevated areas or flat floodplains which may be visually impacted. As the access route will likely be used by a larger number of viewers, these sites were included as potential target sites.

3.1.1.4 Hills and Mountains

Elevated positions within the landscape often have views over large areas of the landscape. Many of these hills and mountains are important as tourist attractions, often with lookouts points boasting panoramic views at the summits. These sites were included as potential target sites.

3.1.1.5 Towns and Homesteads

As towns represent centres of population with high numbers of potential viewers, these sites were included as a potential target sites. Although homesteads receive in comparison, a smaller number of visitors, they are still locally important features which should be surveyed.

3.1.1.6 Lookouts

There are several lookouts within the region most often located adjacent to major transportation corridors. As these viewpoints are often in elevated positions overlooking visually appealing views, these sites often experience high visitor traffic, and were therefore included as potential target sites. Many lookouts are often demarcated with brown tourist signs, which may increase the likelihood of access by visitors.

3.1.1.7 Public Roads

As public roads are the most highly valued transportation corridors in the region, these sites are likely to receive a large amount of viewer traffic. Road sites may include layovers, roadhouses, stop overs, bridges (often demarcated lookouts or photo points, where visually appealing views often occur) or in some cases a section of road that may potentially be at risk of impact.

3.1.2 Quantitative Criteria

The term 'significance' especially in terms of amenity is often a very subjective qualitative term. In order to determine the significance of the identified sites in a quantitative sense, it was necessary to consider and evaluate the risk of impact to a site.

$$\text{Risk} = (\text{consequence or severity of impact}) \times (\text{likelihood or probability of impact})$$

As the fundamental principle of VIA is to evaluate the worst case scenario of impact, it can be assumed that the probability of impact is 100% (i.e. there will be visual impacts, albeit at varying levels of) (The Landscape Institute 2000). It is then possible to substitute the probability of visual impact to the probability of impact to visual amenity. As amenity is dependent on receptors (viewers), this is essentially the relative likelihood of viewers accessing a site. This relationship can then be adapted for the risk of impacts to visual amenity:

$$\text{Risk} = (\text{Relative severity of visual impact}) \times (\text{Relative likelihood of viewers})$$

As the relative severity of an impact to visual amenity can be predicted from distance, and the likelihood of viewers can be determined based on accessibility, sites could be ordered by potential risk. This formed the basis of the site selection method for the field survey.

Table 2. Vulnerability of Sites: Potential Impact Versus Likelihood

INCREASING LIKELIHOOD OF VIEWERS			
INCREASING SEVERITY OF IMPACT	Low Significance	Low Significance	Moderate Significance
	Low Significance	Moderate Significance	Moderate Significance
	Moderate Significance	Moderate Significance	High Significance

Potential impact was determined as the distance between the site and the proposed operation areas. The potential vulnerability of a site was determined based on the function of the proximity of the site to centres of population, and the ease of access of the site. These factors are discussed in the following section.

3.1.2.1 Ease of Access

Ease of access was determined based on the type of road access available. A site was given a higher ease of access if it was located within five kilometres of a sealed road, and a lower ease of access if it was in proximity to an unsealed road or track.

3.1.2.2 Proximity to Populations Centres

Ease of access was also determined based on the site’s proximity to population centres (Newman, Paraburdoo and Tom Price). As Newman is considerably larger than Paraburdoo and Tom Price, sites in close proximity were given a higher ease of access rating.

3.1.2.3 Distance from Operational Areas (Potential for Impact)

The potential for impact was determined based on categorisation of the distance of a site from operation areas. Based on the results of other Landscape and Visual Impact Assessments carried out in the region (360 Environmental/GHD 2013; 2014), it was found that (not including vegetation) viewpoints within five kilometres of an operational area generally showed high visual impacts, while viewpoint sites between five and ten kilometres showed moderate impacts. Sites further than 10 km generally constituted low visual impacts. Similarly, viewpoints identified for field assessment were scored according to the above criteria (e.g. points located within zero to five kilometres from any operational areas were given a high potential for impact score).

3.1.3 Limitations and Assumptions of the Desktop Analysis

The survey site selection did not consider topography in assisting with determining potential impact. In theory, a cumulative pre-field survey viewshed analysis using all the target sites would identify sites that would not have views of operational areas. However, this method runs the risk of prematurely discounting sites prior to field verification based on a relatively coarse Digital Elevation Model.

As the viewshed analyses used in this assessment is based on a 30x30 m DEM, rapid changes in terrain smaller than this scale (e.g. some gorges) will likely be smoothed over as an average elevation is used for each cell. If a site is located within a small gorge, with one end of the gorge is open and overlooking an operational area. A viewshed analysis would indicate that this site will not have views of an operation area as the elevation model used would not capture the topography of the site accurately. It is therefore crucial that the desktop analysis is as accurate as possible, so as not to discount potentially important sites.

The post-field survey viewshed analysis is not subject to these same limitations, as the results of that viewshed analysis are compared with photographs of the actual site in order to ground truth and verify the analysis results.

The viewshed analysis also does not take into account the screening effect that vegetation may have, and in many cases an exaggerated viewshed model is generated. These errors are usually rectified when comparing digital photographs taken at the site with the theoretical viewshed from that site.

3.2 Field Assessment

3.2.1 Field Survey Methods

The field assessment phase of the study was undertaken by BHP Billiton Iron Ore environmental scientists onsite. The criteria and methodology for the site based landscape and visual assessment were established prior to undertaking the field visit (Table 3). The identified viewpoints were visited by foot and vehicle on 19 May 2014. Global positioning system waypoints, field notes and digital photographs were taken at each site. The digital photographs were later used in the photomontage analysis. Several sites were surveyed during a field trip for BHP Billiton Iron Ore's Strategic Environmental Assessment in May of the previous year. No major developments have taken place in the area during this time.

Typically, a minimum of three digital photographs taken at a height of approximately 1.65 m were combined to produce a panoramic image with a focal length equivalent to approximately 50 mm (in 35 mm film format) which is acknowledged to be a 'normal' focal length (is similar to what human eyes perceive). This is considerably wider than what the WAPC recommends (90 mm) in Visual Landscape Planning in Western Australia (WAPC 2007). A wider focal length was intentionally used to adequately

capture the wide open space of the region, often considered to be a defining characteristic of the Pilbara. Furthermore the WAPC guidelines is largely oriented towards smaller scaled land development or infrastructure projects which do not require as wide a field of view.

3.2.1.1 Field Assessment Criteria

An example of a field visit survey sheet that shows what was typically recorded when the field assessment was being completed is presented in Table 3. Fields range from geographical aspects of the location, the valued landscape characteristics seen from the viewpoint, as well as potential management and mitigation measures. The coordinate system used in this study is restricted to the Geodetic Datum of Australia (GDA) 1994 with coordinates in decimal degree format. The Map Grid of Australia (MGA) 1994 datum, a Universal Transverse Mercator (UTM) projection, was not used as the OB31 project area sits on the boundary between Zones 50 and 51 which was seen as a potential source of confusion.

Table 3. Field Assessment Criteria

CRITERIA	CHARACTERISTICS	
Location	Latitude: (decimal degrees)	Longitude: (decimal degrees)
Setting	Physical setting of the viewpoint	
Land System	Major Land Systems visible from the viewpoint, from foreground to background	
Viewpoint Elevation	Elevation of viewpoint relative to surrounding landscape	
Viewing Distance	Approximate distance from development	
View Elements	Extent of views, such as foreground and background views	
Motion of Viewer	Speed at which a viewer may be travelling	
Vegetation Screening Potential	Approximate plant density and suitability to provide screening	
Vegetation Type	General vegetation assemblages	
Land Use	Major land use of the viewpoint surroundings	
Accessibility	Ease of access to the site	
Usage	An estimate of the amount of public use a site receives	
Potential Visual Risk	Potential for visual impact at the viewpoint	
Valued Landscape Characteristics	Characteristics contributing to the view experience	

3.2.2 Defining View Experiences

Understanding view experience is an integral part of the development of strategies to manage visual landscape character. In this context, a 'view experience' can be termed as how a view or landscape is valued by an individual. This is usually the result of a combination of landforms, geology, water features, vegetation and topography producing

a relatively positive, neutral or negative view. View experience was qualitatively assessed at each viewpoint during the site visit, with notes taken on the combination of landforms. Greater variety in landforms, topography and vegetation result in a more interesting view and therefore generally positive view experiences.



Plate 1. View experiences from different landform combinations

Different combinations of vegetation, landforms, water features, soils, topography and geology may interact to form different view experiences. The positive view experience example demonstrates a high variety in natural features, including a cliff in the foreground, hills in the background, a water body, different vegetation types as well as soils. Although the neutral experience example does show variety in vegetation types the terrain is relatively plain, with flats in the foreground and midground, and hills in the background. The negative experience on the other hand demonstrates little variation in vegetation type, topography or geology. It is important to note that these definitions are relative, the negative view experience is not negative by itself, but rather is negative in relation to the neutral and positive view experiences available in a particular landscape unit.

3.2.3 Assessment of Cumulative Impacts

The field assessment of cumulative impacts was limited to the capture of existing developments in a qualitative sense. As key viewpoints are identified based on the findings of the field assessment, an important limitation is introduced.

Firstly, as key viewpoints are chosen based on significance to proposed BHP Billiton Iron Ore operations, there is limited ability to assess cumulative impacts at a regional scale. It is not possible to survey a varied number of sites based on potential cumulative impacts without directly performing viewshed analyses on the whole region using footprint data from all proponents.

3.3 Visual Impact Assessment

3.3.1 3D Mine Layout Modelling

At present, preliminary mine designs are available and have been used to generate the 3D site model through the creation of a Triangular Irregular Network (TIN) in the Earth Systems Research Institute's ArcScene. Alongside the Pit and OSA model, conceptual infrastructure was also modelled. These are illustrated below and will form the inputs to the viewshed and photomontage analysis.

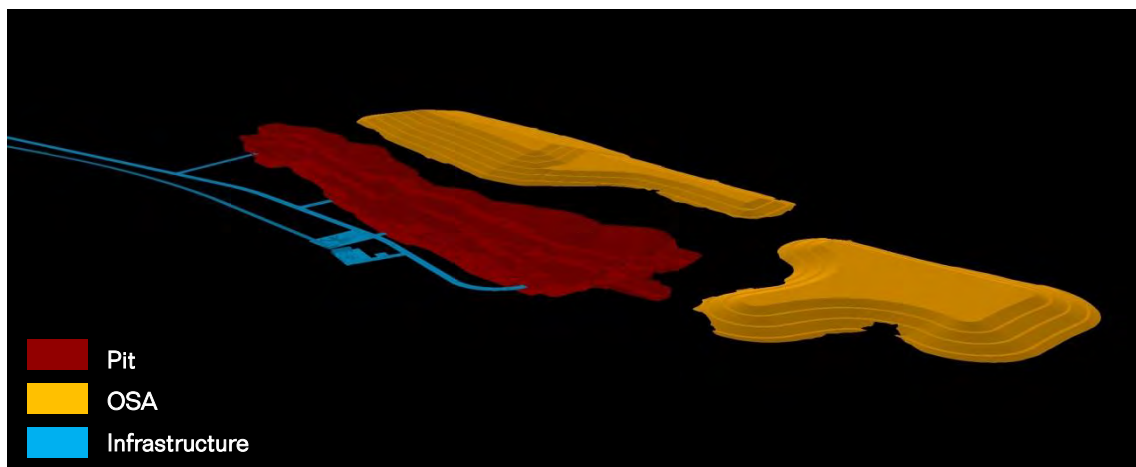


Figure 5. 3D Site Model

The 3D mine layout is then stamped into a pre-development Digital Elevation Model (DEM) to produce a post development topography. This process is illustrated below in Figure 6.

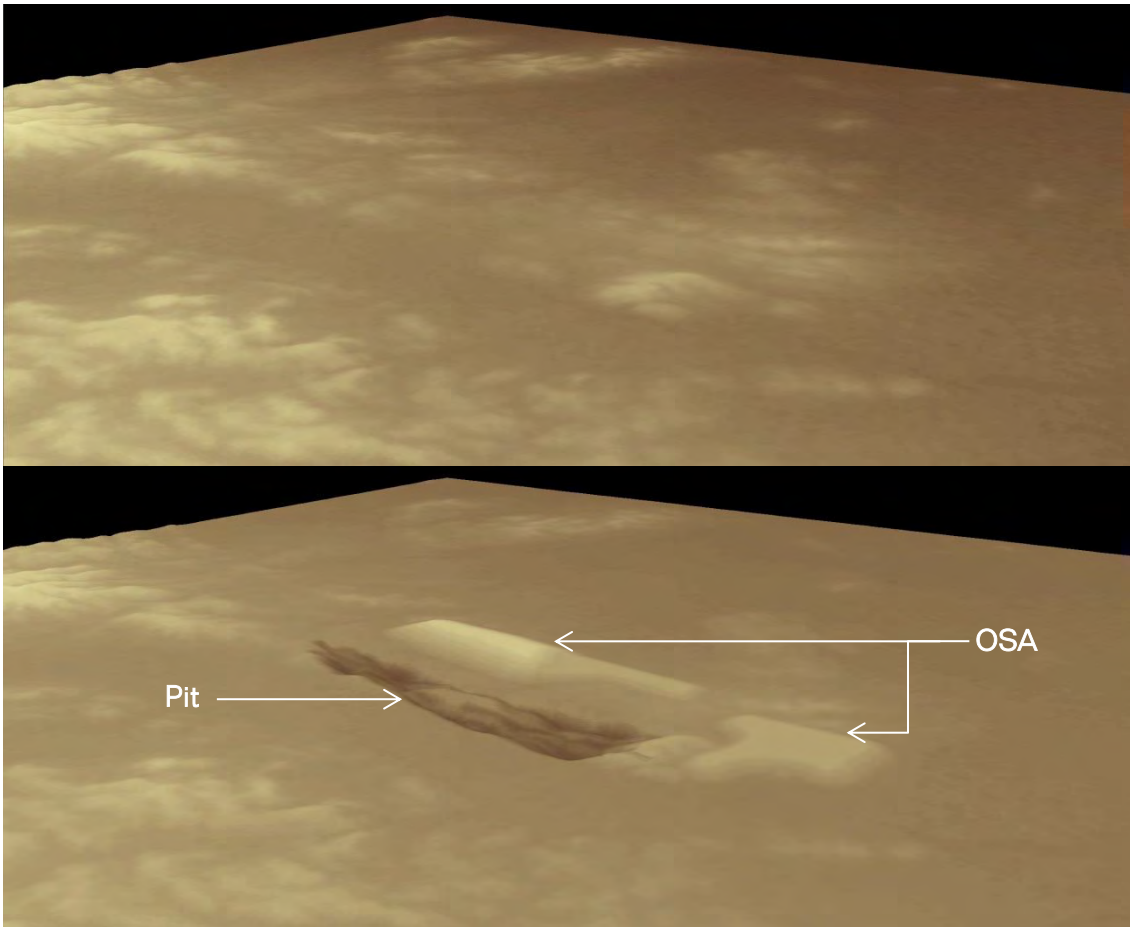


Figure 6. Pre and Post Development Terrain Models

3.3.2 Viewshed Analysis

Viewshed analysis was conducted on pre development and post development topographies for all key viewpoints that were identified. By comparing the changes to the viewshed before and after the development takes place, it is possible to quantify the types of direct impacts that can be expected. The change in value of an individual cell in the viewshed from any given site can be translated into several categories of change in the viewshed for that site. These categories (present in the legend for Figure 7) are described below and can be interpreted as percentage of the entire viewshed.

- **No Change – Always Visible:** areas of the landscape that are unchanged directly from development and still either represent natural landscapes or an existing man made landform;
- **No Change – Always Not Visible:** areas of the landscape that are unchanged directly from development and remain outside the viewshed;
- **View Blocked by Development:** Areas of the landscape where views are lost, usually the result of the mounding of an OSA or the excavation of a pit which

results in a loss of views behind the OSA or views of the landscape where the pit is placed;

- **Natural View Created:** a rare case where the removal of a ridgeline exposes natural landscape behind it. This category may appear in some cases when a large amount of a ridgeline is removed;
- **OSA View Created:** The views that result from the construction of an OSA within an area that was previously visible, or was constructed to a height necessary to form part of a viewshed; and
- **Pit View Created:** The rim views of a pit that results from the excavation of a pit that is close to a viewer, or at significantly different elevations, relative to the viewer.

An example of the output generated from the analysis of change between the pre and post development topographies (Figure 6) in relation to a hypothetical viewpoint is shown below in Figure 7.

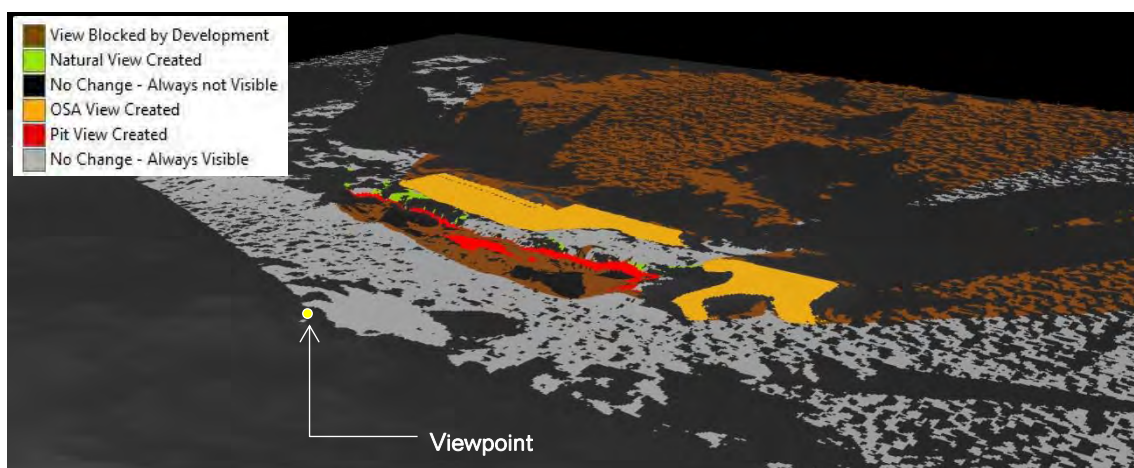


Figure 7. Example of Viewshed Analysis Output from a Hypothetical Viewpoint

The fragmented nature of the resultant areas are a result of artefacts left over from the terrain capture process. It is worth noting that infrastructure areas are not analysed incorporated into the viewshed analyses as infrastructure areas have a 3D profile that constitutes substantially less impact than pits or OSAs.

3.3.3 Photomontage Analysis

The developed 3D mine layouts were positioned within a virtual software environment (ArcScene) to emulate the aspect and view of the key viewpoint photographs obtained at the site. Once an accurate representation of the terrain and development is obtained, a 2D snapshot of the model is then blended into the digital photograph and rendered.

This process accounts for vegetation screening as well as potential coloration and texture of site elements. Where possible, the effects of dust are also simulated taking into account the prevailing wind directions of the area. The Newman weather station

records the prevailing wind direction as being from a westerly direction (BoM 2014). It should be noted that daily/ hourly wind directions can vary enormously from the prevailing direction.

Two photomontage scenarios were completed for each key viewpoint, these were:

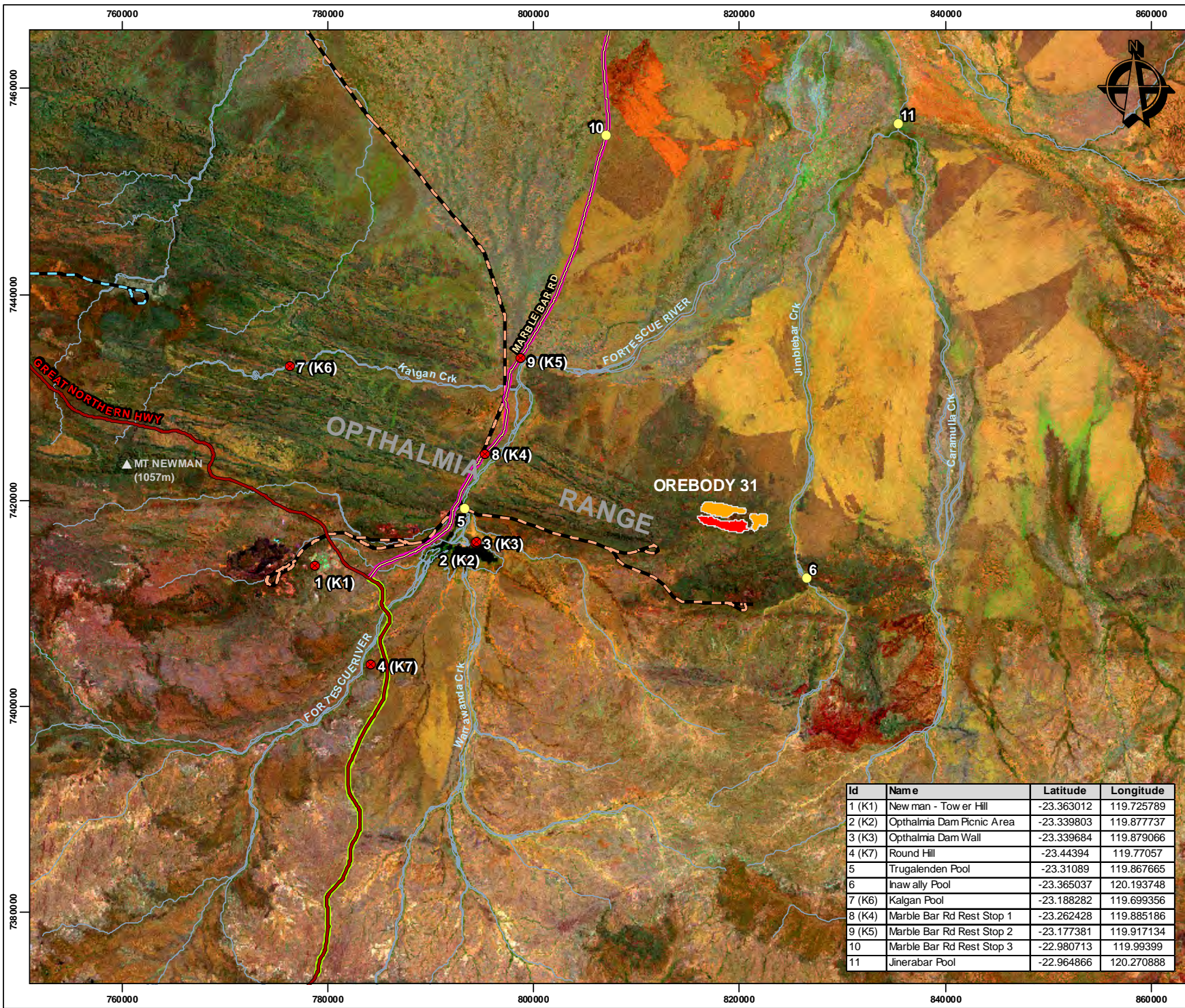
- Schematic (exaggerated colours) scenario; and
- Realistic (Post-development) scenario.

Schematics of the proposed layout, should it be visible is represented by solid red, orange, and blue fills. Red denotes pit areas, orange OSA areas and blue infrastructure areas.

The photomontages are usually annotated with useful information which describes the potential impact as well as anchor points which relate to the corresponding viewshed analysis. Real world locations of notable features in the viewshed analysis are denoted by white arrows with matching alphabets on the photomontages. This allows a simpler interpretation of the viewshed analysis with regards to a real world example.

3.3.4 Assessment of Cumulative Impacts

As the OB31 project is surrounded by other BHP Billiton Iron Ore projects, it is likely that cumulative impacts can be expected. At present the majority of the surrounding resource bodies have already been developed (OB17/18 and the Jimblebar Hub mining operations). Although expansions may occur it is considered that little to no technical assessment on the cumulative impacts of future projects will be needed as the level of impact from other projects in region will likely be similar to that at present.



Legend

Surveyed Sites

- Key Viewpoints
- Surveyed sites

Great Northern Hwy

Marble Bar Rd

Oreboddy 31 Project Areas

- OSA
- Pit

Roads

- Great Northern Highway
- Other Roads
- Watercourses

Existing Major Iron Ore Mines

- BHP Billiton Iron Ore Operated
- Other Operators

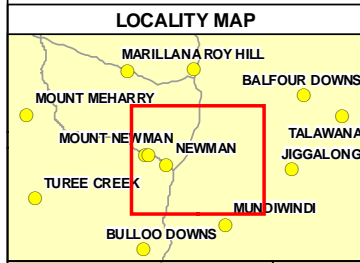
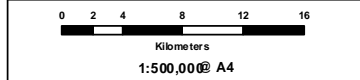
Rail Infrastructure

- BHP Billiton Iron Ore Rail Lines
- Other Operator Rail Lines

- NOTE THAT POSITION ERRORS CAN BE $\pm 5\text{m}$ IN SOME AREAS
 - LOCALITY MAP SOURCED FROM LANDGATE 2006
 - EXISTING MAJOR IRON ORE MINES SOURCED FROM BHP BILLITON IRON ORE, ADAPTED BY 360 ENVIRONMENTAL 2014
 - ALL OTHER DATA SOURCED FROM BHP BILLITON IRON ORE AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT7
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Id	Name	Latitude	Longitude
1 (K1)	New man - Tower Hill	-23.363012	119.725789
2 (K2)	Ophthalmia Dam Picnic Area	-23.339803	119.877737
3 (K3)	Ophthalmia Dam Wall	-23.339684	119.879066
4 (K7)	Round Hill	-23.44394	119.77057
5	Trugalenden Pool	-23.31089	119.867665
6	Inawally Pool	-23.365037	120.193748
7 (K6)	Kalgan Pool	-23.188282	119.699356
8 (K4)	Marble Bar Rd Rest Stop 1	-23.262428	119.885186
9 (K5)	Marble Bar Rd Rest Stop 2	-23.177381	119.917134
10	Marble Bar Rd Rest Stop 3	-22.980713	119.99399
11	Jinerabar Pool	-22.964866	120.270888

DRAWING ID 317		DATE 22/05/2014	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FJ	APPROVED TS	REVISION 0

BHP Billiton Iron Ore Orebody 31

Landscape and Visual Impact Assessment (LVIA)

Figure 8 - Surveyed Sites

4 Results

4.1 Field Assessment

4.1.1 Viewpoints Surveyed

A total of 11 viewpoints were surveyed during the field study. The locations of the sites are detailed in Table 4. These sites, along with those identified as being 'Key', denoted by the prefix 'K' are shown in Figure 8.

Table 4. Surveyed Sites

SITE NO.	SITE NAME	LATITUDE	LONGITUDE
1 (K1)	Radio Tower Hill, Newman	-23.363012	119.725789
2 (K2)	Ophthalmia Dam Picnic Area	-23.339803	119.877737
3 (K3)	Ophthalmia Dam Wall	-23.339684	119.879066
4 (K6)	Round Hill	-23.44394	119.77057
5	Trugallenden Pool*†	-23.31089	119.867665
6	Inawally Pool†	-23.365037	120.193748
7	Kalgan Pool	-23.188282	119.699356
8 (K4)	Marble Bar Road – Rest Stop 1	-23.262428	119.885186
9 (K5)	Marble Bar Road – Rest Stop 2	-23.177381	119.917134
10	Marble Bar Road – Rest Stop 3	-22.980713	119.99399
11	Jinerabar Pool*†	-22.964866	120.270888
12 (K7)	Great Northern Hwy and Marble Bar Road‡	n/a	n/a

* Inaccessible during the field study

† Site details are listed in Appendix A

‡ Entire site not surveyed and will therefore only be assessed through a cumulative viewshed analysis

Detailed descriptions of Key sites are listed in Section 4.1.2. Detailed descriptions of non-key sites are listed in Appendix A.

4.1.2 Key Viewpoints Identified

A number of 'Key' viewpoints were identified based on the information gathered in the desktop and field assessments. These Key sites were those that were determined to either be at high risk of impact with substantial visitor traffic, or sites with potentially less impact but are considered to be high value (based on high levels of public use or interest). Details and characteristics of these Key sites are listed below.

4.1.2.1 K1 - Radio Tower Hill

The Radio Tower Hill is a hill directly adjacent to the Newman Townsite which serves as a public lookout site over the townsite and the Mount Whaleback operation (Plate 2). The site features sheltered lookout spots and is a popular recreational morning walk to the top and back.



Plate 2. K1 - Radio Tower Hill lookout

Characteristics of this site are detailed in Table 5.

Table 5. K1 – Radio Tower Hill lookout site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.363012	Longitude: 119.725789
Setting	Atop the radio tower hill lookout, overlooking Newman and the Mount Whaleback operation (opposite direction to Plate 2). A covered lookout with public seating is a prominent feature of this site.	
Land System	Elimunna: Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands. McKay: Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	
Viewpoint Elevation	Hill top lookout.	
Viewing Distance	Approximately 20 km on a clear day.	
View Elements	Panoramic views of the landscape. The Mount Whaleback and the OB25 operation are visible. The Jimblebar operation is faintly visible in the far background.	
Motion of Viewer	Stationary	

CRITERIA	CHARACTERISTICS
Vegetation Screening Potential	Low; situated on a hill top and the use as a lookout reduces the effectiveness of vegetation to act as visual screens.
Vegetation Type	Eucalyptus and acacia shrubs over scattered spinifex.
Land Use	Tourism, Recreation.
Accessibility	High; accessible via paved road and walking tracks.
Usage	High; a number of joggers and tourists were noted at the site.
Potential Visual Risk	Low-Negligible; the OB31 project area is not visible from this site; impacts to the site are largely from other nearby operations.
Valued Landscape Characteristics	At this site, the views over Newman and surrounding mine sites are a prominent attraction and a valued characteristic.

4.1.2.2 K2, K3 Ophthalmia Dam

Two sites in the vicinity of the dam were surveyed, the picnic area (Plate 3) and the dam wall (Plate 4). Ophthalmia Dam offers unique amenity values to the Newman region. Being the only large, open, and publically accessible freshwater body in the region, it is a popular recreational site for the residents of Newman as well as tourists. Popular activities undertaken at the site include camping, picnicking, boating, various watersports and swimming. The site offers free gas barbeques, a public washroom and picnicking facilities.

It also offers considerable ecological value (which often translates to amenity) as the site contains a large diversity of flora and fauna (waterbirds, reptiles) as well as a state listed Threatened Ecological Stygobiont Community.



Plate 3. K2 – Ophthalmia Dam picnic area

Note that Plate 3 presents the view to the NNW of the viewpoint; the OB31 project area is in the NE direction. The NE view will be used in the viewshed and photomontage analysis.

Table 6. K2 – Ophthalmia Dam picnic area site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.339803	Longitude: 119.725789
Setting	Along the north western banks of Ophthalmia Dam. The site features free to use gas barbeques and covered picnic areas. An area adjacent to the site is used to launch boats into the dam.	
Land System	River: Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.	
Viewpoint Elevation	Low; as it is situated along the waterline of the dam.	
Viewing Distance	Under one kilometre towards the dam wall, approximately five kilometres over the water.	
View Elements	The site offers views across the water, however views of surrounding landscape is restricted by the dam walls.	
Motion of Viewer	Stationary	
Vegetation Screening Potential	Moderate; high stands of eucalypts provide screening potential in some areas, however the open water and dam wall contain no vegetation.	
Vegetation Type	Eucalypts over acacias.	
Land Use	Recreation, tourism.	
Accessibility	High; accessible via paved and unpaved road.	
Usage	High; recent signs of use were noted at time of survey.	
Potential Visual Risk	Negligible; the location of the site in relation to the project area results in no direct views. Distance may also result in low indirect impacts.	
Valued Landscape Characteristics	Views over the water. A considerable amount of amenity is derived from the use of the site for recreation such as camping, picnicking, watersports and boating, due to the limited number of areas in the Central Pilbara where this is possible.	



Plate 4. K3 – Ophthalmia Dam wall

The OB31 Project area is nestled between Wheelarra and Shovellana Hills, the site of BHP Billiton Iron Ore's Jimblebar and OB18 operations, visible in the distance slightly to the right side of the frame, in Plate 4. The view characteristics of this site are detailed in Table 7.

Table 7. K3 – Ophthalmia Dam wall site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.338899	Longitude: 119.879311
Setting	Atop the Ophthalmia Dam wall, looking to the northeast.	
Land System	<p>River: Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.</p> <p>Boolgeeda: Stony lower slopes and plains below systems supporting hard and soft spinifex grasslands or mulga shrublands.</p> <p>Newman: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.</p>	
Viewpoint Elevation	Slightly elevated; dam wall.	
Viewing Distance	15 – 20 km.	
View Elements	Fortescue River floodplain in foreground and midground, Ophthalmia Ridge in background.	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	Low; elevated nature of the site.	
Vegetation Type	Scattered tall eucalypt groves along floodplain, bounded by	

CRITERIA	CHARACTERISTICS
	mulga groves.
Land Use	Recreation, tourism.
Accessibility	High; accessible via paved and unpaved roads.
Usage	Moderate; site receives less traffic than the picnic area site.
Potential Visual Risk	Low; some possibility of indirect impacts from dust emanating from the project area, between Wheelarra and Shovellana Hill, although the OB18 and Jimblebar hub have a markedly higher contribution to impact to this site.
Valued Landscape Characteristics	Views over the Fortescue River floodplain and Ophthalmia Ridge. Views over the dam in the opposite direction are also valued.

4.1.2.3 K4, K5 – Marble Bar Road Rest Stops

The Marble Bar Road is likely the second most important regional road in the Newman area, as it is an alternate route to Port Hedland and connects Newman to Marble Bar and eventually joins the Great Northern Highway close to Port Hedland. K4 and K5 are both rest stop sites (Plate 5 and 6).



Plate 5. K4 – Marble Bar Road rest stop 1

Table 8 details site specific characteristics.

Table 8. K4 – Marble Bar Road rest stop 1 site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.262428	Longitude: 119.885186
Setting	At a rest stop located alongside the Marble Bar Road	
Land System	River: Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex. Newman: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	
Viewpoint Elevation	Low; in line with surrounding landscape.	
Viewing Distance	Less than five kilometres.	
View Elements	Mulga shrublands in foreground and midground, low ridges and hills in background.	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	High; vegetation is dense enough to provide good screening from this distance.	
Vegetation Type	Medium acacia shrubland over tussock grasslands.	

CRITERIA	CHARACTERISTICS
Land Use	Transportation.
Accessibility	High; rest stop is located along paved section of the road.
Usage	High; rest stop is along a regionally important transport route.
Potential Visual Risk	Low; distance to the project area and vegetation cover makes direct impacts from the proposal likely to be very low.
Valued Landscape Characteristics	Dense stands of vegetation.



Plate 6. K5 – Marble Bar Road rest stop 2

Table 9 details characteristics specific to this site.

Table 9. K5 – Marble Bar Road rest stop 2 site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.177381	Longitude: 119.917134
Setting	At a rest stop located alongside the Marble Bar Road	
Land System	<p>River; Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.</p> <p>Newman; Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.</p>	
Viewpoint Elevation	Low; in line with surrounding landscape.	
Viewing Distance	5 – 10 km.	
View Elements	Mulga shrubs and hummock/tussocks, riparian vegetation in the mid-background.	
Motion of Viewer	Stationary / in motion.	
Vegetation Screening Potential	Moderate-high; vegetation in some areas is scattered, but dense enough to provide screening from this distance.	
Vegetation Type	Scattered medium acacia shrubland over mixed buffel grass tussock and spinifex hummock grasslands.	
Land Use	Transportation.	
Accessibility	High; rest stop is located along paved section of the road.	
Usage	High; rest stop is along a regionally important transport route.	
Potential Visual Risk	Low; distance to the project area and vegetation cover makes direct impacts from the proposal likely to be very low.	
Valued Landscape Characteristics	Riparian vegetation along creeklines.	

4.1.2.4 K6 – Kalgan Pool

Kalgan Pool, located along Kalgan Creek is arguably one of the most highly valued tourist attraction in the Newman region, being the most easily accessed pool site in close proximity to the town. Its high tourism, cultural and recreational value to the public was the main driver for considering this site as key, despite its large distance from the Project area and as such, was considered important enough to warrant consideration in this assessment.

At present, Hamersley Iron, owned by the Rio Tinto group has approval to discharge excess groundwater into the creek, approximately 2.3 km downstream from the pool site (EPA 2013b).



Plate 7. K6 – Kalgan Pool

Note that the view presented in Plate 7 is of the actual pool itself, which is to the northwest of the viewpoint surveyed. The OB31 Project area is located to the southeast of the viewpoint, and will be used in the viewshed and photomontage analyses.

Table 10. K6 – Kalgan Pool site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.188282	Longitude: 119.699356
Setting	Viewpoint is located alongside a natural pools along Kalgan Creek.	
Land System	Newman: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	
Viewpoint Elevation	Low; set within a small gorge, therefore making the viewpoint lower than the surrounding landscape.	
Viewing Distance	In excess of 35 km.	
View Elements	Pool, riparian vegetation, rock face.	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	Moderate; stands of tall eucalypts can provide suitable screening, however it is not considered necessary for this site	
Vegetation Type	Scattered eucalypt riparian vegetation	
Land Use	Tourism, recreation.	
Accessibility	Moderate; access with a four wheel drive is relatively easy.	
Usage	Moderate; site is advertised in tourist maps.	
Potential Visual Risk	Low-negligible; the site is nestled within a creek bed surrounded by gorges.	
Valued Landscape Characteristics	Views of the pool and ironstone walls.	

4.1.3 K7 Round Hill

Round Hill is a locally valued recreation spot used primarily for camping and hiking. It offers 360° panoramic views of the Fortescue River Valley as well as of Ophthalmia Ridge (pictured). A portion of the site is also valued as an Aboriginal heritage site.

The site itself is fairly significant in relation to the surrounding landscape as it is the only elevated point along the Fortescue River floodplain in the Newman region.



Plate 8. K7 – Round Hill

Panoramic 360° views can be seen from this site. The view shown here is that to the northeast (Plate 8).

Characteristics of the site itself are detailed in Table 11.

Table 11. K7 – Round Hill site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.44394	Longitude: 119.77057
Setting	View from the north eastern slopes of Round Hill, looking to the north east.	
Land System	<p>Washplain: Hardpan plains supporting groved mulga shrublands.</p> <p>Divide: Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.</p> <p>River: Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.</p> <p>Newman: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.</p>	
Viewpoint Elevation	Elevated; the site is located in a highpoint relative to the surrounding landscape.	
Viewing Distance	In excess of 25 km.	
View Elements	Mulga shrublands on Fortescue River floodplain in the fore-mid ground and Ophthalmia Range in the background.	
Motion of Viewer	Stationary, slow.	
Vegetation Screening Potential	Low; elevated nature of the site reduces the effectiveness of vegetation to act as screens. Rocky soils results in low hummocks and scattered tall trees.	
Vegetation Type	Scattered eucalypts over scattered <i>Triodia</i> hummock grasses.	
Land Use	Recreation.	
Accessibility	Moderate; accessible by an unmarked albeit well used track off the Great Northern Highway.	
Usage	Moderate; signs of recent recreational use (4WD/Camping) were noted at the site during the field survey.	
Potential Visual Risk	Low; the OB31 Project area is located in excess of 25 km from the site. Some dust may be visible, but impacts may be minor.	
Valued Landscape Characteristics	Panoramic and long distance views over the landscape.	

4.1.4 K8 – Great Northern Highway and Marble Bar Road

An eighth 'viewpoint' was also selected, consisting of 103 km of the Great Northern Highway and Marble Bar Road, approximately 41 km south and 62 km north of Newman. This site is not a 'viewpoint' at all, but rather a 'viewline' as the analysis was run on the entire section of road, and the changes to the cumulative viewshed analysed. This was done to better assess impacts to transportation networks as well as due to the relative lack of sites in the vicinity of the OB31 Project. As it was not possible to obtain digital photographs of the entire length of road, this 'site' will only be assessed quantitatively through a viewshed analysis. The location of this section in relation to the Project area is shown on Plate 9.

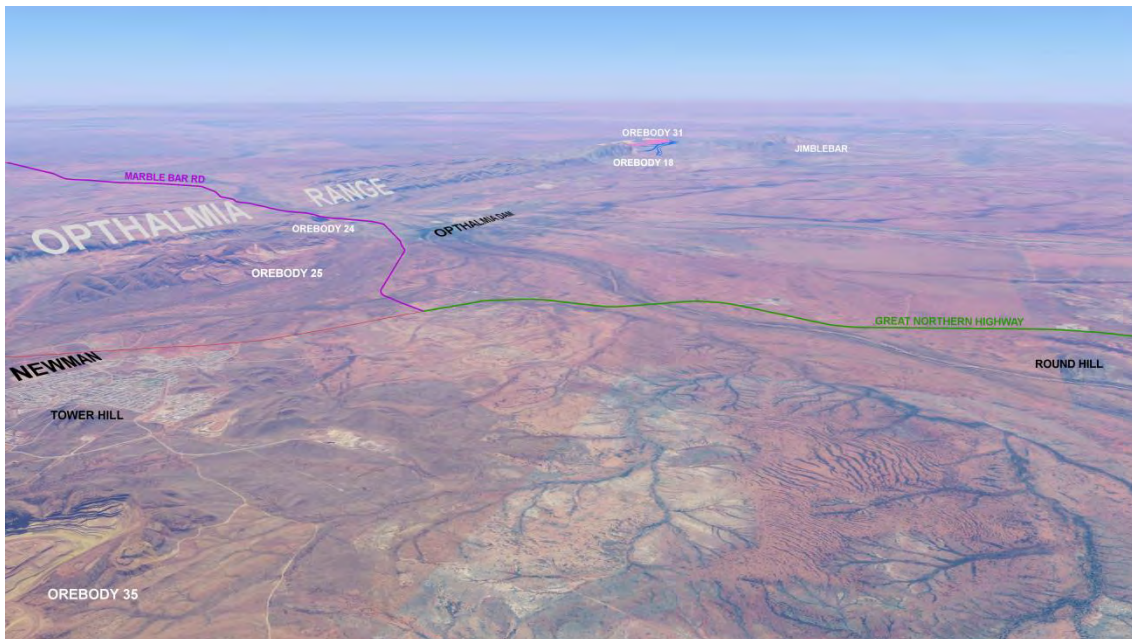


Plate 9. K8 – Great Northern Hwy and Marble Bar Road (aerial image: Landgate 2013)

General descriptions of landscape values along this section of road are presented in Table 12.

Table 12. K6 – Round Hill site characteristics

CRITERIA	CHARACTERISTICS	
Location	Latitude: n/a	Longitude: n/a
Setting	A 103 km stretch of the Great Northern Highway and Marble Bar Road.	
Land System	<p>River: Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.</p> <p>Newman: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.</p>	
Viewpoint Elevation	Low; in line with surrounding landscape, often running alongside creeklines and the Fortecue River floodplain, occasionally topping low ridges.	
Viewing Distance	5 – 20 km.	
View Elements	Mulga shrubs and hummock/tussocks, riparian vegetation alongside a large central portion.	
Motion of Viewer	In motion; speeds ranging from 110 km/h to 60-80 km/h.	
Vegetation Screening Potential	Moderate-high; vegetation in some areas is scattered, but dense enough to provide screening from this distance.	
Vegetation Type	Scattered medium acacia shrubland over mixed buffel grass tussock and spinifex hummock grasslands.	
Land Use	Transportation.	
Accessibility	High; most sections of this stretch of road is paved, and is at the most, 60 km from Newman.	
Usage	High; the Great Northern Highway is a nationally important transportation route while the Marble Bar Road is regionally important.	
Potential Visual Risk	Low; vegetation screening, high travel speeds, low elevation, large distance and the presence of Ophthalmia Range on either side of the road sections closes to the project area results in low risk of overall impact.	
Valued Landscape Characteristics	Riparian vegetation along creek-lines, occasional views of the landscape when topping low ridges.	

4.2 Visual Impact Assessment

4.2.1 Viewshed and Photomontage Analyses

Figures 9 to 15 illustrate the results of the viewshed and photomontage analysis. Figure 16 presents the results of a viewshed analysis conducted on sections of the Marble Bar Road and the Great Northern Highway that were considered most at risk of impact. Each viewshed presents the percentage change that falls into the four impact categories, blocked by development, natural view created, pit view created or OSA view created. The sum of these percentages produces the total impact to the viewshed.

4.2.2 Impacts to Landscape Character and Land Systems

To quantify impacts to landscape character, the disturbance footprint of the Project (based on indicative disturbance areas provided by BHP Billiton Iron Ore) was compared to current extents of the LCTs and Land Systems that the OB31 project falls into. This enabled the estimation of percentage impacts to the landscape at both regional and local levels. Table 13 details the findings of this.

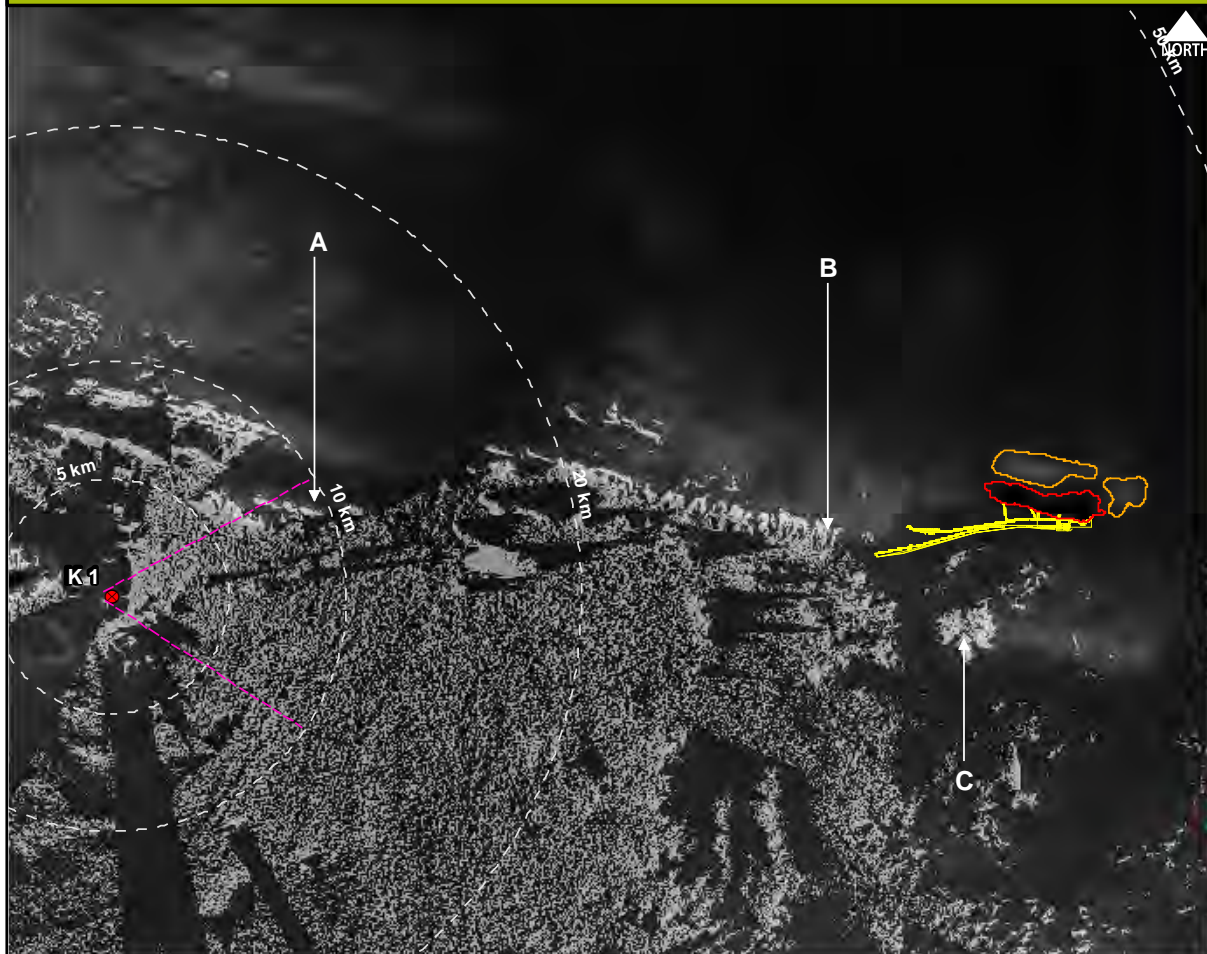
Table 13. Impacts to LCTs and Land Systems

LANDSCAPE CHARACTER TYPES (LCT)	AREA WITHIN OB31 PROJECT (KM ²)	CURRENT EXTENT (KM ²)*	PERCENTAGE IMPACT
284 – Fortescue Valley	17.51	15,300	0.11%
258 – Hamersley Plateaux	23.04	44,450	0.05%
LAND SYTEM	AREA WITHIN OB31 PROJECT (KM ²)	CURRENT EXTENT (KM ²)†	PERCENTAGE IMPACT
BGD – Boolgeeda System	16.86	7,748	0.22%
NEW – Newman System	19.92	14,580	0.14%
WSP – Washplain System	3.42	917	0.37%
MCK – McKay System	0.35	4,202	0.01%

* Sourced from Tille 2006

† Sourced from Van Vreeswyk et al. 2004

Viewshed



- Legend**
- Key Viewpoint
 - Field of View
 - Pit View Created
 - OSA View Created
 - Natural View Created
 - View Blocked by Development
- Site Layout**
- OSA
 - Pit
 - Infrastructure
- Viewshed Analysis Results**
- No Change - Always Not Visible
 - No Change - Always Visible

PROJECT NUMBER	317	360 Environmental 10 Beirmondsey St. West Lonsdale, WA 9308 8360
DRAWN	DATE	
JJ	24-Mar-2014	
CHECKED	APPROVED	
FJ	FJ	

0 1 2 4 6 8 10
Kilometers

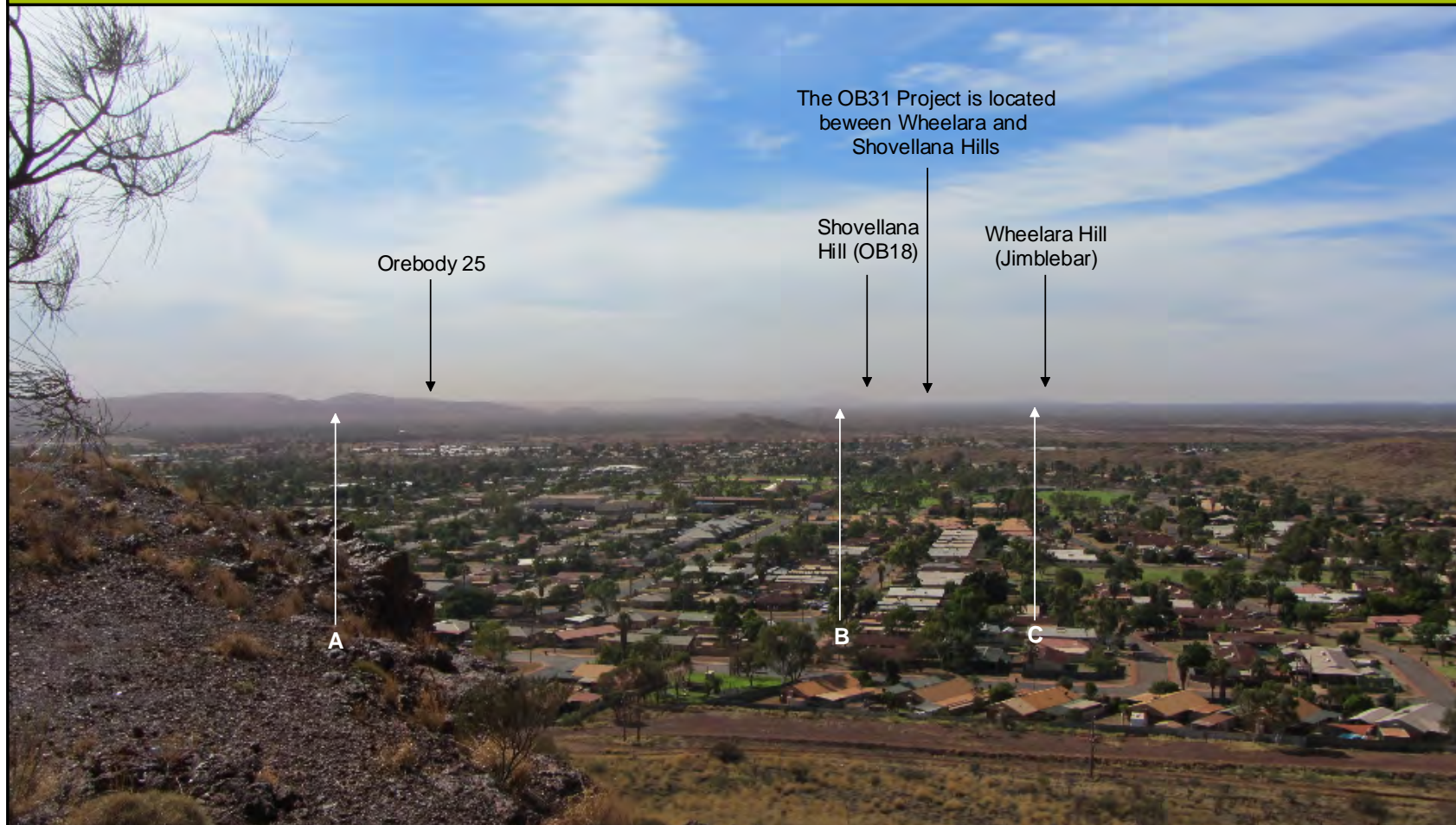
Viewpoint Characteristics

Site No & Name	K1 - Radio Tower Hill, Newman
Location (GDA94)	119.725789, -23.363012
View Direction	E
Land System	Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. Elimunna - Stony plains on basalt supporting snakewood and mulga shrublands with sparse tussock grasses
Description of View	Panoramic views of the surroundings, including the OB25 Project (A) and the distant Ophthalmia Ridge. On a clear day, the Jimblebar mine is faintly visible.
Vegetation Screening Capability	Moderate - Low; vegetation in certain areas are capable of acting as effective screens, however the site is elevated above the landscape, minimising screen effectiveness

Viewshed Statistics		Site Visual Impact	
% Viewshed blocked out by Development	0.00%	Site Significance	Recreation
% Pit views created	0.00%	Visitor Traffic	High
% OSA views created	0.00%	Accessibility	High
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

Figure 9 - K1 Radio Tower Hill, Newman

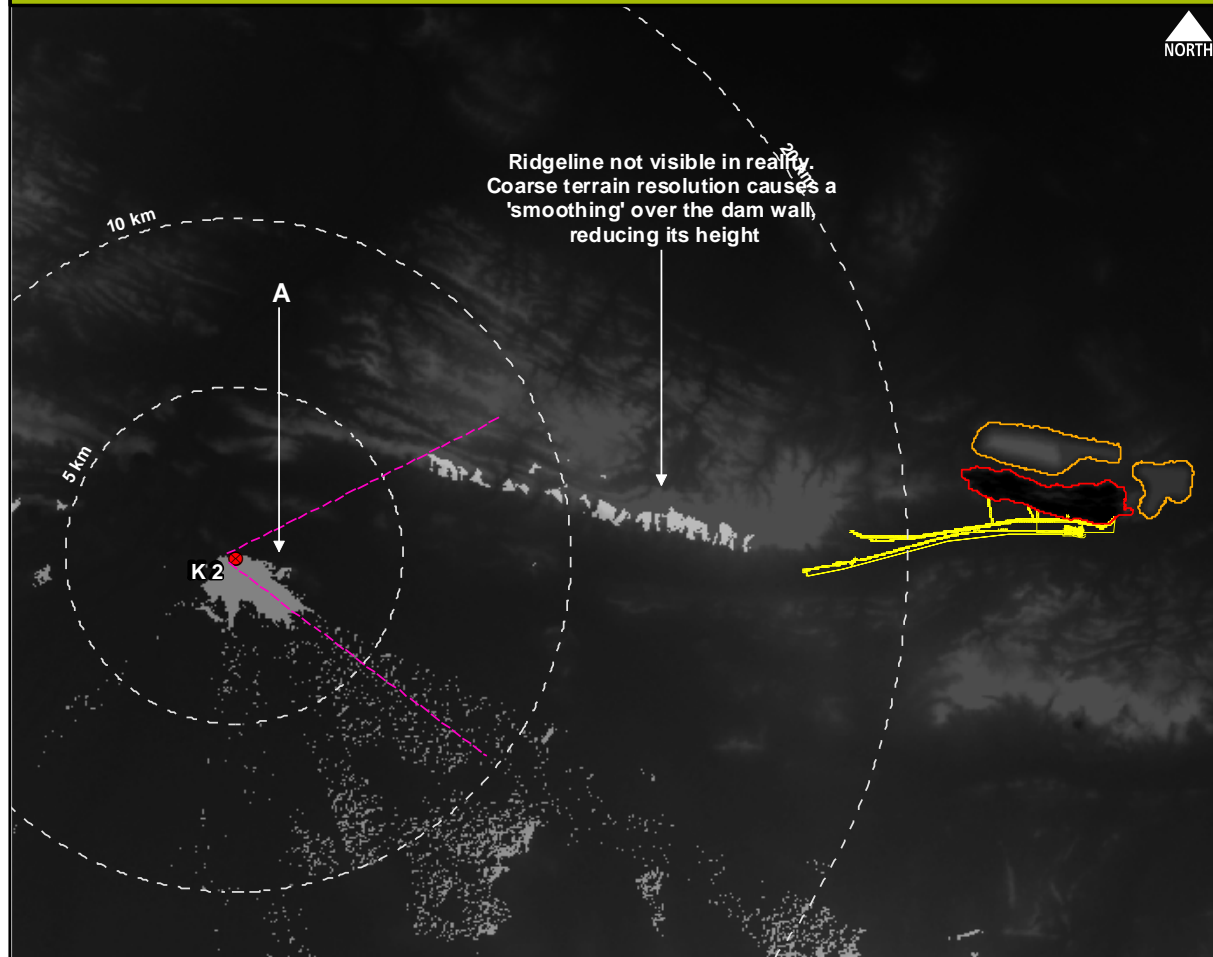
Pre Development Photomontage



Post Development Photomontage



Viewshed



Legend

● Key Viewpoint	--- Field of View	■ Pit View Created
Site Layout	Viewshed Analysis Results	■ OSA View Created
■ OSA	■ No Change - Always Not Visible	■ Natural View Created
■ Pit	■ No Change - Always Visible	■ View Blocked by Development
— Infrastructure		

PROJECT NUMBER	317	360 Environmental 10 Beirmondsey St. West Lonsdale, WA 9308 8360
DRAWN	DATE	
JJ	24-Mar-2014	
CHECKED	APPROVED	
FJ	FJ	bhpbilliton

0 1 2 4 6 8
Kilometers

Viewpoint Characteristics

Site No & Name	K2 - Ophthalmia Dam Picnic Area		
Location (GDA94)	119.877737, -23.339803		
View Direction	E		
Land System	Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. McKay - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.		
Description of View	The site is located along the northwestern banks of Ophthalmia dam and is used as a picnic area. The site features gas barbeque, toilet and picnic facilities.		
Vegetation Screening Capability	Moderate; vegetation in certain areas are capable of acting as effective screens.		
Viewshed Statistics	Site Visual Impact		
% Viewshed blocked out by Development	0.00%	Site Significance	Recreation
% Pit views created	0.00%	Visitor Traffic	High
% OSA views created	0.00%	Accessibility	High
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

Figure 10 - K2 Ophthalmia Dam Picnic Area, Newman

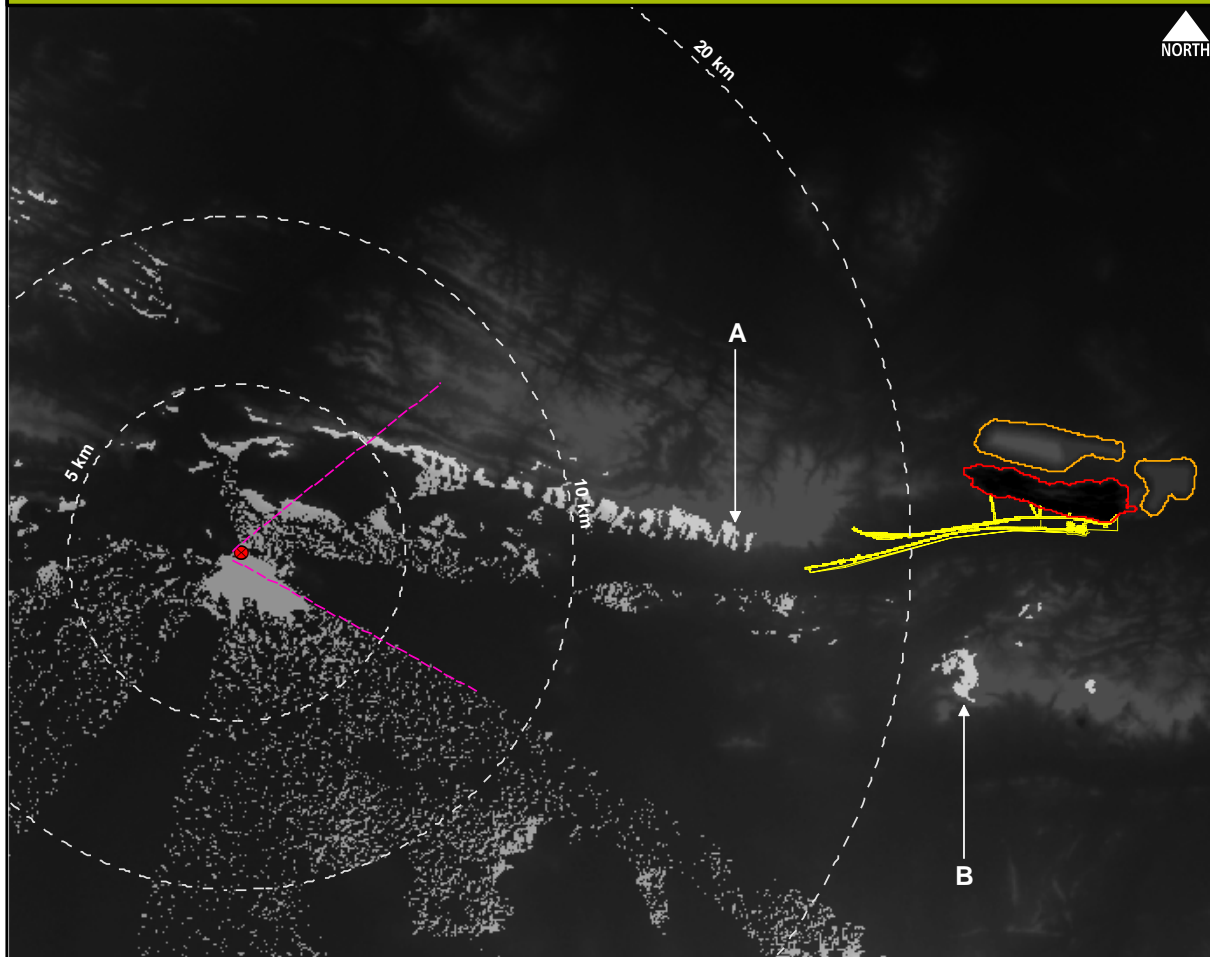
Pre Development Photomontage



Post Development Photomontage



Viewshed



- Legend**
- Key Viewpoint
 - Field of View
 - Pit View Created
 - OSA View Created
 - Natural View Created
 - View Blocked by Development
- Site Layout**
- OSA
 - Pit
 - Infrastructure
- Viewshed Analysis Results**
- No Change - Always Not Visible
 - No Change - Always Visible

PROJECT NUMBER	317	360 Environmental	10 Bemondsey St, West Leederville, WA 6008
DRAWN	JJ	DATE	24-Mar-2014
CHECKED	FJ	APPROVED	FJ
0 1 2 4 6 8		Kilometers	

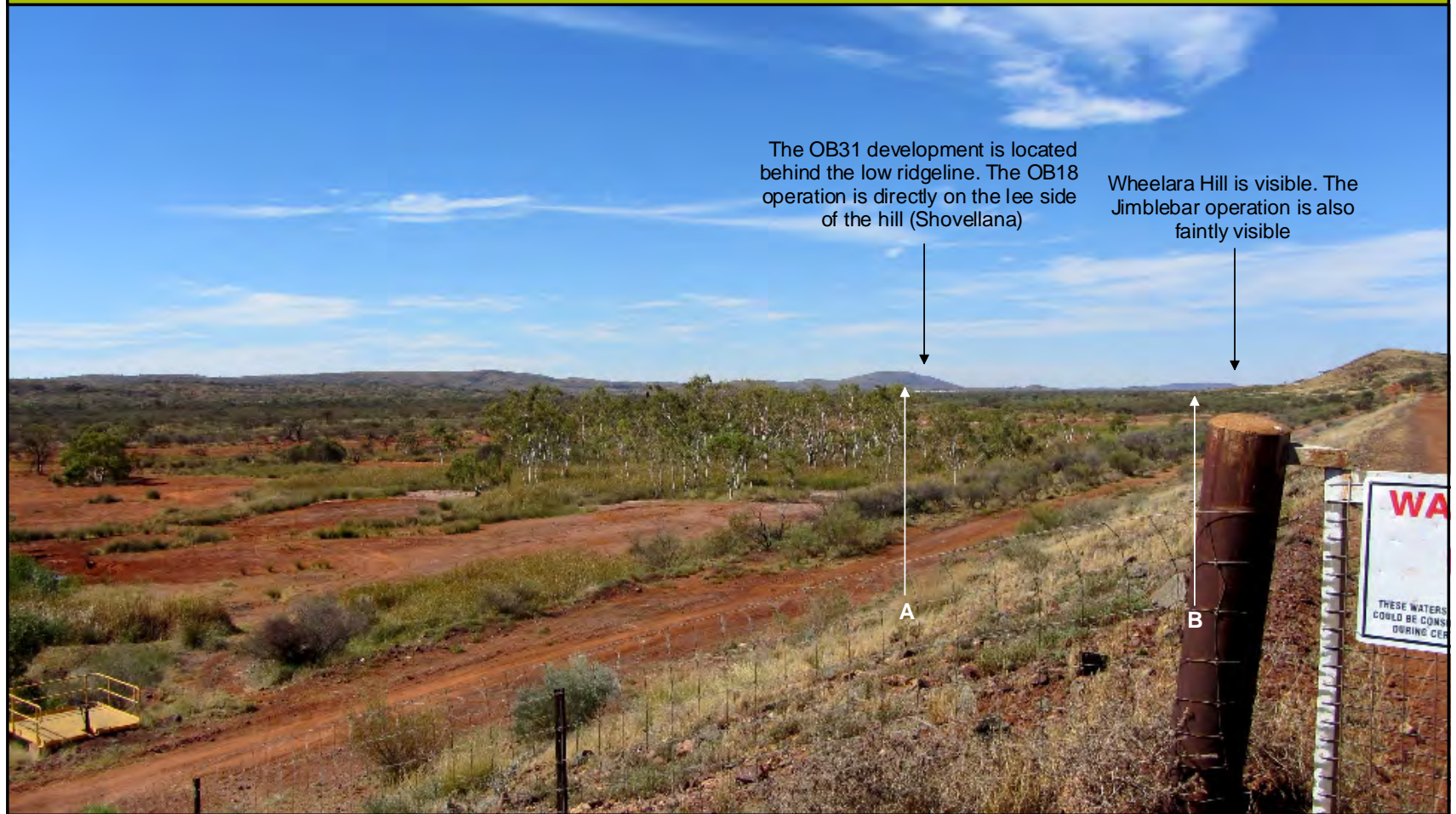
Viewpoint Characteristics

Site No & Name	K3 - Ophthalmia Dam Wall
Location (GDA94)	119.879066, -23.339684
View Direction	E
Land System	River - Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts. Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands
Description of View	A lookout point close to the Ophthalmia Dam picnic area. Panorami views over the Fortescue River floodplain and Ophthalmia Ridge can be seen from this site.
Vegetation Screening Capability	Moderate - Low: Being a floodplain, stands of tall eucalypts do provide spotty screening, however elevation of viewpoint minimises their effectiveness.

Viewshed Statistics		Site Visual Impact	
% Viewshed blocked out by Development	0.00%	Site Significance	Recreation
% Pit views created	0.00%	Visitor Traffic	High
% OSA views created	0.00%	Accessibility	High
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

Figure X - K3 Ophthalmia Dam Wall

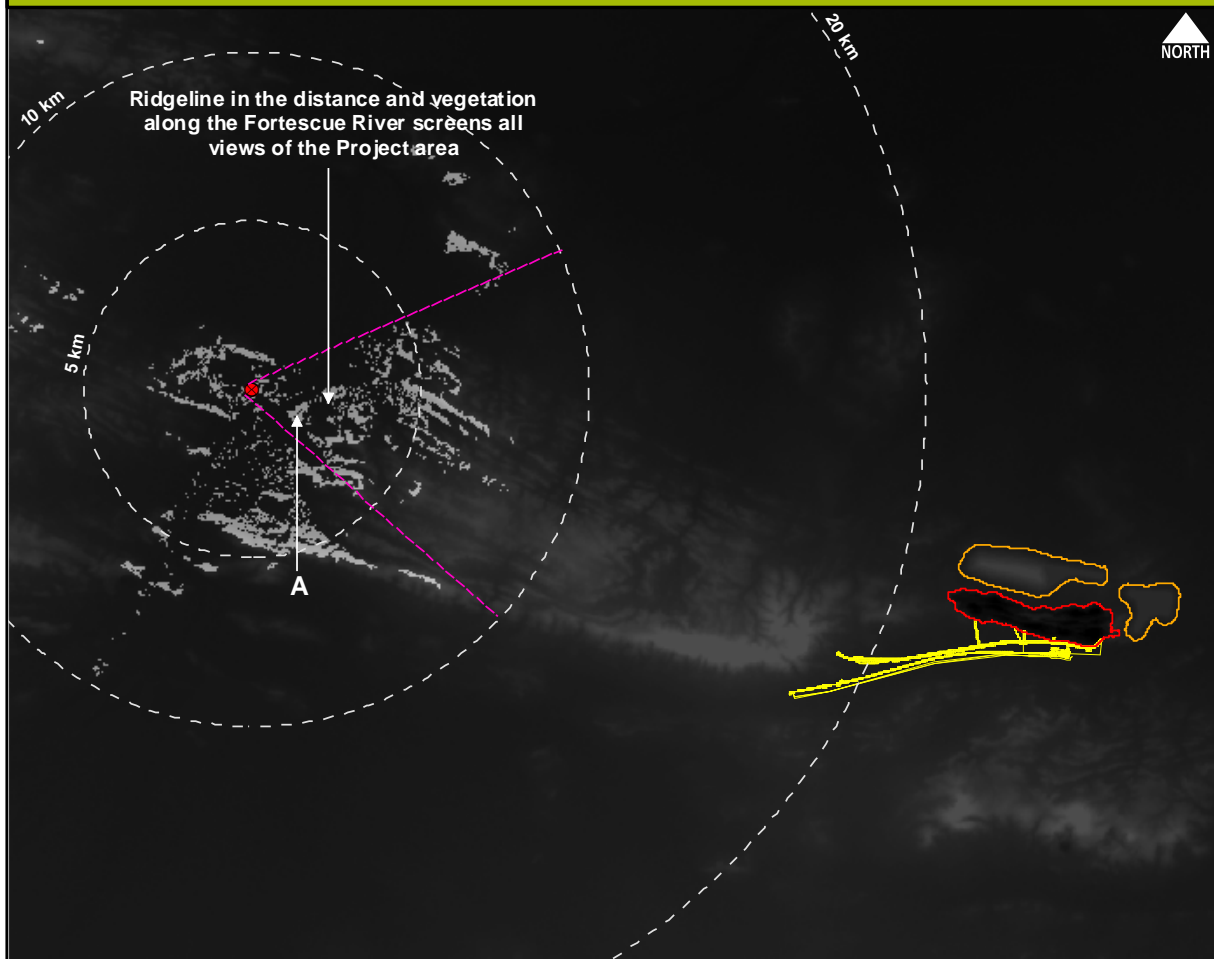
Pre Development Photomontage



Post Development Photomontage



Viewshed



Legend

- Key Viewpoint
- Field of View
- Pit View Created
- OSA View Created
- Natural View Created
- View Blocked by Development
- OSA
- No Change - Always Not Visible
- Infrastructure
- No Change - Always Visible

PROJECT NUMBER	317	360 Environmental	10 Be rdmondsey St, West Leederville, WA 6008, 8390
DRAWN	JJ	DATE	24-Mar-2014
CHECKED	FJ	APPROVED	FJ
0 1 2 4 6 8		Kilometers	

Viewpoint Characteristics

Site No & Name	K4 - Marble Bar Road Rest Stop 1		
Location (GDA94)	119.885186, -23.262428		
View Direction	E		
Land System	River - Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts. Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands		
Description of View	View from along the Marble Bar Road, within the Fortescue River floodplain. Mulga shrublands in the foreground with Ophthalmia Ridgeland in the back.		
Vegetation Screening Capability	High: vegetation is dense enough to provide good screening from this distance		
Viewshed Statistics		Site Visual Impact	
% Viewshed blocked out by Development	0.00%	Site Significance	Transport
% Pit views created	0.00%	Visitor Traffic	Moderate
% OSA views created	0.00%	Accessibility	Moderate
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

Figure 12 - K4 Marble Bar Road Rest Stop 1

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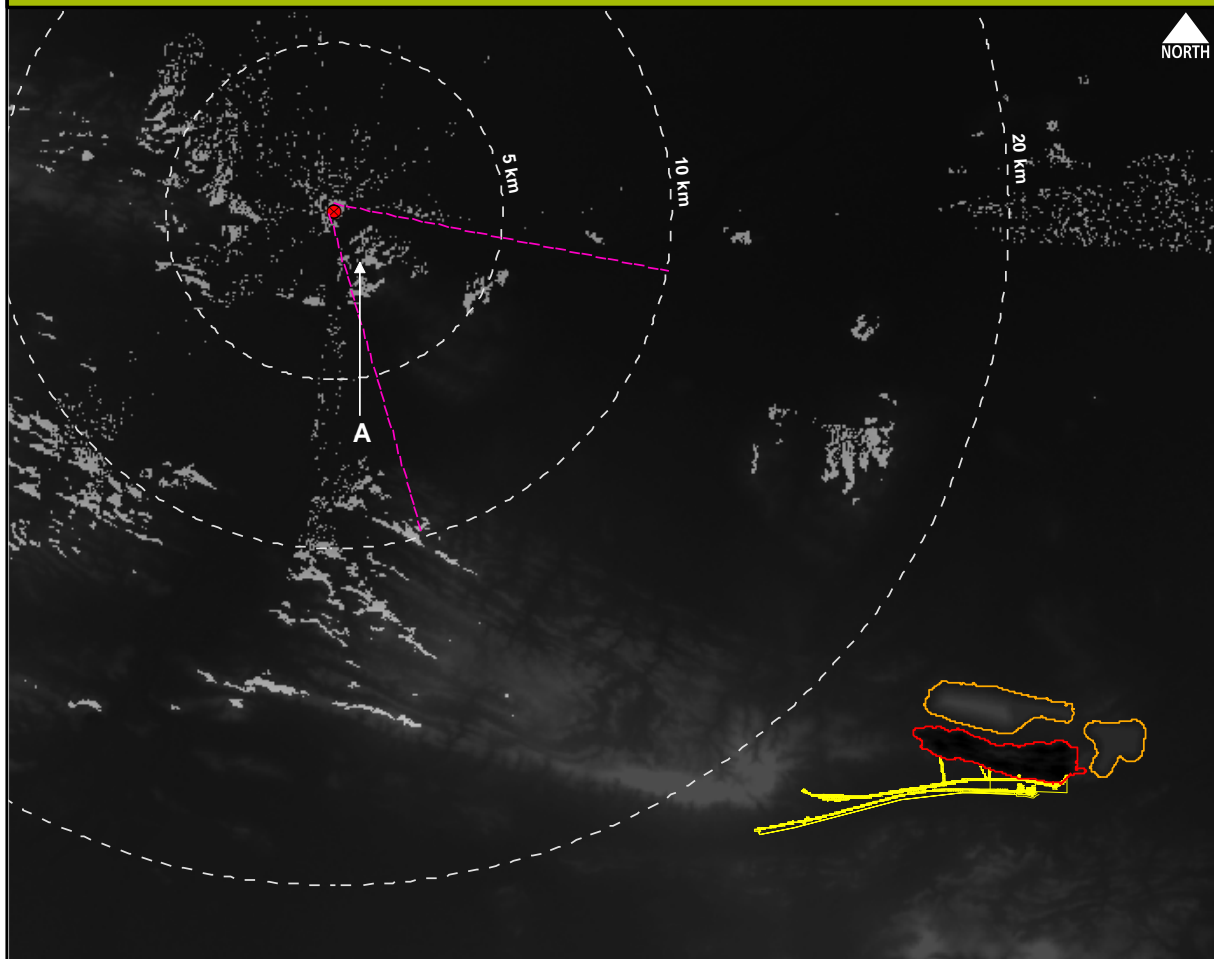
Pre Development Photomontage



Post Development Photomontage



Viewshed



Legend

- Key Viewpoint
- Field of View
- Pit View Created
- OSA View Created
- Natural View Created
- View Blocked by Development
- OSA
- No Change - Always Not Visible
- No Change - Always Visible
- Pit
- Infrastructure

PROJECT NUMBER	317	360 Environmental
DATE	24-Mar-2014	10 Bemondsey St, West Leederville, WA 6008
CHECKED	FJ	APPROVED

Viewpoint Characteristics

Site No & Name	K5 - Marble Bar Road Rest Stop 2		
Location (GDA94)	119.917134, -23.177381		
View Direction	SE		
Land System	River - Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts. Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands		
Description of View	View from along the Marble Bar Road, within the Fortescue River floodplain. Mulga shrublands in the foreground with Ophthalmia Ridgeland in the back.		
Vegetation Screening Capability	High: vegetation is dense enough to provide good screening from this distance		
Viewshed Statistics		Site Visual Impact	
% Viewshed blocked out by Development	0.00%	Site Significance	Transport
% Pit views created	0.00%	Visitor Traffic	Moderate
% OSA views created	0.00%	Accessibility	Moderate
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

Figure 13 - K5 Marble Bar Road Rest Stop 2

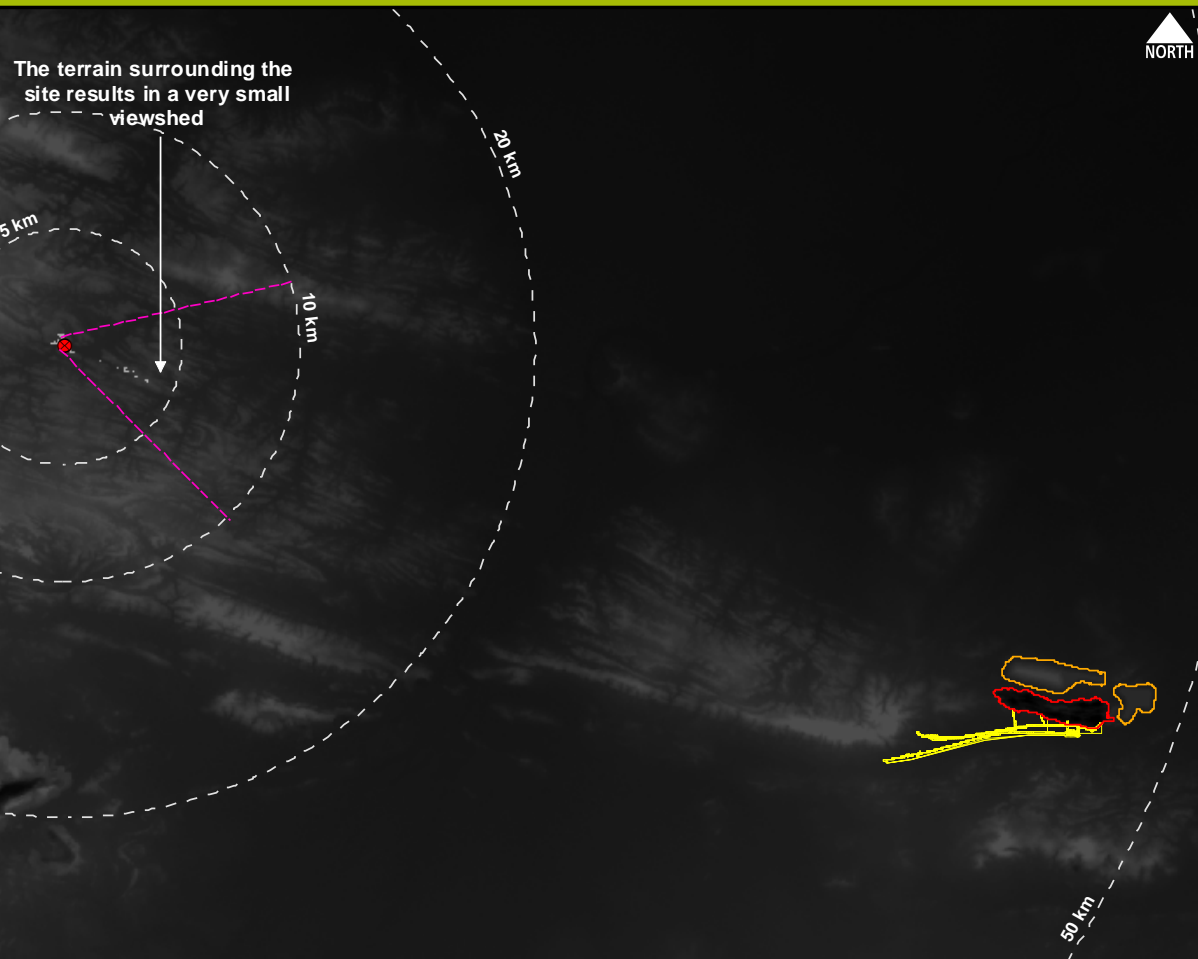
Pre Development Photomontage



Post Development Photomontage



Viewshed



Legend	
● Key Viewpoint	--- Field of View
■ Pit View Created	■ OSA View Created
■ OSA	■ No Change - Always Not Visible
■ Pit	■ No Change - Always Visible
--- Infrastructure	■ Natural View Created
	■ View Blocked by Development

PROJECT NUMBER	317	360 Environmental	10 Bemondsey St, West Leederville, WA 6008
DRAWN	JJ	DATE	24-Mar-2014
CHECKED	FJ	APPROVED	FJ
0 1 2 4 6 8		Kilometers	

Viewpoint Characteristics			
Site No & Name	K6 - Kalgan Pool		
Location (GDA94)	119.699356 , -23.188282		
View Direction	ESE		
Land System	Newman - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands		
Description of View	View of the access road from the Kalgan Pool Viewpoint. The project area is in this direction. The pool itself is located opposite this view.		
Vegetation Screening Capability	High: vegetation is dense enough to provide good screening from this distance. Vegetation screening is not considered necessary due to the sites location within the gorge		
Viewshed Statistics	Site Visual Impact		
% Viewshed blocked out by Development	0.00%	Site Significance	Tourism, Recreation
% Pit views created	0.00%	Visitor Traffic	Moderate
% OSA views created	0.00%	Accessibility	Moderate
% Natural Landscape views created	0.00%	Overall Impact	Negligible

Figure 14 - K6 Kalgan Pool

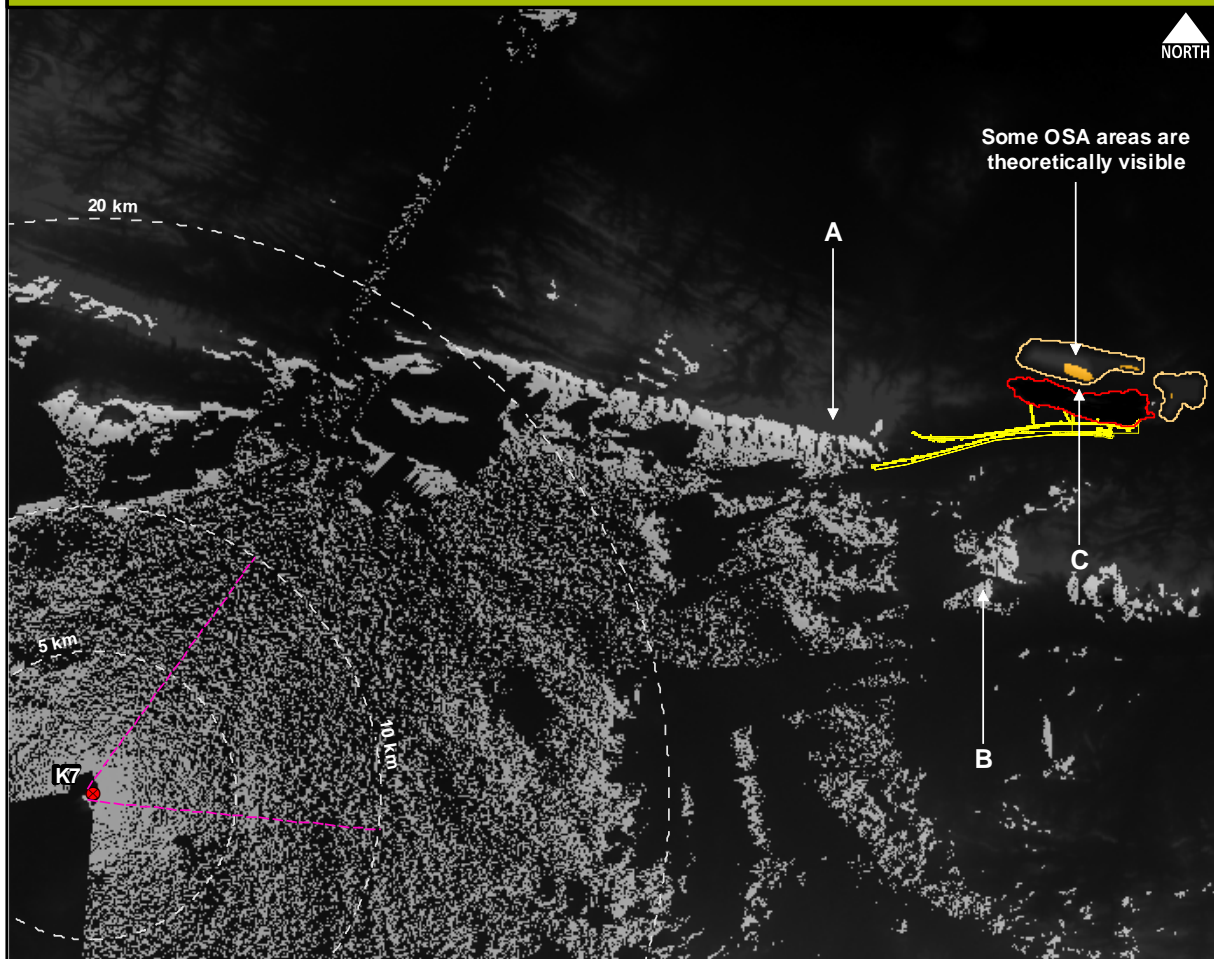
Pre Development Photomontage



Post Development Photomontage



Viewshed



Legend

● Key Viewpoint	--- Field of View	■ Pit View Created
■ Site Layout	■ Viewshed Analysis Results	■ OSA View Created
■ OSA	■ No Change - Always Not Visible	■ Natural View Created
■ Pit	■ No Change - Always Visible	■ View Blocked by Development
■ Infrastructure		

PROJECT NUMBER	317	360 Environmental
DRAWN	JJ	DATE 24-Mar-2014
CHECKED	FJ	APPROVED FJ
0 1 2 4 6 8 Kilometers		10 Bemondsey St, West Leederville, WA 6008, 9390

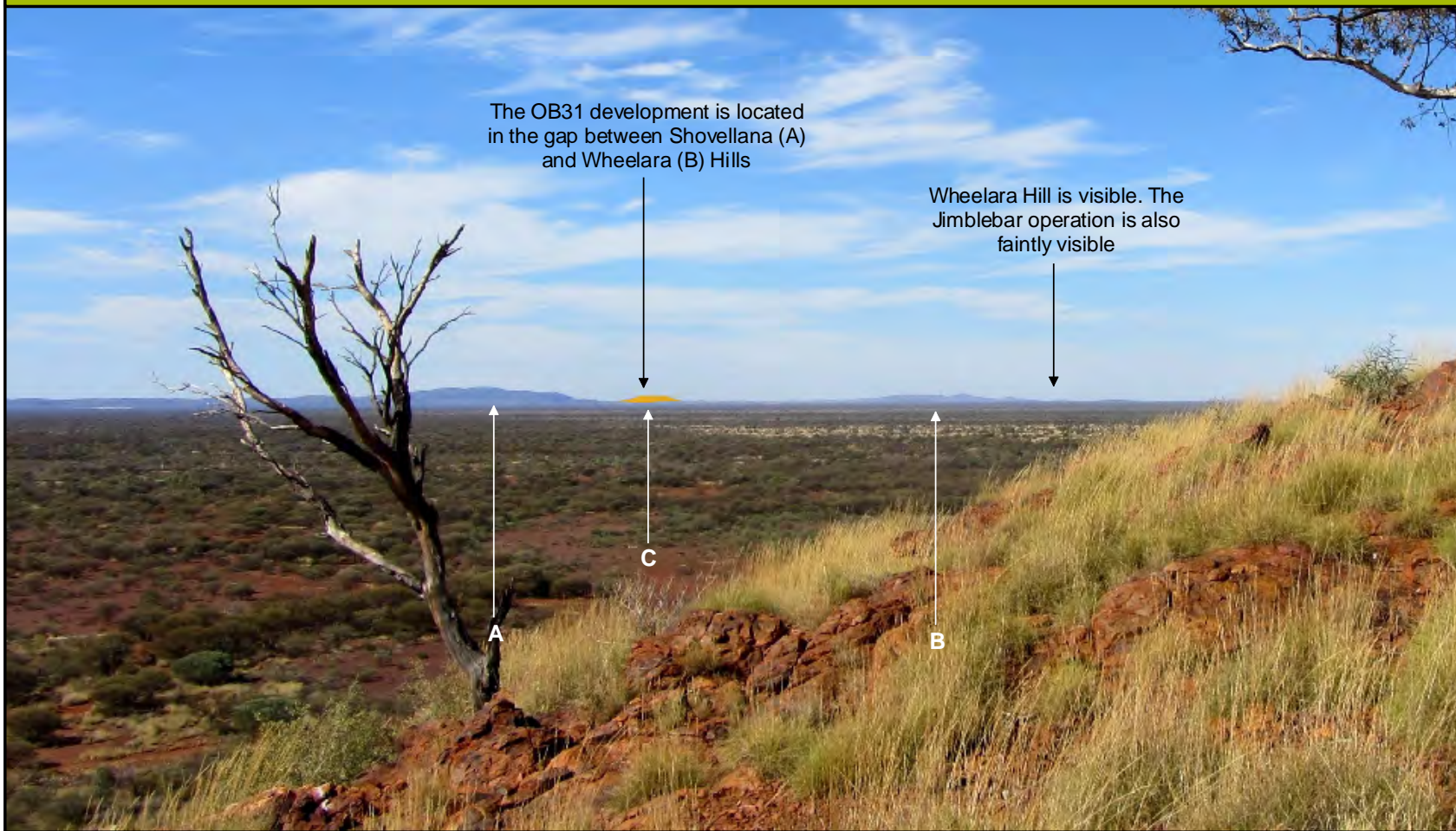
Viewpoint Characteristics

Site No & Name	K7 - Round Hill
Location (GDA94)	119.77057, -23.44394
View Direction	NE
Land System	Divide - Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs. River - Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts.
Description of View	A small elevated hill in the Fortescue River floodplain. Panoramic views across the landscape.
Vegetation Screening Capability	Low: Elevated nature of the viewpoint and scattered vegetation results in limited screening ability

Viewshed Statistics		Site Visual Impact	
% Viewshed blocked out by Development	0.00%	Site Significance	Recreation
% Pit views created	0.00%	Visitor Traffic	Moderate
% OSA views created	1.11%	Accessibility	Moderate
% Natural Landscape views created	0.00%	Overall Impact	Low - Negligible

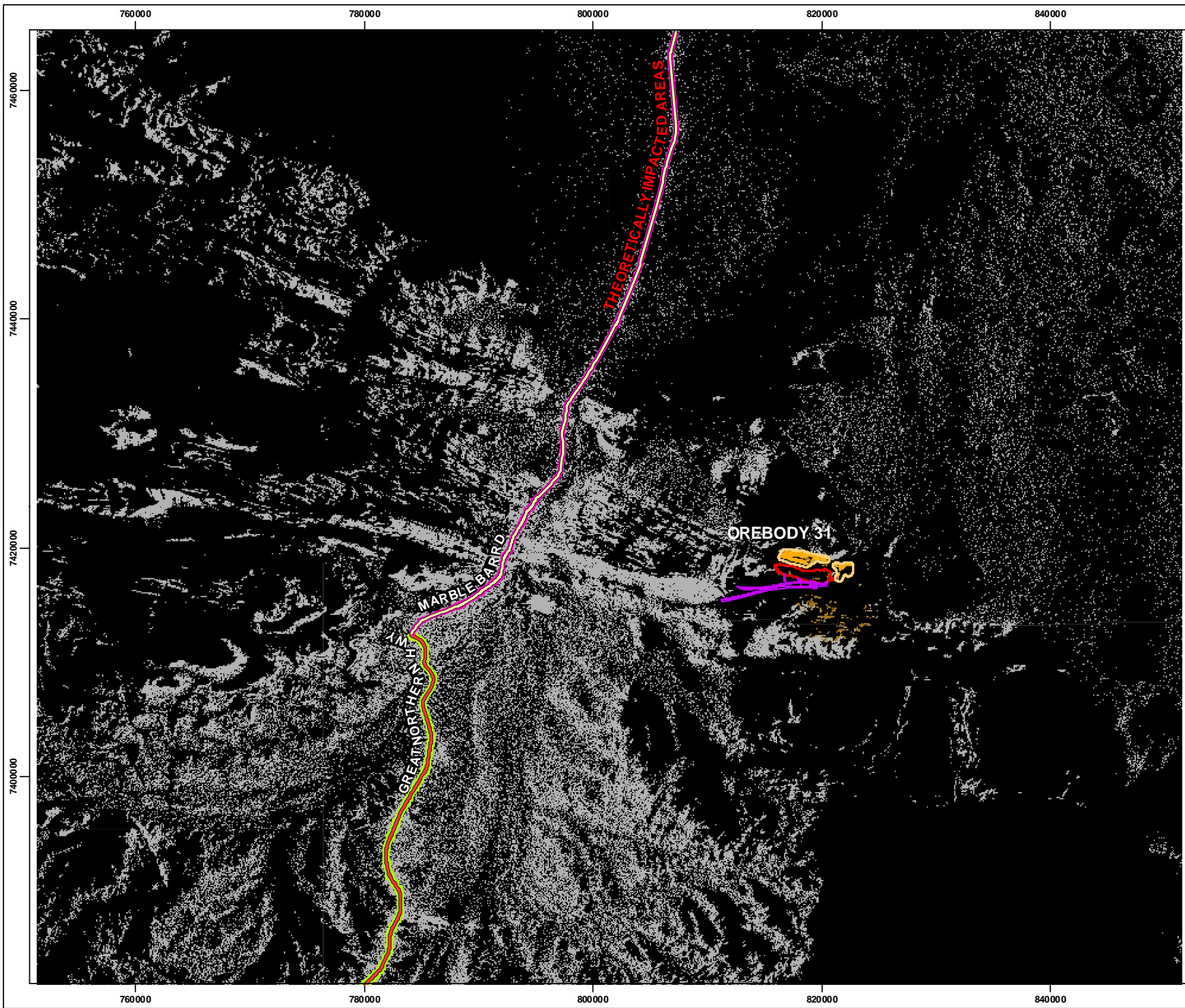
Figure 15 - K7 Round Hill

Pre Development Photomontage



Post Development Photomontage





Legend

- Great Northern Hwy
- Marble Bar Rd
- Orebody 31 Project Areas**
- OSA
- Pit
- Conveyor and Haul Roads

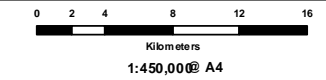
- Viewshed Analysis Results**
- No Change Always Not Visible
 - No Change Always Visible
 - Blocked due to Development
 - OSA View Created
 - Pit View Created

Impact Type	% Change
% Viewshed blocked out by development	0.31
% Pit views created	0.00
% OSA views created	0.34
% Natural landscape views created	0

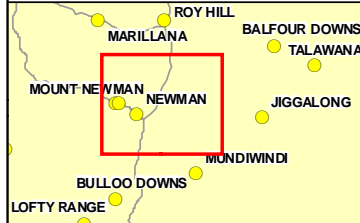
- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - LOCALITY MAP SOURCED FROM LANDGATE 2006
 - LANDSCAPE CHARACTER TYPES ADAPTED FROM TILLE 2006
 - ALL OTHER DATA SOURCED FROM BHP BILLITON IRON ORE
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT7
 © Western Australian Land Information Authority 2013

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LOCALITY MAP



DRAWING ID	DATE
317	22/05/2014

HORIZONTAL DATUM AND PROJECTION
 GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	FJ	TS	0

BHP Billiton Iron Ore Orebody 31
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Figure 16 - Great Northern Hwy and Marble Bar Rd

5 Discussion

5.1 Direct Impacts on Visual Amenity

On a regional scale the direct impact of the Project on landscape character was found to be very small. Direct impact as a result of clearing activities for the development is estimated to affect only 0.11% and 0.05% of the total area of the Hamersley and Fortescue Valley LCTs respectively (Table 13). On a more localised levels, direct impacts to land systems were also relatively low. It is estimated that 0.22% of the Boolgeeda, 0.14% of the Newman, 0.37% of the McKay and 0.29% of the Washplain land systems will be affected (Table 13).

The findings of the viewshed and photomontages analyses for each sensitive receptor site are listed below.

5.1.1 K1 – Radio Tower Hill

The viewshed analysis showed that the OB31 development area was not visible, a finding supported by the on-site survey (Figure 9). Impacts to this site are predominantly from other operations in proximity of it, such as the Mount Whaleback, OB25 and OB35 projects. In addition to this, the site is located in excess of 30 km from the Project area. It is likely that the site will not be impacted by the OB31 development.

5.1.2 K2, K3 – Ophthalmia Dam

Impacts to the picnic site (K2) are likely to be negligible due to the small size and restricted nature of its viewshed (Figure 10). The vast majority of the Project area is also located in excess of 30 km from this site.

There may however be some minor indirect impacts to the dam wall viewpoint (K3), likely to be in the form of dust and noise during blasting events. As ore will undergo further processing at OB18 and potentially Jimblebar, dust plumes from these areas may be visible.

OB3 is still located in over 30 km from the Ophthalmia dam viewpoints which is just beyond the maximum view distance where features are easily recognisable by the naked eye (~25 km).

It is therefore considered that impacts to landscape character and amenity at Ophthalmia Dam are likely to be minor, if not negligible.

5.1.3 K4, K5 – Marble Bar Road

The first rest stop on the Marble Bar Road (closest to Newman) is situated in a section of road that runs on the western side of the Fortescue River, bounded by Ophthalmia Range to the east and west. This results in a geographically restricted viewshed even

before the effects of vegetation is considered. The proximity of the site to a major river has resulted in dense, closed eucalypt woodlands, surrounded by mulga shrublands. These provide a level of screening that is very high (Figure 12).

The second rest stop approximately 10 km north of Ophthalmia Range is still located along the Fortescue River, which results in high levels of vegetation screening.

5.1.4 K6 - Kalgan Pool

Impacts to Kalgan pool and the creek are considered negligible due to the large distance from the OB31 Project area. The pool maybe affected projects upstream from it (Hope Downs 4).

5.1.5 K7 - Round Hill

Round Hill was the only site that may see any direct impacts, as suggested by the viewshed analysis (Figure 15). In total, it is estimated that approximately 1.1% of the viewshed from this viewpoint will be directly altered by the development (OSA). While this figure is small, in reality, it is expected that direct impacts to this site will likely be lower due to the great distance (in excess of 40 km) between the viewpoint and the development area.

5.1.6 K8 - Regional Road Ways - Marble Bar Road and Great Northern Highway

The viewshed analysis conducted on the sections of the Great Northern Highway and Marble Bar Road that are closest to the development shows that the Project is theoretically visible from several areas along the road. It is expected however that impacts are relatively minor considering the extent of surrounding developments, the elevation at most sections of these roads (a large portion runs along the Fortescue River floodplain, which is low lying and surrounded by tall vegetation) and the large distance between the road and the Project area (at its closest point, the road is still approximately 20 km from the Project area).

The analysis suggested that approximately 0.65% of the cumulative viewshed from the 103 km section of road will be affected by the development.

5.2 Cumulative Impacts on Visual Impact

5.2.1 Third Party Developments

No known third party developments are currently anticipated to be active during the life of OB31. Leases directly north of the Project area is currently held by Rio Tinto for exploration purposes (Department of Mines and Petroleum [DMP] 2014).

6 Conclusion

6.1 Summary of Impacts

Impacts to landscape and visual amenity from the OB31 Project have been demonstrated as being minor in relation to existing impacts, due to its unique topographical setting. In many cases, sites with high levels of public interest and use, such as Ophthalmia Dam, the Radio Tower Hill Lookout (and the Newman Townsite) showed little to no alterations in their viewsheds as a result of the development.

Furthermore, desktop and field assessments of the areas surrounding OB31 failed to identify any sites of significance that may be directly impacted by the project.

Cumulative impacts, likely manifested as increased aerial dust concentrations may be expected due to the close clustering of neighbouring projects (the Jimblebar operation). However, as the Newman area on average experiences westerly winds, it is possible that dust may on average move eastwards of the site, away from the town and major roads. As ore from the OB31 project will undergo secondary processing through facilities located at OB18 and possibly Jimblebar, dust impacts from TLO and the OHPs at these sites may result in impacts to amenity from sensitive receptor sites in the Newman area.

The viewshed analyses suggested that at its highest, some areas of the OSAs will be visible from high points in the region such as Radio Tower and Round Hills. However the large distance (in excess of 20-25 km) will likely result in low visibility and are unlikely to cause noticeable impacts on landscape character and amenity at these sites.

Similarly, the viewshed of the Great Northern Highway and Marble Bar Road sections (K8) showed that the OB31 development is theoretically visible from some areas. However, due to the roads relative elevation, distance from the development and the extent of other developments around OB31, it is unlikely that landscape values experienced through the use of these major transport routes will be affected by OB31. In addition to this, the speed of travel along these roads will result in scattered potential views of the development rather than a consistent view.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

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It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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APPENDIX A

Other Sites Considered

Site 5 - Trugallenden Pool (pool not found)



CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.31089	Longitude: 119.867665
Setting	Within the Fortescue River creek bed. The pool itself was not located.	
Land System	River; Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.	
Viewpoint Elevation	Low; the site is located in a lowpoint (creekbed) in the landscape.	
Viewing Distance	<1 km.	
View Elements	Tall riparian vegetation in the mid/foreground, Ophthalmia Range in the Background.	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	High.	
Vegetation Type	Tall eucalypts over annual grasses.	
Land Use	Recreation; the poolsite itself is marked on tourist maps.	
Accessibility	High; the site is directly adjacent to the Great Northern Highway, in close proximity to Newman.	
Usage	Moderate; the proximity to Newman and presence on tourist maps indicate some level of use.	
Potential Visual Risk	Low; the site is located some distance from the OB31 Project	
Valued Landscape Characteristics	Riparian vegetation, pool (not located).	

Site 6 - Inawally Pool



CRITERIA	CHARACTERISTICS	
Location	Latitude: -23.365037	Longitude: 120.193748
Setting	On the banks of Jimblebar Creek at Inawally Pool	
Land System	River; Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.	
Viewpoint Elevation	Low; the site is located in a lowpoint (creekbed) in the landscape.	
Viewing Distance	< 1km.	
View Elements	Pool in the fore and mid ground and riparian vegetation in the mid and background.	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	Medium-High.	
Vegetation Type	Eucalypts lining the side of the creek.	
Land Use	Pastoral, Mining (exploration).	
Accessibility	Low; the site is accessible from the south via restricted access roads on from the North along unmarked and difficult 4WD tracks.	
Usage	Low; no recent evidence of use was noted.	
Potential Visual Risk	High; the OB31 Project is located to the left site of the frame.	
Valued Landscape Characteristics	Pool, flora and fauna values.	

Site 11 - Jinerabar Pool (pool not found)



CRITERIA	CHARACTERISTICS	
Location	Latitude: -22.964866	Longitude: 120.270888
Setting	Along the access road to Jinerabar Pool (pool site was not located).	
Land System	River; Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts, sometimes with tussock grasses or spinifex.	
Viewpoint Elevation	Low; the site is located alongside a creekbed.	
Viewing Distance	<1 km.	
View Elements	Riparian vegetation in foreground, pool site likely dominates the site (if located).	
Motion of Viewer	Stationary.	
Vegetation Screening Potential	High; riparian vegetation is composed of tall eucalypt woodlands and acacia shrubland.	
Vegetation Type	Eucalypt woodland over acacia shrubland.	
Land Use	Pastoral.	
Accessibility	Low; access is a 30 km unmarked 4X4 track.	
Usage	Low; track has been moderately used, however the site is unmarked on most maps.	
Potential Visual Risk	Low.	
Valued Landscape Characteristics	Creek line and pool.	

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