Table 33 Summary of Potential Impacts on Threatened Species and Ecological Communities

COMMON NAME (*LATIN NAME*)	LGA COUNT	PREFERRED HABITAT	IMPACTED HABITAT WITHIN PROJECT BOUNDARY (ha)	TOTAL WITHIN PROJECT BOUNDARY (ha)	INDIRECT IMPACT (ha)	ESTIMATED ABUNDANCE OF HABITAT LOCALLY (ha)	ESTIMATED ABUNDANCE OF HABITAT IN THE SUB-BIOREGION (ha)
BIRDS							
Speckled Warbler (*Pyrrholaemus saggitatus*)	136	F,W	1,665	2,728	1,063	>50,000	~318,000
Spotted Harrier (*Circus assimilis*)	4	F,W,G	2,079	3,373	1,294	125,600	~784,400
Little Eagle (*Hieraaetus morphnoides*)	19	F,W,G	2,079	3,373	1,294	125,600	~784,400
Square-tailed Kite (*Lophoictinia isura*)	14	F,W,G	2,079	3,373	1,294	125,600	~784,400
Fork-tailed Swift (*Apus pacificus*)	1	F,W,G	2,079	3,373	1,294	125,600	~784,400
White-throated Needletail (*Hirundapus caudacutus*)	30	F,W,G	2,079	3,373	1,294	125,600	~784,400
White-browed Woodswallow (*Artamus superciliosus*)	23	F,W	1,665	2,728	1,063	>50,000	~318,000
Black-necked Stalk (*Ephippiorhynchus asiaticus*)	7	Wetland	<0.5	<0.5	<0.5	125,600	~10,600
Brown Treecreeper (*Climacteris picumnus*)	92	F,W	1,665	2,728	1,063	>50,000	~318,000
Diamond Firetail (*Stagonopleura guttata*)	17	F,W	1,665	2,728	1,063	>50,000	~318,000
Painted Honeyeater (*Grantiella picta*)	21	F,W	1,665	2,728	1,063	>50,000	~318,000
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	4	F,W	1,665	2,728	1,063	>50,000	~318,000
Regent Honeyeater (*Xanthomyza phrygia*)	7	F,W	1,665	2,728	1,063	>50,000	~318,000
Rainbow Bee-eater (*Merops ornatus*)	75	F,W	1,665	2,728	1,063	>50,000	~318,000
Satin Flycatcher (*Myiagra cyanoleuca*)	9	F,W	1,665	2,728	1,063	>50,000	~318,000
Varied Sittella (*Daphoenositta chrysoptera*)	35	F,W	1,665	2,728	1,063	>50,000	~318,000
Hooded Robin (*Melanodryas cucullata*)	22	F,W	1,665	2,728	1,063	>50,000	~318,000
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	130	F,W,G	2,079	3,373	1,294	125,600	~784,400
Little Lorikeet (*Glossopsitta pusilla*)	38	F,W	1,665	2,728	1,063	>50,000	~318,000
Swift Parrot (*Lathamus discolor*)	0	F,W	1,665	2,728	1,063	>50,000	~318,000
Turquoise Parrot (*Neophema pulchella*)	114	F,W	1,665	2,728	1,063	>50,000	~318,000
Barking Owl (*Ninox connivens*)	129	F,W	1,665	2,728	1,063	>50,000	~318,000
Masked Owl (*Tyto novaehollandiae*)	8	F,W	1,665	2,728	1,063	>50,000	~318,000
MAMMALS							
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	46	F,W	1,665	2,728	1,063	>50,000	~318,000
Koala (*Phascolarctos cinereus*)	344	F,W	1,665	2,728	1,063	>50,000	~100,000
Little Pied Bat (*Chalinolobus picatus*)	6	F,W	1,665	2,728	1,063	>50,000	~318,000
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	0	F,W	1,665	2,728	1,063	>50,000	~318,000
Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)	7	F,W	1,665	2,728	1,063	>50,000	~318,000
South-eastern Long-eared Bat (*Nyctophilus timoriensis*)	52	F,W	1,665	2,728	1,063	>50,000	~318,000
Eastern Cave Bat (*Vespadelus troughtoni*)	2	F,W	1,665	2,728	1,063	>50,000	~318,000

COMMON NAME (*LATIN NAME*)	LGA COUNT	PREFERRED HABITAT	IMPACTED HABITAT WITHIN PROJECT BOUNDARY (ha)	TOTAL WITHIN PROJECT BOUNDARY (ha)	INDIRECT IMPACT (ha)	ESTIMATED ABUNDANCE OF HABITAT LOCALLY (ha)	ESTIMATED ABUNDANCE OF HABITAT IN THE SUB-BIOREGION (ha)
PLANTS							
Pultenaea setulosa		F,W	1,665	2,728	1,063	>50,000	~318,000
Scant Pomaderris (Pomaderris queenslandica)		F,W	1,665	2,728	1,063	>50,000	~318,000
ECOLOGICAL COMMUNITIES							
Box Gum Woodland and Derived Native Grassland			544	944	400	<25,000	<100,000
Plains Grassland			0	1	1	No data	No data

Note: F - Forest, W – Woodland, G Grassland

The fragmentation may effectively isolate remaining vegetation on either side of the rail spur and Mine Access Road. The bridge for the rail crossing over the Namoi floodplain will be elevated and will not create a barrier effect for fauna, such as ground dwelling mammals found along the river.

No Koala have been identified during the field surveys within the Project Boundary and the data collected indicates that this species has very limited use of the Project Boundary. The Project will clear low quality habitats with little or no use by Koala except for periodic use as a corridor to move to other habitats. The dominant trees within the Project Boundary include species that are regarded as important secondary feed species such as White Box (Eucalyptus albens). Primary browse trees including River Red Gum (Eucalyptus camaldulensis) do not occur in significant numbers within the Project Boundary.

Groundwater Dependent Ecosystems

No groundwater dependant ecosystems have been identified to occur within the Project Boundary.

The groundwater impact assessment (**Section 7.11**) predicts a zone of depressurisation that extends beyond the Project Boundary beneath Back Creek which is located on the northern extent of the Project Boundary. Back Creek contains Melaleuca Riparian Forest along the fringes of this ephemeral drainage line. This vegetation may potentially be impacted should the Project's groundwater depressurisation zone intercept groundwater from the perched water tables along Back Creek.

A desktop assessment was undertaken by ALS Water Sciences to review the potential impacts of the Project upon stygofauna in the neighbouring groundwater aquifers. Stygofauna are small groundwater invertebrates, consisting mostly of crustaceans less than 2 cm in size.

Recent sampling of the Maules Creek alluvial aquifer has identified a unique diversity of stygofauna with several endemic species identified. There has also been some limited work undertaken in and around the Namoi River alluvials, which has identified the presence of stygofauna.

No sampling for stygofauna is known to have occurred within the Boggabri Volcanics or the Maules Creek Formation, although, the presence of stygofauna in these aquifers is considered unlikely given the low transmissivity in these aquifers. However, the proximity to the Maules Creek alluvials, the fresh quality of the groundwater and the relative shallow groundwater table make it possible for stygofauna to be present. If they are, they are unlikely to be endemic as they would have migrated to these aquifers via the surrounding alluvium.

As explained further in **Section 7.11**, the Project is predicted to create a drawdown of the surrounding groundwater levels, however is not anticipated to substantially affect the levels within the Maules Creek alluvium.

The Project is unlikely to have any significant effect on stygofauna within and surrounding the Project Boundary.

Cumulative Impacts

Extensive vegetation clearing has already occurred in the locality as a result of agriculture, forestry, and other mining projects. These processes are still occurring and impacting the area. The scale of vegetation clearance that will occur as a result of the Project will exacerbate these existing ecological impacts. If no mitigation or compensatory measures are provided, this will result in cumulative impacts on flora and fauna as habitats are further reduced and fragmented.

Collectively, when considered with the Project, a high proportion of the existing Leard State Forest will be subject to mining within the next two to three decades. Based upon current proposals within the Leard State Forest, the combined impacts of mining could remove 3,081 ha of the 5,053 ha of forest and woodland, a total of 60%. This would include removal of 1,217 ha of 2,153 ha of Box Gum Woodland and Derived Native Grassland, equating to 57% of the CEEC within the forest.

All of the mines within the vicinity of Leard State Forest propose to rehabilitate mined areas and return them to forest and woodland. The mined landscape will be progressively returned as flora and fauna habitat in the medium to long term. Additionally, all of the mines have provisions for offsetting ecological impacts. All of the mines will or have purchased additional surrounding lands that contain forest, woodland and derived native grasslands. These will collectively and significantly increase the total area of native vegetation that exists in the locality in the future and will significantly increase the total area of native vegetation within conservation reserves in the locality and the region.

Some vegetation communities to be impacted, particularly the CEEC Box Gum Woodland and Derived Native Grasslands, are not well represented within secure tenures, particularly within conservation reserves.

However, this situation is likely to change within the locality and subregion (the Nandewar Subregion) in the medium to long term as the mining projects within the Leard State Forest are proposing to establish permanent biodiversity offsets containing Box Gum Woodland and Derived Native Grassland and other closely related vegetation.

All of these mines propose to carry out clearing activities on a progressive basis and will rehabilitate the mined areas as soon as practical, with the key objective to return them to the forest and woodland that currently exists. As such the mined landscape will be progressively returned as flora and fauna habitat in the medium to long term.

7.6.4 Mitigation and Management

Management measures proposed for the Project have followed the OEH's Draft Guidelines for Threatened Species Assessment (DEC 2005d), with the aim to avoid, mitigate or offset all identified impacts, as follows:

- Avoid: to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- Mitigate: where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and
- Compensate: the residual impacts of the Project should be compensated for in some way.

Each of these principles have been applied to the Project and addressed where feasible and reasonable, as discussed below.

Avoid

As discussed in **Section 3.13** the Project mine plan has been revised through the consideration of a number of alternatives which were developed to reduce the potential for adverse impacts to the environment, including specific impacts on Threatened communities and flora and fauna species.

The Project mine plan has been altered to reduce environmental impacts, in particular, the Northern OEA has been aligned to avoid the disturbance of over 100 ha of Box Gum Woodland and Derived Grassland that would have otherwise been disturbed by the Project.

The required footprint to extract the coal resource could not be modified further to reduce the ecological impacts of the Project. Project related infrastructure such as the MIA, CHPP and water storages are illustrated in indicative locations within the Project Disturbance Boundary.

The final alignment and location of these facilities will be designed and constructed in order to avoid the disturbance of areas of CEEC, where engineering practicality and efficiency allows.

Extracting this coal resource by underground mining would sterilise the majority of this internationally sought after coal and render the Project uneconomical.

Aston currently has in place a Land Disturbance Protocol that will be revised for the Project and included within the Flora and Fauna Management Plan. This Land Disturbance Protocol requires the Environmental Manager (or delegate) to carry out an inspection of the proposed disturbance areas prior to any activities occurring. This Protocol provides a process to ensure that compliance with the relevant licences and approvals is achieved, that sensitive ecological features are not impacted upon directly and that appropriate mitigation is in place.

Substantive mitigation and compensation measures are proposed to offset the impacts of the Project on flora and fauna as described in **Section 7.7**.

Mitigate

As part of its EMS, Aston will develop and implement a Flora and Fauna Management Plan that will be prepared to the approval of DP&I. The Flora and Fauna Management Plan will incorporate a number of management and mitigation measures to minimise any adverse impacts to sensitive flora and fauna.

These management and mitigation measures will include:

- A revised Land Disturbance Protocol for the Project that sets out the process for the Environmental Manager (or Delegate) to sign off on the staged clearing activities that will be required for the Project;
- The final design and location of infrastructure will be in existing cleared areas, where engineering and economic conditions allow, to minimise the loss of habitat and impacts upon CEEC;
- Limit the disturbance of vegetation to the minimum necessary for each stage of the pre strip clearing;
- Limits of clearing will be delineated to avoid unnecessary vegetation and habitat removal;
- Implement a pre clearing protocol for all tree clearing to minimise impacts to resident fauna, which may need to be relocated to surrounding habitat prior to disturbance;
- Schedule the clearing of vegetation to times where it is possible to optimise seed collection;
- Collect and propagate native seed for use in rehabilitation areas and other disturbed areas;
- Translocate habitat features such as stags (old dead trees that provide hollows, crevices etc), large logs and boulders to rehabilitation areas;
- Trial and develop regeneration methodologies and strategies with a particular emphasis on Threatened species and species that are part of the Box Gum Woodlands and Derived Grasslands CEEC;
- Progressively rehabilitate mined areas;
- Implement the Ecological Offset Strategy detailed in **Section 7.7**;
- Rehabilitation and restoration of adjoining habitat where possible;
- Implement a flora and flora monitoring program for rehabilitation, and Threatened species remaining within the Project Boundary, to improve the understanding of impacts and assist with rehabilitation efforts;
- Provide linkages and or crossing zones between isolated vegetation remnant patches, where feasible; and
- Contribute to environmental education and research where feasible.

With the implementation of these measures, in conjunction with the proposed Biodiversity Offset Strategy (discussed in **Section 7.7**), it is apparent that although the habitat for the Threatened flora and fauna within the Project Boundary will be adversely effected, on the whole it will result over time in a net improvement in the biodiversity conservation values within the Nandewar Subregion.

7.7 MAULES CREEK BIODIVERSITY OFFSET STRATEGY

7.7.1 Background

Discussions with DP&I and SEWPaC confirmed the significance of the Project and need to develop a carefully planned and comprehensive Biodiversity Offset Strategy that compensated (in accordance with current government requirements) for the proposed impacts upon the listed Box Gum Woodland and Derived Native Grassland and potential habitat for the listed Threatened species, particularly woodland birds and bats.

High level vegetation mapping was undertaken via helicopter surveys to confirm areas containing Box Gum Woodland and Derived Grassland. This initial vegetation mapping was used to prioritise areas containing Box Gum Woodland that would assist as part of a Biodiversity Offset Strategy in maintaining and improving the biodiversity outcomes within the region.

By priority, access was arranged with the respective landholders and field surveys were undertaken by teams of ecologists to validate the findings from the helicopter surveys and assist in completing preliminary mapping of vegetation communities on key properties. Suitable lands were acknowledged during this process and used in the development of the Biodiversity Offset Strategy for the Project. Further detailed surveys of the shortlist of properties are imminent.

The key objectives for the establishment of the Maules Creek Biodiversity Offset Strategy include:

- Reestablishment of habitat linkages to existing areas of habitat in the locality, including existing native vegetation within and closely adjacent to the Project Boundary and the southern portion of the Nandewar Ranges, with a consideration on building on other offset lands within the vicinity;
- Establishment of long term biodiversity offset and management areas for conservation of existing vegetation habitats for locally occurring Threatened species and ecological communities, particularly Box Gum Woodland and Derived Grassland;
- Conservation of land that contains or could be regenerated to provide Ironbark Forest, Dwyer's Red Gum Woodland and other non-EEC vegetation;

- Conservation of land that includes habitat for all relevant Threatened flora and fauna species that could be impacted by the Project;
- Management of land that contains and / or can be regenerated to provide Box Gum Woodland and Derived Grassland;
- Rehabilitation of the mine disturbance areas to native vegetation communities including the Box Gum Woodland and Derived Grassland; and
- A consolidated ecological management program across all biodiversity offset areas and network of wildlife corridors.

This section presents the Biodiversity Offset Strategy that has been established for the Project that aims to compensate the residual impacts of the Project and to help maintain and substantially improve the biodiversity values within the region over the medium to long term.

7.7.2 Offsetting Principles

The Biodiversity Offset Strategy has been developed to generally comply with the biodiversity offsetting principles developed by both the State and Commonwealth Governments and include:

- Biodiversity Banking and Offsets Scheme (DEC 2007);
- Principles for the Use of Biodiversity Offsets in NSW (DECC 2008b);
- Draft Policy Statement: Use of Environmental Offsets under the *Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2007).

The NSW Government has developed a biodiversity banking and offsets scheme (BioBanking Scheme) to assist in addressing the loss of biodiversity values, including Threatened species. This Scheme was established under Part 7A of the TSC Act and uses offsets (where appropriate) to assist in addressing the cumulative effects of development in NSW and in particular, to help meet the goal of maintaining or improving biodiversity. The NSW BioBanking Scheme and associated tools, developed by OEH (DEC 2008b) have been used as a guide to developing the biodiversity offset requirements for the Project.

The Commonwealth requirements for biodiversity offsets are guided by the Draft Policy Statement: Use of Environmental Offsets Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Offsets) (DEWR 2007). The aim of this policy is to outline the Commonwealth government's position in relation to the use of offsets and to ensure that the best environmental outcomes are achieved through the consistent, transparent and equitable application of offsets under the EPBC Act.

One of the key principles of this draft policy is that environmental offsets, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like' (DEWR 2007).

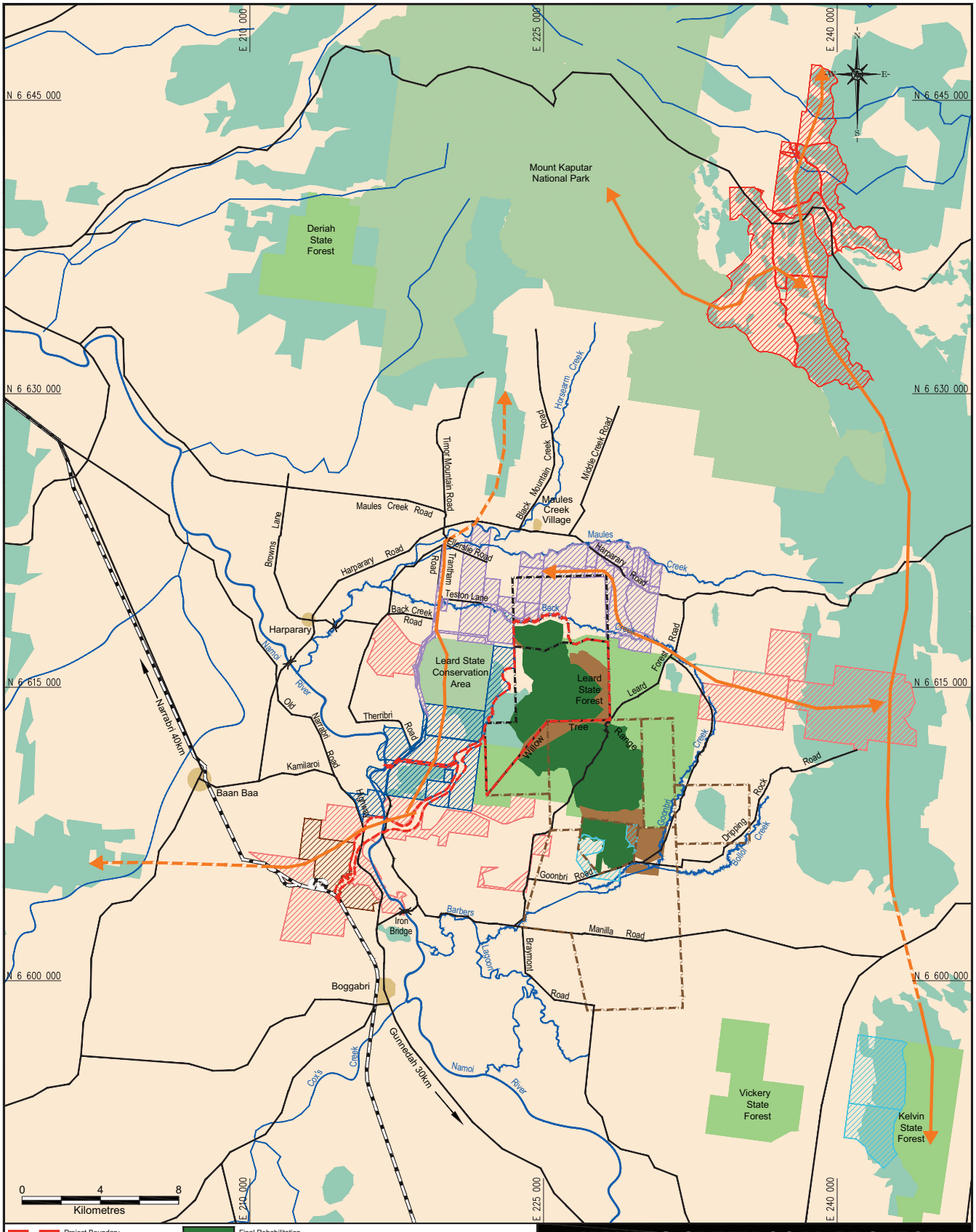
The Biodiversity Offset Strategy for the Project has been developed to comply generally with the above principles in the following ways. It will:

- Provide a net increase in the area of woodland, forest and grassland communities within the locality and the region in the medium to long term which provide key habitat for Threatened species;
- Provide a net increase in the area of the Threatened ecological community Box Gum Woodland and Derived Grassland (both of which will be impacted by the Project);
- Provide a net increase in the area available as habitat for Threatened fauna species such as Threatened woodland birds, Threatened birds of prey (Masked Owl), microchiropteran bats and the Koala;
- Provide an increase in the habitat available for Threatened flora species such as Pomaderris queenslandica, Pultenaea setulose, and Lepidium aschersonii;
- Conserve and improve the biodiversity values of all types of woodlands, open forest and grassland that will be impacted upon by the Project;
- Provide land that will be strategically selected to build upon the previous vision of corridors that aim to link the Namoi River floodplain, Leard State Forest and the Nandewar Ranges;
- Provide a significant extension of the Mt Kaputar National Park, Leard State Conservation Area and other conservation areas within the Nandewar Sub Bioregion; and
- Provide long term protection of the offset lands.

7.7.3 Biodiversity Offset Strategy

The Biodiversity Offset Strategy that has been formulated for the Project requires the acquisition of a large area of land holdings that contain substantial amounts of remnant vegetation. The land holdings are shown on **Figure 26** and are located in the immediate vicinity of the Project Boundary and further away within the region, including:

- **Northern Offsets:** two properties to the north of the Project Boundary that are in the process of being acquired for use as compensatory habitat. These two properties are named *"Mt Lindesay"* and *"Wirradale"* and are extensively vegetated, link to each other and to adjacent conservation lands, including the Mt Kaputar National Park; and



MAULES CREEK COAL PROJECT

Project Ecological Offsets in Regional Setting

Cad File: 07100J.dwg	Date: 20.07.11	Drawn: JD	Figure 26

- **Western Offsets:** properties in the vicinity of the Leard State Conservation Area and the Namoi River riparian corridor on the western margins of immediately around the Project Boundary that have and/or will be acquired for conservation and farming purposes;
- **Eastern Offsets:** properties on the eastern and north-eastern side of the Project Boundary that have and/or will be acquired for conservation and farming purposes; and

Aston also possesses property in shared ownership with Boggabri Coal to the south-west of the Project Boundary and intends to incorporate this into the Biodiversity Offset Strategy for the Project.

During the offset selection process, a large emphasis was placed on sourcing potential offset properties with realistic prospects for long term security. The properties (and portions of properties) were chosen for inclusion in the Biodiversity Offset Strategy because they are located outside existing mining/exploration tenements and do not contain some areas of prime agricultural land that are likely to be attractive to future land managers.

Numerous field inspections and preliminary mapping have indicated that these offset properties contain areas of suitable habitat values to address the Project impacts on Threatened communities and species. They are strategically located to assist in building on neighbouring mining operations' offset areas to create a valuable corridor for Threatened communities and species within the Namoi Valley region.

Further detail in relation to each of these Offset areas is provided in the following sections.

Northern Offsets

The Northern Offset properties were selected with the prime purpose of conserving and enhancing Box Gum Woodland. They were also selected to enhance and conserve affiliated species, including a suite of threatened species of birds, bats, mammals and potentially threatened plants, targeting threatened species typical of forest and woodland habitats. It is likely to provide high quality foraging and roosting habitat for a wide variety of threatened birds and bats. It will also enhance and expand the Mt Kaputar National Park and improve linkages between large existing tracts of forest and woodland for these and other species.

The Northern Offset properties contain extensive areas of native forest and woodland, and semi-natural derived native grassland. The combined area of the two properties is approximately 6,353 ha and they are located approximately 17 km to the north-east of the Project Boundary. These properties are located adjacent to the south-eastern boundary of the Mt Kaputar National Park and will build on the existing vegetated corridors and provide key habitat for a range of Threatened species.

The majority of the Northern Offset property contains CEEC of similar community to that to be disturbed by the Project, including approximately 2,200 ha of high quality Box Gum Woodland and 1,900 ha of Derived Native Grassland. A further 130 ha of Low Diversity Derived Native Grassland exists that may be regenerated to Derived Native Grassland and eventually Box Gum Woodland.

The Northern Offset Properties contain more than 800 ha of woodland and forest dominated by the Ironbark species of the type to be impacted by the Project and 200 ha of White Box Shrubby Woodland which would provide suitable habitat for Threatened species (see **Appendix I** for habitat provided for Threatened species). Only 945 ha of the land within the Northern Offsets properties has previously been cleared and is currently sown with improved pasture.

The native vegetation within the Northern Offset properties contains suitable habitat for all of the Threatened and migratory fauna that are predicted to be impacted by the Project (see **Table 33** and **Appendix I**). There are extensive areas of well connected forest and woodland that provide excellent habitat for a wide variety of species, potentially including species that are not found within the Project Boundary, such as the Spotted Tailed Quoll which is Endangered under the EPBC Act.

These Northern Biodiversity Offset properties provide substantial compensation for impacts to habitat for a range of Threatened species and the Box Gum Woodland CEEC as a result of the Project.

Agreement for the acquisition of these properties has been made with these landholders for inclusion as part of the Biodiversity Offset Strategy.

Western Offsets

The purpose of the Western Offsets was to build upon the existing remnant vegetation that exists within Leard State Conservation Area, forming a link to the Namoi River. This area will contribute to forming a large block of Ironbark Forest, Box Gum Woodland and related vegetation. It will provide a sizeable tract of foraging, roosting and dispersal habitat for threatened species that are predicted to be impacted by the Project, mainly threatened woodland birds and bats.

Aston has committed to conserving and enhancing approximately 600 ha of forest, woodland and derived native grassland, whilst avoiding impacts to prime agricultural land. Furthermore, it is anticipated that additional lands containing other native vegetation may be acquired by Aston in the future. Most of this land located to the south-west and west of the Project Boundary will be set aside as conservation lands and used to contribute towards an offset for the Project.

The native vegetation within these offset properties provides suitable habitat for all of the threatened and migratory fauna that are predicted to be impacted by the Project. There are extensive areas of well connected forest and woodland that provide excellent habitat for a wide variety of species, potentially including species that are not found in Leard State Forest, such as the nationally endangered Spotted Tailed Quoll (along the Namoi River corridor).

The Western Offsets will occur in close proximity to some land proposed as an offset by Boggabri Coal. The Leard State Conservation Area is large and contains mainly Ironbark Forest, with some Box Gum Woodland and other forest types. The proposed offset lands contain Box Gum Woodland, Derived Native Grassland, Ironbark Forest and some ephemeral riparian habitats. When combined with the existing Leard State Conservation Area, the total forest and woodland area will comprise at least 1,776 ha. This is an area that is large enough to afford sustainable habitat to threatened species of birds and bats, particularly as it has links to the Namoi River.

As the mined land is rehabilitated, the restored vegetation will link to this area and will significantly increase the area of forest and woodland available for wildlife and it will eventually be linked to the southern tip of the Nandewar Ranges.

To a lesser extent, the lands around the south-west of the Project Boundary and those along the north will bolster corridor connections from Leard State Conservation Area towards the Pilliga. These lands will not form completely connected habitats but will contribute to form *"stepping stones"* in the landscape for flora and fauna.

Eastern Offsets

The purpose of the Eastern Offsets is to build upon the northern and eastern side of Leard State Forest, and contribute to a link to the Nandewar Ranges and form a large block of Ironbark Forest, Box Gum Woodland and related vegetation that forms a sizeable tract of habitat. The offset has been designed to target threatened species typical of forest and woodland habitats, providing foraging, roosting and dispersal habitat for woodland birds and bats.

Aston has committed to conserving and enhancing 400 ha of forest, woodland and derived native grassland along the north-eastern edge of the Project Boundary. Properties along the north-eastern margin of the Project Boundary contain some productive croplands that are completely cleared of native vegetation.

Within these properties, selected areas of Box Gum Woodland and other native vegetation will be conserved and used as offsets, while the cleared farmlands will continue to be utilised for agricultural production.

The native vegetation within the Eastern Offset properties has habitat for all of the threatened and migratory fauna that are predicted to be impacted by the Project. There are extensive areas of well connected forest and woodland that provide excellent habitat for a wide variety of species, potentially including species that are not found in Leard State Forest, such as the nationally endangered Spotted Tailed Quoll.

A primary objective of the management of conserving forest within the Eastern Offsets will be to complement and build upon land proposed by Boggabri Coal to form wildlife corridors from Leard State Forest east to the Nandewar Ranges. As per the Western Offsets, as the mined land is rehabilitated, rehabilitation will link the Eastern Offsets and Western Offsets to Boggabri Coal's offset strategy and will significantly increase the area of forest and woodland available for wildlife.

Shared Property

Aston owns property under a joint venture ownership with Boggabri Coal. The shared property is located on the western side of the Kamilaroi Highway to the south-west of the Project Boundary. A small proportion of this land will be utilised for the proposed rail spur.

Aston intends to dedicate the remainder of their 50% of this land to the Offset Strategy. As Boggabri Coal also intends to incorporate the remainder of their half of the shared property to the Boggabri Coal Offset Strategy (Parsons Brinckerhoff Australia Pty Ltd, 2010), this would contribute to a regional East-West strategy comprising various offsetting efforts and conservation/forestry reserves in the locality.

Reasons for Selection

The Northern Offsets and the East-West Corridor Offsets have been chosen as they boast values of ecological significance that will assist in maintaining and enhancing the biodiversity values within the region within the medium to long term. Their characteristics include:

- Appropriate vegetation communities exist in good condition, which are comparable to or in better condition than the flora and fauna that are proposed to be cleared for the Project;
- They contain extensive areas of high quality habitat for Threatened fauna species, including all species predicted to be impacted by the Project;
- Broad areas of the grassland vegetation can be feasibly regenerated and improved to provide additional woodland in the medium term (Low Diversity Derived Grassland);
- Avoids the prime agricultural lands on the Namoi River alluvial floodplain by strategically selecting vegetated land parcels on the elevated slopes, whilst aiming to improve the corridor habitat values within the region;

- The areas are located in an area that will build onto the existing conservation areas (Mt Kaputar and Horton Falls National Parks) and / or land that contains significant remnant native vegetation;
- Permanent streams exist within these areas, including the upper reaches of Maules Creek, that form high quality habitat for wildlife;
- They will form new, or improve the existing, habitat corridors; particularly:
- Links between Mt Kaputar National Park, Horton Falls National Park, forested Crown land and the current vegetation on the two properties themselves; and
- East-West Links between the Namoi River, Leard State Forest, Leard State Conservation Area and the southern tip of the Nandewar Ranges (joining with similar quantities of land that have been acquired by Boggabri Coal for forming East-West Corridor Links).

Exist as freehold land that is free of other mining companies mining authorities.

Rehabilitation

The Biodiversity Offset Strategy for the Project is dynamic and aims to maintain and then improve the biodiversity values of the landscape in the medium to long term. This will be achieved through the restoration and conservation of land with the potential to regenerate to build onto areas of existing native vegetation and provide additional habitat for Threatened species.

As discussed in **Section 7.16**, the mining area will be progressively rehabilitated over the life of the Project. A key objective of rehabilitation will be to establish native forests and woodland with a focus on the Threatened Box Gum Woodland community and other habitat structures characteristic of the pre mining landscape.

Local native plant species will be utilised where possible which will be supplemented by additional native species represented in the area to ensure the rehabilitation objectives are achieved.

Where practical, topsoil will be translocated from proposed mining areas to conserve the native seed bank of local ecological communities which will:

- Maintain or establish corridor connectivity as mining progresses;
- Improve the quality and diversity of native growth in rehabilitation areas;
- Maximise the establishment of a diversity of native species, particularly the understorey species that maintain the ecological function of native vegetation communities; and
- Provide additional habitat for native flora and fauna.

The rehabilitation areas within the Project Boundary will form part of the Biodiversity Offset Strategy. The objective of the post mine landform will provide for self sustaining native forest communities that are capable of maintaining pre mine biodiversity values.

As discussed in **Section 7.16**, a Rehabilitation Management Plan will be developed that prescribes the staged rehabilitation of all mine disturbed areas. The key objectives of this plan will be to restore, where possible, the pre mining biodiversity within a safe and stable landform, including 544 ha of the Box Gum Woodland and supplementary habitat features, including translocated hollow logs.

Management

A Biodiversity Offset Plan (BOP) will be developed for the Project to guide the restoration and the overall management of land for biodiversity offsets. The management program will ensure the development and implementation of a scientifically based process for the reestablishment of Box Gum Woodland understorey and in the longer term, the over storey in relation to the rehabilitation areas within the Project Boundary, as well as poorer quality offset land that requires restoration works.

The BOP will prescribe the management of existing vegetation within the Project Boundary, revegetation of cleared or degraded areas, fire management, weed and feral animal control and management of the habitats of Threatened species of flora and fauna.

Aston is investigating a number of mechanisms that are available under the NP&W Act and EP&A Act to assist in the long-term security of the land as part of the biodiversity offset strategy. The ultimate mechanism to be utilised will be dependent upon existing land tenure, land covenants and ongoing discussions with the National Parks and Wildlife Service and other relevant regulators. The outcomes of the above investigations will be described within the BOP which will be submitted to the relevant regulators for review.

7.7.4 Biodiversity, Corridor Linkages and Enhancement

The Biodiversity Offset Strategy will add to conservation areas already established in the Bioregion by the Brigalow and Nandewar Community Conservation Agreement (CCA) (such as the Leard State Conservation Area and the Mt Kaputar National Park) and to local conservation areas to be provided by other mines in the locality as shown on **Figure 26**.

The establishment, enhancement and maintenance of habitat corridors is proposed as a major feature of the offset package for this Project, particularly areas of remnant vegetation that occur between forests, woodlands and grasslands of high conservation value in order to provide connectivity between these remnant areas.

Research has highlighted the importance of maintaining treed habitats in the intervening disturbed landscape as these patches or corridors are important for fauna movement and seed dispersal. Remnant patches also serve as *"stepping stone"* corridors that facilitate the movement of fauna in the landscape.

"Stepping stones" have been shown to be important in maintaining landscape connectivity and maintaining gene flow between separate populations because of the movement of pollen and seed vectors such as animals and insects (Lindenmayer, 2006).

7.7.5 Cumulative Offsets

The Biodiversity Offset Strategy has been designed to provide a net benefit to flora and fauna in the locality and region. This is to be achieved principally by:

- Adding to the vegetation that is already permanently protected, so that there is a substantial increase in conserved woodland and open forest in the long term;
- Linking large blocks of forest and woodland to the rehabilitation areas and to substantial blocks of habitat in the locality, including the Nandewar Ranges and the riparian forests around the Namoi River; and
- Providing for the conservation and management of vegetation and Threatened species for the life of the Project.

When considered with the Project, a high proportion of the existing Leard State Forest will be subject to mining within the next two to three decades. All of the mines propose to rehabilitate their mined areas and return them to forest and woodland. The mined landscaped will be progressively returned as flora and fauna habitat in the medium to long term.

Additionally, all of the mines have provisions for offsetting ecological impacts with each having purchased additional surrounding lands that contain forest, woodland and derived native grasslands. These will collectively and significantly increase the total areas of native vegetation that exist in the locality in the future and will significantly increase the total area of native vegetation within conservation reserves in the locality and the region.

The available data indicates that in the medium to long term, the mining activities will result in a net increase in forest and woodland in and around Leard State Forest, and in the wider locality.

Excluding mine rehabilitation, this is likely to include offsets in the order of 17,320 ha. It is estimated that the combined offsetting will provide 8,013 ha of Box Gum Woodland and Derived Native Grassland. Combined with neighbouring mine offset strategies, the proposed Biodiversity Offset Strategy will also decrease habitat fragmentation.

Such long term increases in forest and woodland cover are likely to have significant benefits to native flora and fauna, including all Threatened species covered within this assessment.

7.7.6 Conclusion

The Project mine plans were designed in the early stages of the Project in order to minimise the disturbance of areas of CEEC. A number of mitigation and management measures will be implemented in an effort to reduce the potential impacts of the Project. Further to this, the Project will result in the designation of a number of properties within two proposed Offset Areas to form the Maules Creek Biodiversity Offset Strategy: the Northern Offsets Area; the Western Offsets, the Eastern Offsets and the Shared Property.

The Northern Offsets Area will comprise approximately 6,353 ha of land area, which is broken down into approximately 2,200 ha of Box Gum Woodland and approximately 1,900 ha of Derived Native Grassland, with a further 130 ha of Low Diversity Derived Native Grassland to be regenerated to comply with the CEEC. The Northern Offsets Area also contains approximately 945 ha of Ironbark Woodland and Forest and around 200 ha of White Box Shrubby Woodland similar to that to be impacted by the Project which will provide further habitat for the Threatened species that are known to occur in the area.

The Northern Offsets properties adjoin one another and are also located to the south-eastern boundary of the Mt Kaputar National Park, creating another large portion of conservation lands. In the medium to long term, it is anticipated that the Low Diversity Derived Grassland will be regenerated to Box Gum Woodland to assist in building onto the corridor that currently exists.

The Western Offsets will comprise properties located to the west of the Project Boundary, adjoining the Leard State Conservation Area and are either owned by Aston or have been predicted to be adversely impacted as a result of the Project. Aston proposes to include within this Offset Area up to 600 ha of native vegetation on certain properties that are predicted to be impacted by the Project. Properties within this area will be strategically selected, only including vegetated areas that are on the foothills, not on prime, agricultural land. This will ensure that prime agricultural farmland is not locked up in Offset Areas.

These properties will also be strategically selected in order to build upon the Boggabri Coal Offset Strategy. As these combined properties are regenerated with native vegetation, the value of the additional lands to be included by Aston will complement the existing remnant vegetation within the Leard State Conservation Area.

The Eastern Offsets will build on the remaining section of the Leard State Forest and link with the Boggabri Coal Offset Strategy, building on the link towards the Nandewar Ranges.

The Project is predicted to affect a few properties within and surrounding the Project Boundary by elevated noise and air quality emissions. Aston has identified areas of land on some of these as potential properties for part of the Eastern and Western offset for the Project (incorporating a further 1,000 ha of forest and woodland to the Biodiversity Offset Strategy).

Some of these properties are either owned by Aston or subject to a private agreement with Aston for purchase. Discussions will continue to take place with the remaining landholders in relation to the possible purchase of their property to be included as part of the Biodiversity Offset Strategy for the Project.

Aston has acquired or has subject to an agreement 1,227 ha (582 ha of Derived Native Grassland and 645 ha forest and woodland) of the proposed 1,000 ha of forest and woodland; and 407 ha of condition A and B Box Gum woodland (of the proposed 500 ha committed). Any shortfall meeting the 1,000 ha committed to as part of the offset would be subject to successful negotiations with other identified landholders in the zone of affectation.

The Project will improve biodiversity values within the region in the medium to long term. It will increase the area of forest and woodland under ecological protection within the locality adding substantial areas of Box Gum Woodland and derived native grassland to conservation tenure.

7.8 ABORIGINAL ARCHAEOLOGY AND CULTURAL HERITAGE

AECOM has prepared an Aboriginal Archaeology and Cultural Heritage Impact Assessment for the Project which is reproduced in **Appendix J**. The aim of the assessment was to review and assess the nature of the archaeological landscape of the Project Boundary and assess the potential impacts that the Project may have on Aboriginal cultural heritage values. A summary of this assessment is provided in the following sections.

7.8.1 Methodology

Desktop Survey

A comprehensive desktop study was undertaken which included:

- A review of previous archaeological reports relevant to the regional and local area to assess the current status of Aboriginal cultural heritage and to provide a basis for developing a predictive model for the site location;
- A search of the OEH AHIMS databases for all registered sites with a 15 km radius surrounding the Project Boundary; and
- A review of the landscape character and land use history which influences patterning of sites.

A number of previous reports were identified relevant to the local area to assess the current status of Aboriginal cultural heritage. Those previous studies that have been undertaken within the Project Boundary were reviewed to gain an understanding of the Aboriginal heritage and cultural heritage values of the vicinity and include:

- Besant (2010) – surveyed an area of approximately 2,390 ha associated with the Boggabri EA. A total of 104 sites were identified in the area with 77 previously unrecorded 'archaeological loci'. Of the identified sites, 63 were proposed to be impacted by the development and recommended for salvage;
- Haglund (1986) – resurveyed the areas covered in the original 1983 survey, combined with additional properties to the south. An additional eight stone artefact scatters were identified primarily within the steep sided gully;
- Dallas (1986) - surveyed the rail loop and coal haul route. Four sites along or adjacent to the haul route were identified, no sites were identified on the rail loop. Three sites were open artefacts scatters and the fourth site was a rock shelter; and
- Haglund (1983) – identified a total of 13 sites including six artefact scatters and seven isolated finds. Recorded sites were recommended not to be regarded as separate occurrences, but as part of a general scatter of stone artefacts on and in most flat and / or gently sloping surfaces in the vicinity of temporary water sources.

The information found from the review of these previous assessments and database findings were then used to form a predictive model of site types and locations which was then tested by field assessment.

The desktop study found that sites consisting of stone artefact scatters and isolated stone artefacts are the most common type of Aboriginal archaeology found within the vicinity of the Project Boundary. The AHIMS database search and Besant 2010 indicated that a total of 158 Aboriginal sites were located within the 15 km vicinity of the Project Boundary.

The Aboriginal stakeholder engagement program has been conducted in accordance with the 'Aboriginal cultural heritage consultation requirements for proponents 2010' and is discussed in **Section 5.4.6**.

Field Methodology

The Aboriginal heritage impact assessment aimed to:

- Relocate and re-record all AHIMS registered Aboriginal archaeological sites located within the Project Boundary;
- Identify any previously unrecorded sites by way of targeted pedestrian transects over all landform types within the Project Boundary;
- Achieve a survey coverage that adequately reflects the variable archaeological potential of differing landform types within the Project Boundary;
- Inspect, where appropriate, areas of known or potential Aboriginal cultural value, as identified by Aboriginal stakeholder representatives; and
- Obtain sufficient data to facilitate the development of management and mitigation measures for the Project.

A targeted survey strategy was adopted for the Project, involving the division of the Project Boundary into its constituent landform types to ensure that all landforms within the survey areas were sampled. A proportional field emphasis on those considered having higher archaeological potential (i.e. creek / river flats) was adopted.

At the same time, in recognition of disturbance and visibility issues, it was decided that decisions concerning the number, placement and length of transects was best suited to be proactively made in the field.

The field survey was broken up into two main survey periods, with the first covering the majority of the Project Boundary including the Leard State Forest, Aston owned land within and adjacent to the Project Boundary, the proposed Rail Spur and Loop corridor, Mine Access Road corridor and pipeline corridor. The second survey covered a relatively small area of land consisting of 220 ha located in the north of the Project Boundary.

The field surveys were conducted over a period of 18 days. Three AECOM archaeologists, one Hansen Bailey representative and six Aboriginal stakeholder representatives per day carried out these surveys on a rostered team basis.

The approach used a pedestrian based survey within a typical linear transect width of 50 m with Aboriginal representatives and archaeologists evenly spaced depending on the visibility of each transect.

The location of all transects was recorded using a hand held Trimble Differential GPS, with additional transect data (e.g. landform, exposure, Ground Surface Visibility (GSV), land use and disturbance) being recorded separately. The principal environmental characteristics of each transect and other pertinent features (i.e. erosion scalds, etc) were also photographed. All mature trees were inspected for possible cultural scarring.

Likewise, all areas for potential rock shelter formations were physically investigated where safe to do so.

All Aboriginal archaeological sites identified during the survey were recorded to the standard required by the Code of Practise for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010b) (the Code). Individual artefact locations were determined by the GPS at each site that was located or revisited.

Associated site data (e.g. location, type, content) was documented including raw material, type and size (i.e. maximum length, width and thickness). Photographic records of each site were also taken and where provided, information concerning the cultural value(s) of recorded sites and their associated environmental characteristics was noted.

The assessment included the identification of areas of sub-surface potential. The effective survey coverage achieved was sufficient to assess the scale and character of the archaeological resource within the Project Boundary.

7.8.2 Impact Assessment

Archaeological Resource

The archaeological potential of the landform units investigated was constrained by the extent to which human activity was represented by preserved evidence, the degree to which post-depositional processes have affected the archaeological record, the extent to which land use (e.g. cultivation or forestry development) has altered the archaeological landscape, the landforms present within the study area, the time of year and the conditions under which the survey was conducted.

The archaeological resource within the Project Boundary is comprised of sites previously identified by Haglund 1983, Dallas 1986, Haglund 1986 and Besant 2010 that have not been subject to salvage, in addition to the sites recorded as part of this study.

A total of 97 Aboriginal sites were identified during the field survey, including 38 previously recorded sites (Registered AHIMS and published sites) and an additional 59 new sites. Of these, 78 occur within the Project Boundary, with 19 sites occurring outside the Project Boundary on Aston owned land.

All Aboriginal sites identified within the Project Boundary during the field survey are presented on **Figure 27**. The location of other sites identified outside of the Project Boundary on Aston owned lands are described in **Appendix J**.

The majority of Aboriginal sites located during the survey were stone artefact sites, with 47 artefact scatters and a further 25 isolated artefacts also identified. In addition to these, 21 scarred trees were identified within the Project Boundary with the majority having been identified adjacent to the Namoi River within the proposed pipeline corridor. Three grinding groove sites were also identified, including one fixed groove in sandstone bedrock and two portable grinding stones. All grinding groove sites were identified within the steep sided gully landform in the vicinity of the proposed Rail Spur. The remaining site type is a rock shelter previously identified but not registered with AHIMS, which is located outside of the Project Boundary and will not be impacted by the Project.

In total, 21 sites with high archaeological significance were identified during the field survey within the Project Boundary. The most expansive site was that of Leard SF AS1, an artefact scatter of approximately 320 artefacts located near a well known soak (Lawler's Waterhole) within the Leard State Forest. Sites listed as highly significant include Leard SF AS1, grinding grooves and scarred trees.

The characteristics of each of the sites and the distribution of archaeological deposits within the Project Boundary are explained in more detail in the Aboriginal Archaeological and Cultural Heritage Impact Assessment in **Appendix J**.

Statement of Significance

The significance assessment was based on the relevant criteria from the Burra Charter which was adopted by the Australian International Council on Monuments and Sites for the conservation of places of cultural significance in 1979 (ICOMOS 1979). A significance assessment attempts to ascertain a relative value of heritage sites.

The appropriate criteria to determine significance in this study included cultural (importance to Aboriginal people), scientific (archaeological value) and Aboriginal heritage (evidence of past Aboriginal activity) significance.

The significance of Aboriginal heritage material within the Project Boundary can be assessed on two levels: either a site by site basis, or an archaeological distribution basis. The majority of Aboriginal sites identified within the Project Boundary are stone artefact scatters and isolated stone artefacts. However, a number of scarred trees are also present, particularly in association with the Namoi River landform. Relevant considerations in assessing the level of significance are the assemblage content and whether the landscape pattern differs from that already established.

The cultural significance determined by the Aboriginal stakeholders is reflected in their responses to the Aboriginal Archaeological and Cultural Heritage Impact Assessment as described in **Section 5.4.6** and **Appendix J**.

The following significance statement addresses the scientific importance (or archaeological significance) of the sites recorded. It is based on the potential for sites to add scientific data to the archaeological record, in terms of age and integrity. The potential to add scientific data or preserve that data is influenced by the representation and rarity of the site, as demonstrated by its contents and context.

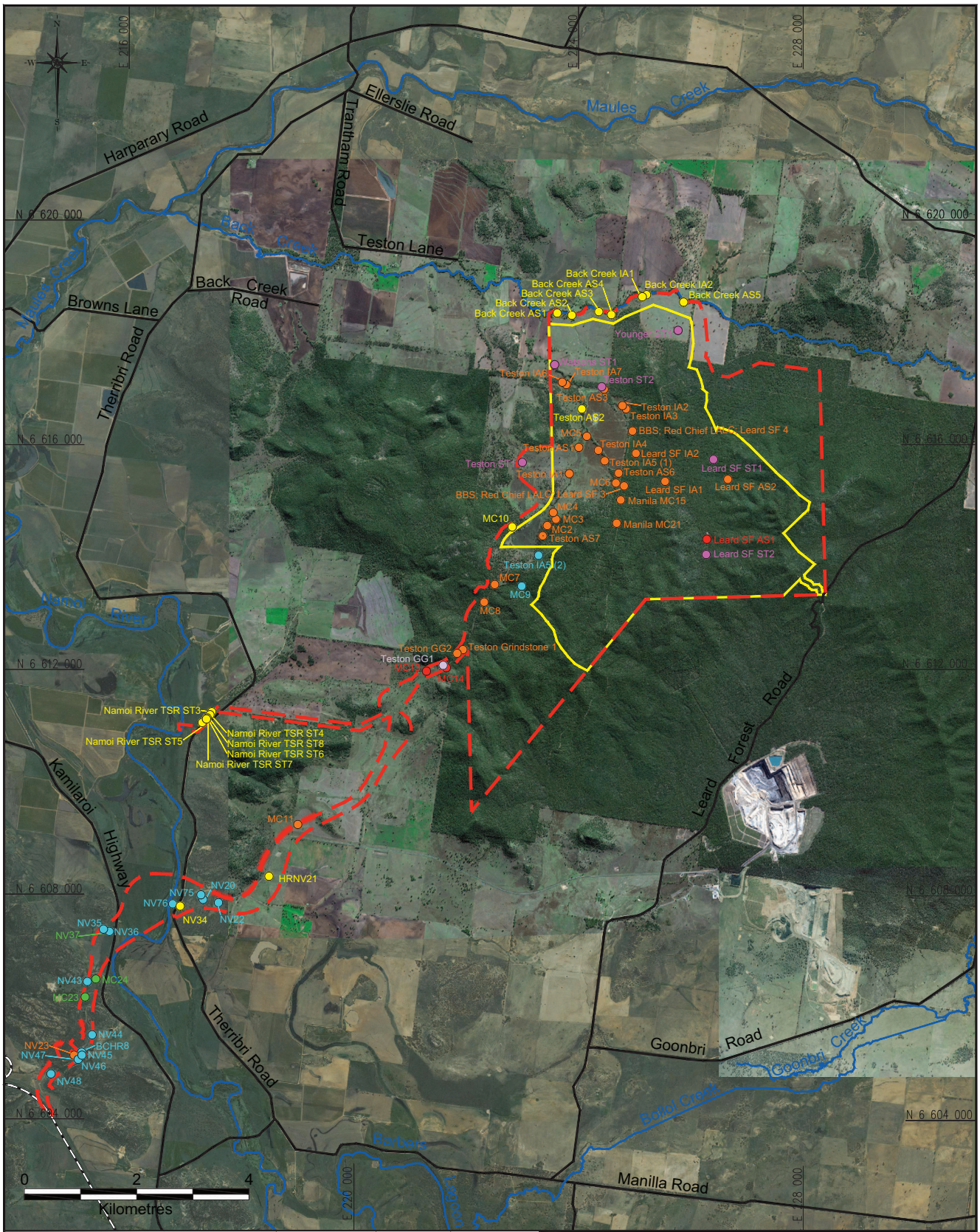
Previous assessments were also used as a guide to assist in determining appropriate levels of significance, where a number of characteristics can be drawn including:

- Aboriginal sites have the potential to occur in all parts of the landscape;
- Aboriginal sites differ in the density of artefacts within exposures (more being found closer to intermittent creek beds);
- A greater concentration of stone artefacts may be anticipated closer to high order creeks;
- Artefacts generally co-occur within exposures associated with intermittent creek junctions, in contrast to areas more than 100 m from creeks where exposures without artefacts are more abundant, reflecting isolated artefact discard in these locations;
- Aboriginal site content includes mostly flakes and broken flakes of chalcedony, indurated mudstone / tuff and silcrete with minor proportions of quartz, igneous stone, petrified wood and quartzite; and
- Abraded artefacts such as stone hatchet heads, grindstones and mullers are rare.

The sites identified within the Project Boundary were assessed as to how they fit this pattern. Aboriginal sites considered in isolation within the Project Boundary are generally of a low or moderate significance with the following exceptions:

- Artefact scatters with more than 25 artefacts and / or artefact scatters possessing unique or rare artefact types;
- Scarred trees with well formed scars or rare scar shapes (circular);
- Unique or rare isolated artefacts; and
- Grinding grooves.

Overall, 21 sites of high significance were identified during the field survey, with 13 consisting of excellent examples of scarred trees, particularly within the Namoi River Travelling Stock Route (TSR).



MAULES CREEK COAL PROJECT

Aboriginal Heritage Sites

Cad File: 06972l.dwg	Date: 12.07.11	Drawn: CP	Figure 27

The remaining sites include six large artefact scatters (including a major camping site Leard SF AS1); and two examples of portable grinding grooves (both located within a steep sided gully).

The majority of moderate sites included small artefact scatters, poorly preserved scarred trees and one poorly defined grinding groove. The remaining sites of low significance were mostly isolated flakes and cores.

The heritage values within the Project Boundary include the pre contact Aboriginal activity evident in the widespread stone artefact evidence present within the topsoil in close association with intermittent creeks and some nearby slopes.

Heritage values within the Project Boundary also consist of a pre contact landscape of high intensity Aboriginal activity associated with a gully connecting the Namoi River around Boggabri with the upper waters of Maules Creek and Back Creek, distinct from low intensity activity in the upper reaches of intermittent creeks where creek margins are more inclined.

Table 34 provides a summary of Aboriginal sites identified within the Project Boundary, notes their significance, the likely impact of the Project on each site and the recommended management measure.

7.8.3 Mitigation and Management

As part of its EMS, Aston will develop an Aboriginal Archaeology and Cultural Heritage Management Plan (AHMP) to the approval of DP&I. The AHMP will be guided by specific policies and procedures to manage Aboriginal archaeological sites within the Project Boundary. The AHMP will be developed consistent with **Table 34** and be periodically reviewed in consultation with Aboriginal stakeholders and OEH. The AHMP will include as a minimum:

- Protection of sites prior to salvage and impact;
- Protection of sites that are not impacted by the Project by means of fencing and management controls;
- Detailed salvage methodologies to be carried out prior to impact;
- Development of protocols for the monitoring of earth works, as required; and
- Identification of the storage location and procedure for the care and control of salvaged artefacts in accordance with the Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales (DECCW 2010b).

Aston will fund and construct a Keeping Place during the period of the Project. The Keeping Place will be developed in consultation with other mines in and adjacent to the Leard State Forest, the Aboriginal community and OEH. It will house the artefacts salvaged as part of the Project.

The Keeping Place will be accessible to appropriately trained Aboriginal Community Representatives, or those otherwise agreed with the Keeping Place management team.

Aston will also offer training for one member of each of the registered Aboriginal stakeholder groups for the Project in relation to site recording and artefact recording and basic analysis. It will also support the opportunity for one representative of the Aboriginal community to be a member of the Maules Creek CCC.

7.9 NON INDIGENOUS HERITAGE

An assessment was undertaken by Archaeology Australia to determine the potential impacts of the Project on Non Indigenous Heritage items identified within and adjacent to the Project Boundary. A summary of this assessment is provided below while the full report is reproduced in **Appendix K**.

7.9.1 Background

An historical overview of the area provides an indication of the land use of the region and how this has been developed. The first European to explore the area was John Oxley, who crossed the Liverpool Plains in 1817 and reached the Nandewar Range in 1818.

The first settler in the area was George Clarke who was more commonly referred to as the 'Barber'. George Clarke was an escaped convict, and by 1825 was living to the north of where the township of Boggabri is now located. Clarke assimilated with the local Aboriginal people until his capture and subsequent hanging for his crimes.

Barber's Pinnacle and Barber's Lagoon are two local landmarks that bear his name.

Following early exploration of the area by Major Thomas Mitchell, the first known squatter in the vicinity of the Project Boundary was Edward Cox who took up residence in the 'Namoi Hut' in 1835.

The original homestead was established about 20 km to the south of the Project Boundary on the Namoi River. However severe flooding destroyed this settlement in the 1850's. The new site was that of 'Namoi Hut', located on higher ground around the confluence of the Namoi River and Cox's Creek. The site was later to become the township of Boggabri.

By 1847 the number of squatters in the area had increased with each having exceptionally large landholdings, the largest being 'Gullendaddy' consisting of 162,560 acres.

Early agriculture was primarily associated with sheep and cattle grazing and as land was cleared the timber was used for the construction of buildings and stock yards.

Table 34 Project Impacts on Aboriginal Artefacts

SITE TYPE	SITE NAME	SCIENTIFIC SIGNIFICANCE	PROJECT IMPACT	MANAGEMENT
Artefact Scatter	Leard SF AS1	High	Open Pit	Salvage Excavation
	MC13	High	Rail Spur	Salvage Excavation
	MC14	High	Rail Spur	Salvage Excavation
	Manila MC21	Moderate	Open Pit	Surface Collection of Artefacts
	MC5	Moderate	Overburden Area	Surface Collection of Artefacts
	Leard SF AS2	Low	Open Pit	Surface Collection of Artefacts
	Teston AS3	Low	Overburden Area	Surface Collection of Artefacts
	Teston AS6	Low	Overburden Area	Surface Collection of Artefacts
	Teston AS1	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	NV23	Low	Rail Spur	Surface Collection of Artefacts
	MC11	Low	Rail Spur	Surface Collection of Artefacts
	MC8	Moderate	Rail Spur	Surface Collection of Artefacts
	MC7	Moderate	Rail Spur Option	Surface Collection of Artefacts
	Manila MC15	Moderate	Open Pit	Surface Collection of Artefacts
	Teston AS2	Low	Project Disturbance Boundary	Site to be fenced
	MC10	Low	Rail Spur	Site to be fenced
	HRNV21	Low	Rail Spur Option	Site to be fenced
	Back Creek AS1	Moderate	Not Impacted	Site to be fenced
	Back Creek AS2	Moderate	Not Impacted	Site to be fenced
	Back Creek AS3	High	Not Impacted	Site to be fenced
	Back Creek AS4	Low	Not Impacted	Site to be fenced
	Back Creek AS5	Low	Not Impacted	Site to be fenced
	Back Creek AS6	High	Not Impacted	Site to be fenced
	MC23	Low	Rail Spur	Inspection during salvage to determine extent
	MC24	Low	Rail Spur	Inspection during salvage to determine extent
	MC4	Moderate	Project Disturbance Boundary	Surface Collection of Artefacts
	MC6	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	MC2	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	MC3	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	Teston AS7	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	MC22	Moderate	Not Impacted	No Impact – No Further Requirements
	MC25	High	Not Impacted	No Impact – No Further Requirements
	NV20	Low	Not Impacted	No Impact – No Further Requirements
	NV22	Low	Not Impacted	No Impact – No Further Requirements
	NV43	Low	Not Impacted	No Impact – No Further Requirements
	NV 44	Low	Not Impacted	No Impact – No Further Requirements
	NV45	Low	Not Impacted	No Impact – No Further Requirements
	NV46	Low	Not Impacted	No Impact – No Further Requirements
	NV47	Low	Not Impacted	No Impact – No Further Requirements
	NV48	Low	Not Impacted	No Impact – No Further Requirements
	NV75	Low	Not Impacted	No Impact – No Further Requirements
	Teston AS4	Moderate	Not Impacted	No Impact – No Further Requirements
	Teston AS5	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS1	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS2	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS3	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS4	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS5	Low	Not Impacted	No Impact – No Further Requirements

SITE TYPE	SITE NAME	SCIENTIFIC SIGNIFICANCE	PROJECT IMPACT	MANAGEMENT
	Velyama AS6	Low	Not Impacted	No Impact – No Further Requirements
	Velyama AS7	Low	Not Impacted	No Impact – No Further Requirements
	MC12	Moderate	Not Impacted	No Impact – No Further Requirements
	MC9	Low	Not Impacted	No Impact – No Further Requirements
Isolated Artefact	Leard SF IA1	Low	Open Pit	Surface Collection of Artefacts
	Leard SF 4	Low	Overburden Area	Surface Collection of Artefacts
	Leard SF IA2	Low	Overburden Area	Surface Collection of Artefacts
	Teston IA2	Low	Overburden Area	Surface Collection of Artefacts
	Teston IA3	Low	Overburden Area	Surface Collection of Artefacts
	Teston IA4	Low	Overburden Area	Surface Collection of Artefacts
	Teston IA5 (1)	Low	Overburden Area	Surface Collection of Artefacts
	Leard SF 3	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	Teston IA1	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	Teston IA6	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	Teston IA7	Low	Project Disturbance Boundary	Surface Collection of Artefacts
	Back Creek IA1	Low	Not Impacted	Site to be fenced
	Back Creek IA2	Low	Not Impacted	Site to be fenced
	Teston IA5 (2)	Low	Not Impacted	No Impact – No Further Requirements
	Teston IA8	Low	Not Impacted	No Impact – No Further Requirements
	Teston IA9	Low	Not Impacted	No Impact – No Further Requirements
	Velyama IA1	Low	Not Impacted	No Impact – No Further Requirements
	Velyama IA2	Low	Not Impacted	No Impact – No Further Requirements
	Velyama IA3	Low	Not Impacted	No Impact – No Further Requirements
	Velyama IA4	Low	Not Impacted	No Impact – No Further Requirements
	Velyama IA5	Low	Not Impacted	No Impact – No Further Requirements
Scarred Tree	Teston ST2	Moderate	Overburden Area	Removal of Scarred Tree
	Leard SF ST1	High	Open Pit	Removal of Scarred Tree
	Leard SF ST2	Moderate	Open Pit	Removal of Scarred Tree
	Teston ST1	Moderate	Rail Spur	Removal of Scarred Tree
	Younger ST1	Moderate	Overburden Area	Removal of Scarred Tree
	Watsons ST1	Moderate	Project Disturbance Boundary	Removal of Scarred Tree
	NV37	TBD	Rail Spur	Inspection during salvage to determine extent
	NV34	High	Rail Spur Option	Site to be fenced
	Namoi River TSR ST3	High	Water Pipeline	Site to be fenced
	Namoi River TSR ST4	High	Water Pipeline	Site to be fenced
	Namoi River TSR ST5	High	Water Pipeline	Site to be fenced
	Namoi River TSR ST6	High	Water Pipeline	Site to be fenced
	Namoi River TSR ST7	High	Water Pipeline	Site to be fenced
	Namoi River TSR ST8	High	Water Pipeline	Site to be fenced
	NV36	Moderate	Not Impacted	No Impact – No Further Requirements
	Namoi River ST1	High	Not Impacted	No Impact – No Further Requirements
	Namoi River TSR ST1	High	Not Impacted	No Impact – No Further Requirements
	Namoi River TSR ST2	High	Not Impacted	No Impact – No Further Requirements
	Namoi River TSR ST9	High	Not Impacted	No Impact – No Further Requirements
	Velyama ST1	High	Not Impacted	No Impact – No Further Requirements
	NV76	Moderate	Not Impacted	No Impact – No Further Requirements
Grinding Groove	Teston Grindstone 1	High	Rail Spur	Surface Collection of Artefacts
	Teston GG2	High	Rail spur Option	Surface Collection of Artefacts
	Teston GG1	Moderate	Rail spur Option	Community Consultation if Impacted

Wool was an important resource and the 'Gullendaddy Woolshed' is a testament to those activities with over 40,000 sheep shorn annually during the 1860's. Crops were raised from the period of early settlement with much of the produce for local consumption. The first commercial crops were planted around 1890 and the area under cultivation increased over time; in 1907, 18,436 bushels of wheat were harvested in the Boggabri district and by 1939 this had increased to 1,804,073 bushels. A flour mill began operations in 1910 and grain silos were opened at Boggabri in 1944.

During the 20th century, intensive irrigation schemes were introduced in the area which resulted in cotton becoming a major income producer in the surrounding areas. Logging has been carried out in the local forests (including Leard State Forest) since the time of settlement, however has never been a major industry in the area. The Pilliga Forest was the principal forest in the region although Leard State Forest was dedicated as a forest reserve in 1878 (declared then as the Back Creek Forest Reserve).

7.9.2 Methodology

This assessment was undertaken in accordance with the *NSW Heritage Office guidelines for heritage impact studies* (NSW Heritage Office, 2001), the *NSW Heritage Manual* (NSW Heritage Council 1996) and the NSW Heritage Branch Department of Planning 2009 publication, *Assessing Significance for Historical Archaeological Sites and 'Relics'*.

The methodology for the assessment consisted of several components to ensure that all relevant Non Indigenous heritage items that had a potential to be impacted by the Project were identified and assessed and included:

- Review of historical and archival research and searches of the relevant Commonwealth and State heritage lists to identify any known heritage items of significance within 2 km of the Project Boundary that may have the potential to be impacted by the Project. No items of heritage significance were identified during these searches;
- Discussions with local residents and members of the Boggabri Historical Society to ascertain any knowledge in relation to the historical significance of the area within the Project Boundary; and
- A field survey undertaken from 13 to 18 October 2010 by Dr. Jennifer Lambert Tracey and Dr Michael MacLellan Tracey (for Archaeology Australia) over the areas identified as having the potential to contain evidence of any historical items of interest, based on the devised predictive model and information obtained during the course of the historical and archival research.

Two levels of significance exist in the NSW heritage management system: Local and State. **Table 35** illustrates the significance assessment criteria that have been utilised for the assessment of cultural heritage significance for items and places within and adjacent to the Project Boundary.

Impact Assessment

The Non Indigenous Heritage Assessment did not identify any items of Non Indigenous heritage significance within the Project Boundary. Items of heritage significance identified in proximity to the Project Boundary are shown on **Figure 28**.

A total of five sites were identified in proximity to the Project Boundary and are listed in **Table 36**. All sites are located outside the Project Boundary and will not be impacted by the Project.

7.9.3 Mitigation and Management

No identified Non Indigenous heritage items will be impacted as a result of the Project. As such, no management or mitigation measures are required for the identified sites. As part of its EMS, Aston will develop a Non-Indigenous management procedure to ensure:

- If any previously unidentified relic is found, it will be reported to the Heritage Council of NSW in accordance with **Section 1**46 of the Heritage Act;
- The Velyama Homestead, Shearing Shed and Burial Ground will be managed in relation to each other in order to preserve the aesthetic integrity and the contextual relationship between all three sites; and
- As part of its EMS, Aston will ensure the preservation of the archaeological and cultural significance of the sites, in particular works to minimise any loss deterioration or damage to the Burial Yard.

Table 35 NSW Heritage Significance Criteria

GRADING	JUSTIFICATION
State Heritage Significance	In relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item (NSW Heritage Branch 2009).
Local Heritage Significance	In relation to a place, building, work, relic, moveable object or precinct, means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item (NSW Heritage Branch 2009)

Table 36 Non Indigenous Heritage Sites

SITE NAME	SITE DESCRIPTION	SIGNIFICANCE
Velyama Homestead Site	Archaeological site of the former residence of Colonial artist, Blagden Chambers and family. Extensive exotic plants, native shrubs, fruit trees remain in the garden	Local Significance
Velyama Shearing Shed	Extant shearing shed and shearing plant. Wool press c. 1904 and evidence of Wool bale mark. Wool wash and yards (recently demolished)	Local Significance
Velyama Burial Ground	Graves of Blagden Chambers and his family – enclosed with modern stock fence	Local Significance
Warriahdool Hut	Corrugated iron and timber hut c.1940. Associated archaeological features of habitation: earth floors, pit toilets, collapsed stone fireplaces, and scattered artefact material c.1930 – 1950	Local Significance
Therribri Homestead Site	Homestead site c.1897 (archaeological integrity destroyed), house removed, concrete tank and scattered bricks / timber remaining	Local Significance

Aston will compile an Oral History Report for any land owners which are identified to be adversely impacted by the Project in **Section 7.1.3** or **Section 7.3.3** and who are to be acquired by Aston in accordance with the conditions of Project Approval. A copy of the Oral History Report will be provided to the landholders who participated, DP&I and the Boggabri Historical Society.

7.10 SURFACE WATER

A surface water impact assessment has been undertaken for the Project by WRM Water & Environment and is included in full in **Appendix L**. The assessment incorporates a review of the existing catchments, the layout of the proposed water management system, consideration of the proposed infrastructure and an overall water balance for the various years of the Project. A summary of this assessment is provided in the following sections.

7.10.1 Background

Catchment Description

The Project is located on the southern side of Back Creek, a tributary of Maules Creek. Maules Creek drains to the west into the Namoi River about 10 km to the west of the Project Boundary and 30 km to the south-east of Narrabri. Flow in the Namoi River is regulated by releases from Keepit Dam, a 420 Gigalitre storage facility located about 50 km south-east of Boggabri. The Namoi River has a catchment area of about 22,600 km^2 to Boggabri and consists of an incised main channel that meanders across a wide alluvial floodplain.

Back Creek which adjoins the northern side of the Project Boundary has a catchment area of approximately 44 km^2 to the upstream and 63 km^2 to the downstream or western end of the Project Boundary.

The land surrounding Back Creek has been fully or partially cleared for agricultural purposes. Back Creek is an ephemeral creek and flows only for short periods after intensive rainfall.

The main areas of disturbance resulting from the Project include the Northern OEA and open cut pit which are drained by numerous small tributaries of Back Creek which flow northwards from the Willow Tree Range through the Leard State Forest (see **Figure 1**). The Project Boundary also includes some small gully catchments on the southern side of Willow Tree Range which drain southwards to the Namoi River floodplain.

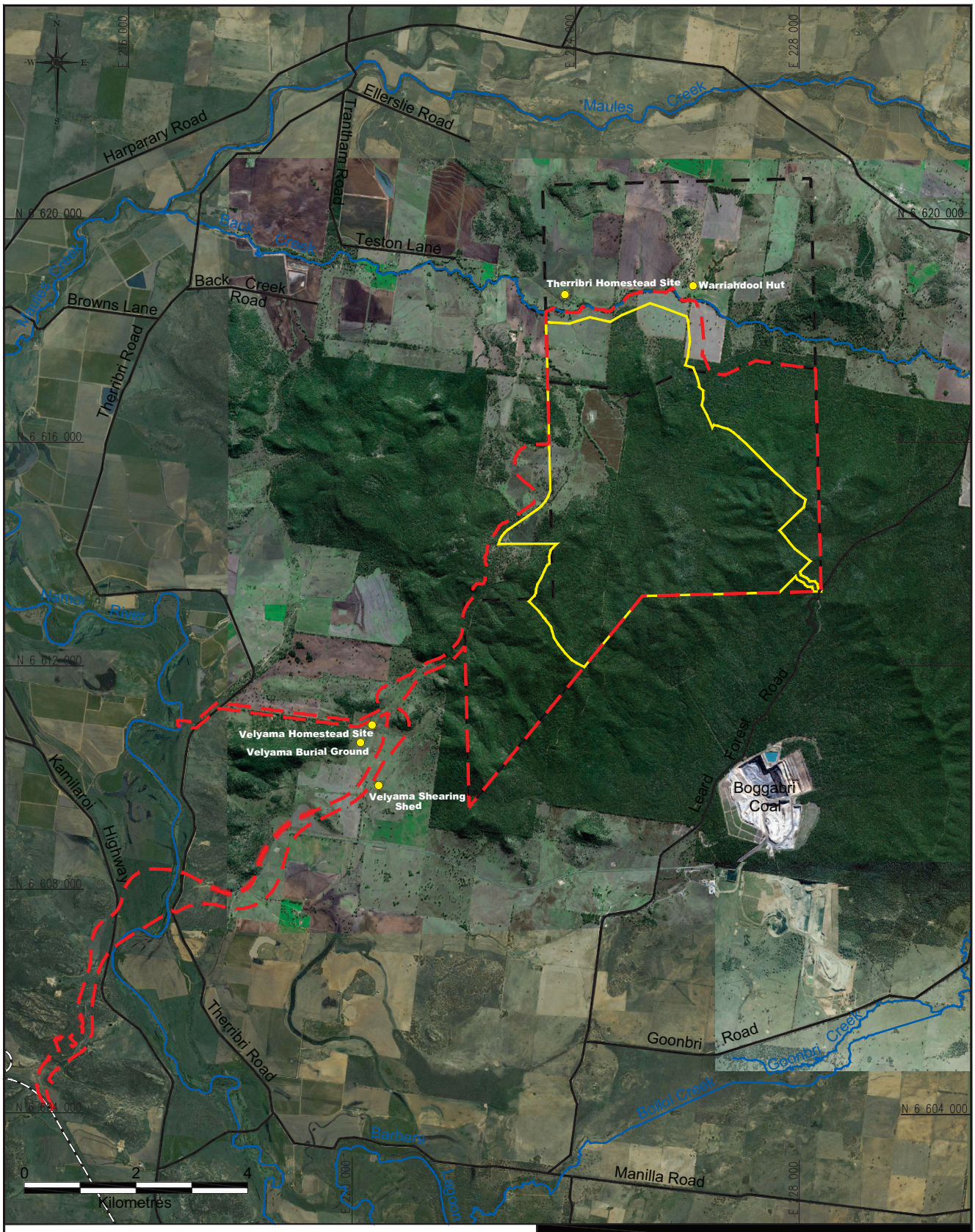
All tributaries draining from the Project Boundary are ephemeral. The Development Dam (see **Figure 5**), constructed as part of DA 85/1819 has a capacity of approximately 42 ML. The Development Dam has been constructed along one of the tributaries of Back Creek and has a catchment area of about 9.4 km^2.

Existing Water Use Entitlements

The Project Boundary is located within the Lower Namoi Regulated River Water Source which extends from Keepit Dam to the Barwon River.

Flows in this reach of the Namoi River are regulated by the WSP for the Lower Namoi River Water Sources (Namoi WSP) which allows for the authorised extraction of water from the Namoi River in accordance with an access licence. Aston holds a high security water allocation in the Lower Namoi; being 3,000 unit shares of a total 3,418 unit shares. High security licences have a higher priority allocation of water than general security licences.

Back Creek and Maules Creek are not regulated systems. Landholders along these creeks access surface water for stock and domestic purposes.


Harparary Road
Ellerslie Road
Maules Creek
Traintham Road
Teston Lane
Back Creek
Back Creek Road
Browns Lane
Therribri Road
Therribri Homestead Site
Warriahdool Hut
Namoi River
Velyama Homestead Site
Velyama Burial Ground
Velyama Shearing Shed
Kamilaroi Highway
Leard Forest Road
Boggabri Coal
Goonbri Road
Goonbri Creek
Barbers Lagoon
Bohol Creek
Manilla Road
N 6 620 000
N 6 616 000
N 6 612 000
N 6 608 000
N 6 604 000
E 216 000
E 224 000
E 228 000
0
2
4
Kilometres
Project Boundary
Mining Tenement Boundary
Roads
Rivers and Creeks
Werris Creek to Mungindi Railway
Project Disturbance Boundary
Non Indigenous Heritage Site
Hansen Bailey
ASTON RESOURCES
Co-ordinate System: MGA 94 Zone 56
Source: Aston 2005, 2010, Archaeology Australia 2010
MAULES CREEK COAL PROJECT
Non Indigenous Heritage
Cad File: 06987F.dwg
Date: 25.03.11
Drawn: CP
Figure 28

Existing Water Quality

Water quality data available for the Namoi River at the Turrawan gauging station was reviewed for the period 15 October 1976 to 28 October 1986. The Turrawan gauging station is located about 15 km downstream of the Maules Creek confluence. The review of the monitoring results confirmed the exceedance of the default trigger values under ANZECC and ARMCANZ (2000) as follows: 87% of the time for electrical conductivity (EC); 50% of the time for pH; and 17% of the time for turbidity.

Additional water quality monitoring was undertaken at 22 sites throughout the Namoi River catchment during 2000 and 2001 (DLWC, 2002). Data from three water quality monitoring sites including at the Namoi River at Gunnedah, Coxs Creek at Boggabri and Narrabri Creek (Namoi River) at Narrabri are of relevance to regional water quality in the vicinity of the Project Boundary (see **Figure 6**). Of the samples tested, the ANZECC and ARMCANZ default trigger values for EC were exceeded 100% of the time at the two Namoi River stations and 97% of the time at the Coxs Creek station. The default trigger value for turbidity was exceeded between 69% and 88% of the time at the three locations and total phosphorus (TP) was exceeded between 97% and 100% of the time.

In order to derive a relationship between water quality and flow rates in the Namoi River, continuous water quality data measuring EC was analysed from the Gunnedah gauging station.

The available water quality data for the Namoi River at Gunnedah indicates that:

- EC varies between 200 μS/cm and 1,200 μS/cm at Gunnedah with the majority of elevated EC values occurring when flows are lower than 1,000 ML/day;
- There is a strong relationship between flow rate and EC with high flows, associated with floods, measuring lower EC values;
- Higher EC values tend to occur when there are limited releases from Keepit Dam to supply the downstream irrigation demand and the majority of the flow is being generated from the Peel and Mooki Rivers which join the Namoi between Keepit Dam and Gunnedah. This generally occurs during the winter months; and
- Elevated EC values can occur for many months during low flow periods.

Analysis of water quality data in the local catchment indicates consistently low EC values for Back Creek and for local catchments draining the site. Also demonstrated is slightly lower pH values in the site catchments (6.8 to 7.2) compared to Back Creek (7.3) and the Namoi River (7.6 to 8.4). Recorded Total Suspended Solids (TSS) values for Back Creek are high with median values of 2,060 mg/L and upper values above 11,000 mg/L.

Site catchment TSS values are high, but not as high as Back Creek. The reasons for the high TSS levels from onsite catchments and Back Creek are uncertain.

Proposed Water Management Infrastructure

The key objective of the Water Management System will be to keep fresh water separate from poorer quality mine water. Further, the poorer quality water will be prioritised for use over extracting water from external sources. As illustrated in **Figure 9** to **Figure 13**, the main components of water-related infrastructure for the Project include:

- Sediment dams to collect and treat runoff from the OEAs;
- Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams;
- Clean water drains to divert runoff from undisturbed catchments through areas disturbed by mining;
- A Raw Water Dam to store fresh water from the Namoi water supply pipeline;
- Mine Water Dams to store water pumped out of the mining area. The Mine Water Dam will also collect runoff from the CHPP and coal stockpile area, as well as decant water from the tailings drying area. The Mine Water Dams will be the first priority water source for road watering and CHPP water demands; and
- Highwall Dams to collect runoff from undisturbed catchments draining towards the mining area which will be diverted into the clean water drains to divert runoff around operations.

All water management structures will be suitably engineered to the standard required to safely capture, storage and divert water of various qualities and avoid adverse impacts to the neighbouring environment.

The Project also includes the construction and operation of a water supply pipeline from the Namoi River to meet water demands on site that cannot be met through recycling of water captured onsite.

7.10.2 Modelling Methodology

Site Water Balance

A long term water balance analysis has been undertaken which aimed to assess the performance of the site water management system under a range of climatic conditions. The GoldSim software (developed by GoldSim Technology Group) was used to simulate the water balance of the mine on a daily basis over the 21 year life of the Project. The model was configured to represent the inflows to and outflows from the mine water management system (as shown in **Table 37**) and transfers of water between the various mine site storages.

Table 37 Simulated Inflows and Outflows to Mine Water Management System

INFLOWS	OUTFLOWS
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	CHPP demand
Groundwater inflows to open cut pit	Dust suppression demand
Raw water supply from Namoi River	Vehicle washdown
	Pumped outflows from highwall dams
	Offsite spills from storages

To assess the performance of the water management system under a range of climatic conditions, water balance modelling was undertaken using a set of 89, 21 year rainfall sequences, extracted from recorded historical data.

The water balance model was configured to represent the changing characteristics of the mine water management system over the 21 year mine life, including the addition of new storages and changes in contributing catchment areas and catchment types as represented in the mine plans.

Figure 29 provides a conceptualisation of the water balance model. **Table 38** outlines the storage details adopted in the site water balance model. The adopted water demand for the CHPP was based on an assumed water requirement of 200 L per ROM coal tonne, with production increasing from 4 Mtpa in Year 1 to 13 Mtpa by Year 5.

Water demand for the haul road dust suppression was calculated using historical rainfall and evaporation data. The formulas used to calculate the daily demand are:

- Daily Haul Road water demand = max (0, Evaporation – Rainfall) x Haul Road Surface Area; and
- Haul Road Surface Area = Haul Road Length x 30 m.

The water demand for the vehicle washdown area was adopted at 90 ML/annum (~0.25 ML/day).

The water balance model incorporated the Australian Water Balance Model (AWBM) to simulate catchment runoff inflows to the mine water management system. Separate AWBM model parameters were developed for the following catchment types:

- Natural (undisturbed catchments and fully rehabilitated spoil);
- Compacted areas (haul roads, pit floor, mine infrastructure); and
- Spoil (non-rehabilitated OEAs).

Further detail of modelling assumptions and calibration can be found in **Appendix L**. A summary of estimated water demands for the Project is discussed further below. The predicted groundwater inflows to the mining void were obtained from the Project's groundwater impact assessment as discussed in **Section 7.11**.

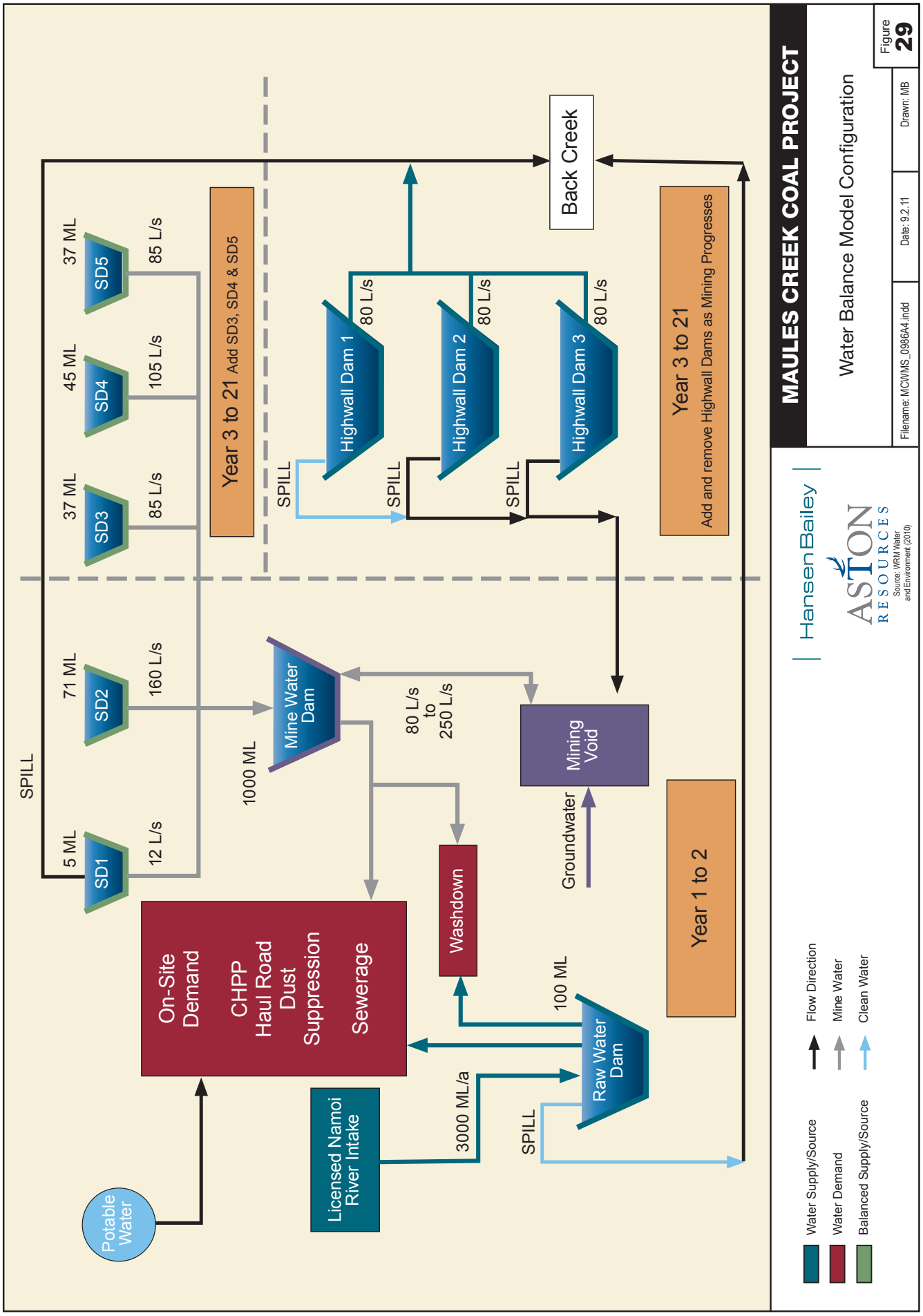
Flooding

The potential for impacts upon flooding has been investigated for Back Creek (adjacent to the proposed Northern OEA) and the Namoi River (where the proposed pump station, Rail Spur and Mine Access Road are to be constructed on the floodplain) to confirm any possible impacts upon the flooding regime of these two waterways.

The Rational Method was used to estimate 100 year Average Recurrence Interval (ARI) design flood discharges in Back Creek along the reach adjacent to the proposed Northern OEA.

Table 38 Indicative Water Storages for Modelling

STORAGE	CAPACITY (ML)	MAXIMUM SURFACE AREA (ha)
Raw Water Dams	100	6.0
Mine Water Dam	1000	16.5
SD1	5	0.8
SD2	71	3.2
SD3	37	3.4
SD4	45	2.9
SD5	37	3.0
Highwall Dam 1	80	2.8
Highwall Dam 2	100	4.1
Highwall Dam 3	60	2.3


MAULES CREEK COAL PROJECT
Water Balance Model Configuration
Figure 29
Filename: MCWMS_09864A4.indd
Date: 9.2.11
Drawn: MB
HansenBailey
ASTON RESOURCES
Source: WRM Water and Environment (2010)
Water Supply/Source
Water Demand
Balanced Supply/Source
Flow Direction
Mine Water
Clean Water
Potable Water
On-Site Demand
CHPP
Haul Road Dust Suppression
Sewerage
Licensed Namoi River Intake
3000 ML/a
Raw Water Dam
100 ML
SPILL
Washdown
Mine Water Dam
1000 ML
80 L/s to 250 L/s
Mining Void
Groundwater
Year 1 to 2
Year 3 to 21
Add and remove Highwall Dams as Mining Progresses
Back Creek
Highwall Dam 1
Highwall Dam 2
Highwall Dam 3
80 L/s
SPILL
Year 3 to 21 Add SD3, SD4 & SD5
SD1
5 ML
12 L/s
SD2
71 ML
160 L/s
SD3
37 ML
85 L/s
SD4
45 ML
105 L/s
SD5
37 ML
85 L/s
SPILL

Discharges were estimated at the upstream and downstream locations where the Project Boundary is closest to Back Creek. Rational Method parameters were estimated using the recommended methodology in Australian Rainfall and Runoff (IEAust 1998) for eastern NSW.

The rail spur and Mine Access Road to be constructed by the Project will cross the Namoi River and its associated floodplain. A review of the flooding impact assessment presented in the Boggabri EA (Hansen Bailey 2010) was undertaken to confirm impacts should the Boggabri rail spur be utilised for the Project. Should the alternative route as presented within this EA be utilised, a detailed flooding assessment will be undertaken to ensure the final design minimises any potential impacts on flood flow patterns and flood levels.

Final Void Water Balance

An assessment of the conceptual final void was undertaken to confirm levels and quality of the water within the final landform, should mining not continue beyond the 21 years.

The water balance of the conceptual final void included a consideration of:

- Long term synthetic 1,000 year rainfall sequence;
- Open water evaporation, applying a reduction factor to the open water evaporation to account for the reduction in evaporation at depth in the Conceptual Final Void;
- A stage-area-volume relationship for the Conceptual Final Void derived from design elevation data for the conceptual final landform;
- Estimated long term groundwater inflows into the void (see **Section 7.11.3**); and
- Surface runoff inflows estimated using the synthetic 1,000 year rainfall sequence and catchments that are likely to drain into the Final Void, including:
  - Surface area of water in the void which varies with elevation based on the stage-area relationship;
  - Surface water runoff into the void; and
  - Infiltration through spoil into the void.

A salt balance was undertaken to assess the likely change in water quality within the conceptual Final Void over time. The salt balance was undertaken by assigning a representative concentration of TDS to the various inflows to the final void, including direct rainfall, surface runoff, infiltration and groundwater.

The analysis assumed instantaneous full mixing of water from all sources and assumed no loss of salt mass from the conceptual Final Void which is considered conservative.

The assumptions for salt concentrations for various sources of water to enter the final void were derived from the findings of the Geochemical Impact Assessment of the Project as discussed further in **Section 7.12**.

7.10.3 Impact Assessment

The potential impacts of the Project on the local and regional surface water resources include:

- Impacts on water availability in the Namoi River due to operational water requirements of mining operations;
- Adverse impacts on the quality of natural surface runoff draining from the local onsite catchments to Back Creek;
- Loss of catchment area draining to Back Creek due to capture of runoff within onsite storages and the open cut pit. This could potentially reduce runoff volumes to Back Creek;
- Interference with flood flows along Back Creek;
- Impacts associated with the proposed pump station on the Namoi River and water supply pipeline; and
- Flood and drainage impacts associated with the proposed Rail Spur and the Mine Access Road to the Project.

Catchment Changes

Alteration to the natural drainage system will occur within the Project Boundary as the mine water management system captures runoff which would have previously flowed to Back Creek. The captured catchment area will change as the mine develops and progresses over time.

Table 39 shows the catchment area captured within the mine water management system for the various stages of Project development. The maximum catchment area draining to the mine water management system is approximately 1,590 ha in Year 5, which represents approximately 25% of the catchment area of Back Creek to the downstream (D/S) boundary of the Project Boundary. This area captured also represents approximately 2.1% of the total Maules Creek catchment. By Year 10, the catchment from the Northern OEA will be allowed to be released back into the Back Creek catchment after treatment in sediment dams. This is reflected in the numbers within **Table 39**. Based on median rainfall and runoff rates, the volume of surface runoff captured within the mine water management system will vary between about 340 ML and 875 ML per year. However, this will vary from year to year based on climatic conditions and the progress of mining. Aston will seek the relevant licence to account for its loss to this water source.

Flooding

A flood study was undertaken to determine the extent of flooding along Back Creek and to quantify any impacts of the Project on flood levels and flood behaviours.

The proposed limit of disturbance of the Project is outside the 100 year ARI flood extent (see **Figure 6**). Hence, the Project is not likely to have an adverse impact on flood levels or flood behaviour along Back Creek for events up to the 100 year ARI event.

A previous study undertaken for the Boggabri EA was reviewed and applied to the Project for this assessment. Should the Boggabri Coal rail spur be utilised for the Project, no additional environmental impacts are anticipated. Otherwise the final designs of the rail spur will be designed and constructed in accordance with the relevant Governmental standards following flood modelling to minimise aflux upstream of these structures.

Simulated Water Balance

Table 40 provides predicted water inflows and outflows for the Project for Year 1, Year 5, Year 10, Year 15 and Year 21 for the 89 year sequence with median runoff inflows.

The annual volumes of makeup water required from the Namoi River pipeline vary for each year of operation from the 89 climatic scenarios modelled. In very wet years, it may be possible to obtain all water requirements for the mining operations from local runoff and groundwater inflows. However, during average years it is predicted that annual volumes in the order of 1,000 to 1,800 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP. The simulation showed that during dry years, around 2,000 to 2,500 ML would be required from the River. The maximum simulated water requirement from the Namoi River for any year was 2,730 ML, which is less than Aston's existing high security water allocation.

Table 39 Catchment Area within Mine Water Management System

YEAR	CAPTURED CATCHMENT AREA (ha)				PROPORTION OF BACK CREEK CATCHMENT AREA TO THE D/S PROJECT BOUNDARY
	NORTHERN OEA	OPEN CUT PIT	MIA / STOCKPILE / RAW WATER DAM	TOTAL	
1	250	239	125	614	9.7%
5	605	860	125	1,590	25.1%
10	274	975	125	1,374	21.7%
15	222	917	125	1,264	19.9%
21	222	774	125	1,121	17.7%

Table 40 Water Balance Model Summary Results

DETAIL	SOURCE	ANNUAL VOLUME FOR REALISATION WITH MEDIAN RUNOFF (ML)				
		YEAR 1	YEAR 5	YEAR 10	YEAR 15	YEAR 21
Inflows						
Runoff and Direct Rainfall	All Catchments	694	1,233	1,103	1,109	1,115
Pipeline Water	Namoi Pipeline	290	1,620	1,860	920	2,090
Groundwater Inflow	Pit	175	36	350	1,107	257
Outflows						
Evaporation	All Water Storages	60	47	39	70	37
Overflows	Raw Water Dam and Sediment Dams	20	9	11	18	18
Pumped Offsite	Highwall Dams	0	88	81	28	0
CHPP Demand	Total (Raw Water Dam and Mine Water Dam)	802	2,384	2,598	2,598	2,605
Dust Suppression Demand	Total (Raw Water Dam and Mine Water Dam)	80	328	453	489	574
Washdown Demand	RWD	91	91	91	91	91

Storage behaviours in the Mine Water Dams was investigated for the 89 climatic sequences over the Project life. The median over the 89 scenarios modelled indicated that stored volumes within the Mine Water Dams are likely to be less than 200 ML. However, the modelling indicates that the volume of these storages is sensitive to climatic conditions.

The simulation showed that during wet periods, the storage capacities of the Mine Water Dams are likely to be exceeded for around 7% of the mine life. Resulting from this, up to 600 ML of water may need to be stored within the Open Cut Pit for more than 5% of the mine life, should very wet climatic conditions be experienced. During average climatic conditions less than 200 ML of water is likely to be stored within the Open Cut Pit for 95% of the time.

Final Void Assessment

The model results indicate that should mining cease at year 21, the Final Void water level will rise quickly to a depth of about 60 m (160 mAHD). The rate of water level rise will slow as evaporation from the water surface comes closer to average inflows. The final steady-state water level of about 210 to 220 mAHD will not be reached until 300 to 400 years following the cessation of mining operations. The simulated long term water level is consistent with the equilibrium water level of 225 mAHD as derived in the groundwater impact assessment as discussed in **Section 7.11**. The steady state water level is more than 100 m below the overflow level of about 340 mAHD and as such, water will not spill from the Final Void.

The results of the salt balance indicate that the salinity in the Final Void will gradually increase over time. Due to the relatively low salinity of leachate and surface runoff, TDS will increase at a relatively slow rate of about 900 mg/L per 100 years. It will take more than 500 years for the void water to reach a salinity of 5,000 mg/L. The rising salinity level in the Final Void will have no adverse impact on surface water because the long term water level is more than 100 m below the overflow level.

Further, the groundwater will not be affected as the Final Void will remain as a groundwater sink.

Conclusion

In summary, the surface water impact assessment concluded:

- Net water demands for operation of the mine can be met through utilisation of the existing high security water licence held and as such no further water source is required;
- The Project will have no impact on flood behaviour along Back Creek for a flood event up to 100 year ARI;
- The proposed Rail Spur and Mine Access Road will be designed to ensure minimal impacts upon the flooding regime of the Namoi River;
- The proposed water management system will ensure the separation of clean and dirty water on the site and that no spills occur from the Mine Water Dam;
- Simulation of the water balance for the Final Void indicates that the water level will take several hundred years to reach an equilibrium level which will be more than 100 m below the overflow level; and
- Simulation of water quality in the Final Void indicates that salinity will gradually increase over time, however due to the low salinity of leachate and surface runoff, salinity will increase at a very slow rate with no adverse impact on surface water or groundwater to be experienced.

7.10.4 Mitigation and Management

As part of its EMS, Aston will develop a Water Management Plan for the construction and operation of the Project in accordance with its conditions of Project Approval, which shall include details of the mine site water management system (conceptually illustrated in **Figure 29**), a sediment and erosion control plan and a surface water monitoring program.

The mine site water management system will aim to segregate clean runoff, dirty runoff, mine water and contaminated water generated from rainfall events and mining operations as well as to avoid uncontrolled discharges from mine site storages. The mine site water management system will also aim to reuse as much contaminated water onsite as possible to meet dust suppression and CHPP demands to minimise the need for use of fresh water from the Namoi River.

Aston will develop a leading practice real time water management system at the site which shall include design to ensure runoff from disturbed areas is separated from clean area runoff and captured in sediment dams to encourage the settling of suspended solids.

Design of the site drainage infrastructure, such as clean and dirty water diversion drains, as well as erosion and sediment control measures, will be based on the recommended design standards in *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries* (DECC 2008a).

The main clean water drain through the mine site will be designed to convey clean water runoff at non-erosive velocities for flows up to the 20 year ARI peak stormwater discharge, with discharge capacity equal to the 100 year ARI discharge. To achieve these design objectives, the drain may require engineered drop structures and/or channel rock lining in steep sections. Site drainage will be designed to provide a stable long-term drainage network at the completion of mining.

Aston will develop a Water EMP to the approval of DP&I which shall include monitoring at sites upstream, onsite and downstream of mining operations and within sediment dams and mine water storages. The monitoring regime will be developed in consultation with OEH and undertaken in accordance with relevant licence conditions for parameters including pH, EC, TSS, turbidity, major anions, major cations, alkalinity and metals.

Surface water flows and seepage from the OEAs and areas where rejects have been emplaced will be monitored for pH, EC, TSS and dissolved metals (including arsenic, molybdenum and selenium). Water levels and / or any surface flows in Back Creek will also be monitored.

7.11 GROUNDWATER

A Groundwater Impact Assessment was undertaken for the Project by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE). A full copy of this report is provided in **Appendix M**. The objective of the study was to assess the impact of the Project on the groundwater regime and water users and to quantify predicted inflows into the mining area throughout the life of the Project.

7.11.1 Background

In order to adequately assess the potential impacts of the Project on the groundwater regime, it is important to understand the current conditions of the groundwater system. A brief outline to the existing groundwater system within and surrounding the Project Boundary is provided in the following sections.

Previous Groundwater Investigations

A number of hydrological studies were undertaken in the vicinity of the Project Boundary during the early 1980s to understand the surrounding hydrological regime and to assess the potential impacts of mining for inclusion within the Maules Creek EIS. These studies were undertaken by Coffey and Partners and generally involved the collection of baseline data from the region, consideration of potential water supplies from the surrounding alluvial groundwater aquifers, and the characterisation of the hydrogeology.

Other groundwater investigations have also occurred for the neighbouring mining operations, government organisations and neighbouring industry (including the Cotton Research Centre) which have been utilised to understand details about the groundwater regime in the vicinity of the Project Boundary. Monitoring locations are shown on **Figure 6**.

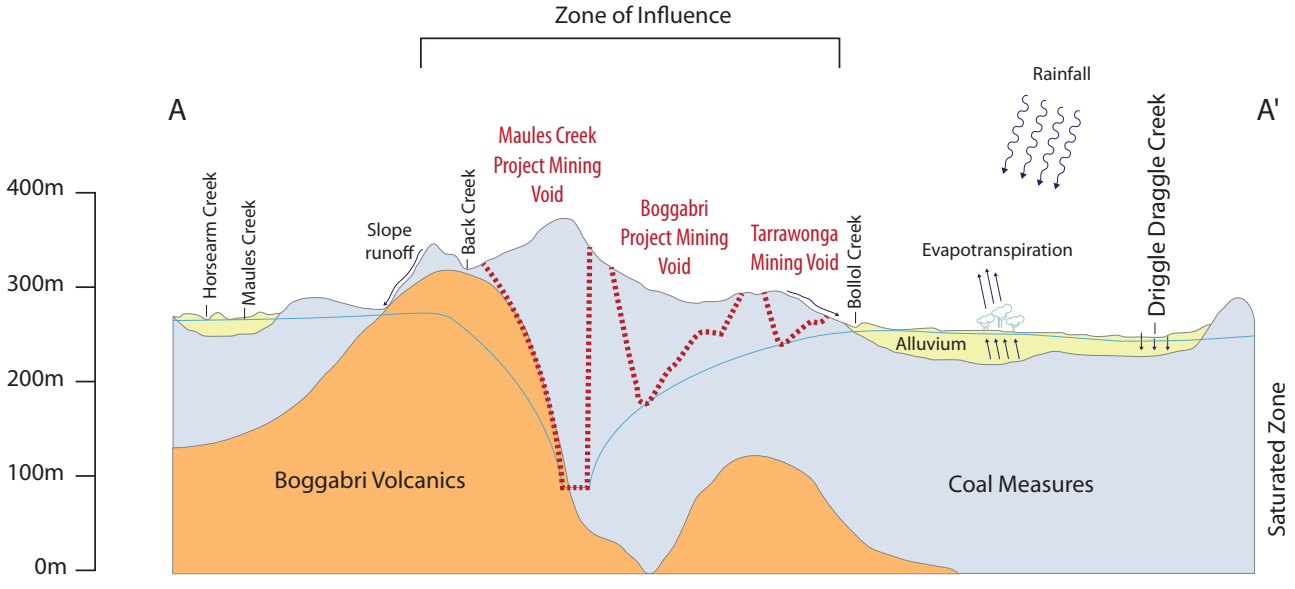
Existing Groundwater System

The regional groundwater system within the vicinity of the Project Boundary consists broadly of three aquifer systems:

- The extensive Namoi Valley alluvial aquifer system that is associated with the Namoi River floodplain and its tributaries (such as Maules Creek, Bollol Creek, Driggle Draggle Creek and Barneys Spring Creek);
- A thin veneer of weathered bedrock (regolith) near the ground surface; and
- Permian bedrock aquifers, in particular the coal seams of the Permian Maules Creek Formation.

A conceptual cross section of the three aquifer systems and how they are anticipated to interact is shown in **Figure 30**.

Figure 30 Cross Section – Main Aquifer Systems



Source: AGE (2011)

The Namoi Valley alluvial aquifer is a regionally significant groundwater resource being widely used for irrigation, stock watering, town water, domestic and industrial purposes. The alluvial aquifer to the south of the Project Boundary covers approximately 240 km^2.

Bollol Creek drains the upper northern portion of the alluvial plain with Driggle Draggle Creek and Barney's Spring Creek to the south. These creeks discharge to the Namoi River, which flows northerly through a productive alluvial plain. The alluvial lands narrow at Gins Leap and widen again beyond this area before merging with the Maules Creek alluvium.

The Maules Creek alluvials to the north of the Project Boundary is also divided into two distinct zones by a constriction in the floodplain created by an outcropping Permian basement. Upstream of this constriction, the Maules Creek alluvium covers an area of more than 90 km^2 and is drained by Horsearm Creek, Middle Creek and Maules Creek. Downstream of the constriction, Middle Creek and Horsearm Creek discharge into Maules Creek where a zone of permanent waterholes known as the Elfin Crossing is present.

The Namoi River alluvial aquifer has two stratigraphic units, the basal Gunnedah Formation and the overlying Narrabri Formation. The Narrabri Formation is up to 70 m thick and is comprised of clayey flood deposits with interbeded sand and gravel which typically form low yielding aquifers.

The underlying Gunnedah Formation is a productive aquifer used for irrigation, being up to 115 m thick and is dominated by sand and gravel deposits that fill paleo-channels. Finer grained sediments in the Narrabri Formation can act as a storage zone for salts with water quality varying from fresh to saline. The coarser sediments in the underlying Gunnedah Formation generally contain better quality low salinity groundwater.

The bedrock underlying the alluvial aquifers outcrop as distinctive, sometimes rugged hills surrounded by the generally flat to gently sloping plains of the Namoi Valley alluvial aquifer. The shallow bedrock aquifer is comprised of superficial soils and weathered rock. The shallow bedrock aquifer averages about 25 m in thickness and is sometimes up to 60 m thick within the Project Boundary. The shallow bedrock aquifer is generally dry in the elevated areas of the Leard State Forest, however acts as a temporary groundwater store during continued wet periods and provides recharge into the underlying fresh rock.

Rainfall recharge percolates downwards from the regolith at a reducing rate as increasing confinement and reducing permeability impede flow. This vertical flow regime is predominantly fracture flow, where pathways depend upon fracture and joint connectivity within the rock strata.

Investigations undertaken for the Maules Creek EIS in the early 1980s revealed that the sandstones and conglomerates in the sequence are tightly consolidated with very little primary porosity, secondary porosity is greater from weathering, faulting and jointing, the weathered profile is generally unsaturated and the coal seams are the main aquifers in the Permian Maules Creek Formation. Coal seams act as confined aquifers and have generally poor productivity in comparison to the Namoi Valley alluvial aquifer.

The coal seams are generally low yielding and contain poorer quality water compared to the Namoi Valley alluvial aquifer. Monitoring of bores intersecting the coal seams has found spatially variable water quality from fresh to slightly brackish.

The Permian Boggabri Volcanics form the basement to the overlying more productive aquifers and are generally recognised as a low permeability unit that typically does not supply useable volumes of groundwater.

Recharge to the Namoi Valley alluvial aquifer occurs through direct rainfall seepage, runoff from the surrounding hill slopes, and leakage from the beds of rivers and creeks. Recharge to the coal seam aquifer is through the outcrop and subcrop zones. The rate of recharge is highest over the alluvial deposits, at the contact zone between the hills and the floodplain and through the beds of ephemeral creeks.

Recharge is typically very low where the Permian bedrock outcrops as hills. The natural groundwater flow from the Permian aquifers in the outcropping hills is to discharge into the alluvial aquifers which in turn discharge to the Namoi River.

Existing Groundwater Users

In the vicinity of the Project Boundary, there are a number of land uses including agriculture (for irrigation and stock) and domestic bores which utilise water from alluvial aquifers as shown on **Figure 31**. In addition the neighbouring mines, Boggabri Coal Mine and Tarrawonga Mine, utilise groundwater for various activities in the mining process such as dust suppression.

7.11.2 Methodology

The key objectives of the study were to:

- Determine the existing groundwater environment and to identify any existing users and Groundwater Dependent Ecosystems (GDEs);
- Assess the cumulative impacts on groundwater that may arise from the Project, together with the existing and approved mines in the region;
- Complete detailed numerical modelling of potential groundwater impacts;
- Interpret data and report on groundwater seepage, drawdown and other impacts on connected groundwaters associated with the Namoi Valley alluvial aquifer;
- Describe any measures that would need to be implemented to avoid, minimise, mitigate and offset the impacts of the Project (subject to more effective measures being identified in the future); and
- Determine groundwater management and monitoring protocols to be adopted to meet licensing conditions.

Data necessary for the assessment of the groundwater regime was from historical groundwater reports for the Maules Creek Coal Project, databases of groundwater monitoring information, along with further field observations undertaken to support this information. Further drilling was undertaken during 2010 to better understand the groundwater regime across the Project Boundary. Additional groundwater monitoring bores were installed to facilitate an ongoing monitoring program. Shared geological and publically available hydrogeological data from the neighbouring Boggabri Coal Mine and Tarrawonga Mine were also used where relevant.

A numerical model was developed using the finite difference method using recent hydrology, hydrogeology and geological structure data.

The three-dimensional groundwater flow model (MODFLOW SURFACT) was used to simulate the impact of the Project (and other activities) on the groundwater regime over time. The modelling used conservative parameters and values and is considered to represent the worst case scenario for potential groundwater impacts resulting from the Project and other activities.

7.11.3 Impact Assessment

The groundwater modelling exercise simulated the existing conditions of the groundwater regime and provided predictions of the potential impacts of future mining activities.

Existing Mines and Industry Impacts

Mining activities at the Boggabri Coal Mine and Tarrawonga Mine have resulted in depressurisation of the coal seam aquifers. The adjacent Boggabri Coal Mine currently recovers coal from the upper Braymont, Bollol Creek, Jeralong and Merriown Seams. The Tarrawonga Mine extracts coal to the floor of the Nagero Seam. These mines are currently the main users of groundwater from the Permian Maules Creek Formation within the region.

As these mines are in relatively close proximity to each other, there is an interaction between the zones of depressurisation created by each mine. The combined zone of depressurisation created by dewatering of these two mines is creating a cumulative impact on groundwater levels.

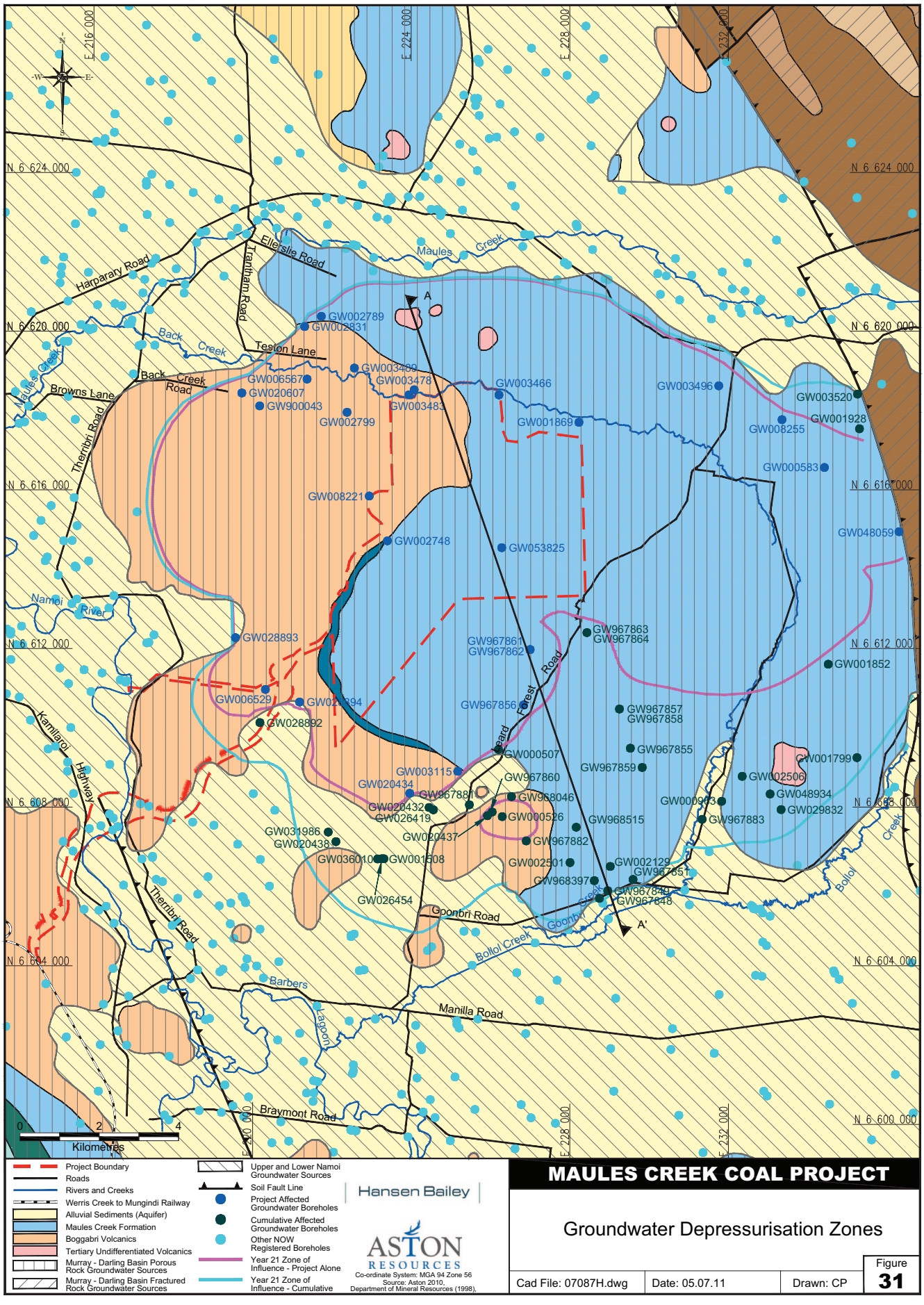
Predicted Project Impacts on Regional Groundwater System

Seepage of groundwater from the aquifers intersected during mining will reduce groundwater pressures in the coal seams and overburden / interburden aquifers around the open cut mining void. This will lower the water table of an unconfined aquifer or depressurise a confined aquifer, lowering the potentiometric surface. The numerical model developed considers the cumulative impact of the Project, the Boggabri Coal Mine and the Tarrawonga Mine on water levels in the regional groundwater system.

The model has predicted the development and magnitude of the zone of influence (also referred to as zone of depressurisation) for the Project. The zone of influence will propagate out from the highwall of the open cut void and gradually increase in size as mining progresses.

The depressurised zone (as indicated by the 1 m drawdown contour at the end of mining in Year 21) extends between 5 km and 7 km from the Project open cut pit as shown in **Figure 31**. The zone of influence largely remains within the Permian outcrop zone, but does extend slightly into the alluvial aquifer, in the south-west, where a thin zone of alluvium is present in a small valley extending into the outcropping hill.

As the alluvium thickens to the south-west, the transmissivity and ability to transmit water increases and the zone of influence does not extend beyond this point. The modelling indicates that the Project will not result in significant drawdown of groundwater levels in the Maules Creek alluvial aquifer. Therefore, the groundwater dependent vegetation identified along the creek alignment will not be impacted by the Project.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Maules Creek
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Ellerslie Road
Tarrtharm Road
Back Creek
Teston Lane
Back Creek Road
Browns Lane
Therribri Road
Namoi River
Kamilaroi Highway
Goonbri Road
Bollol Creek
Barbers Lagoon
Manilla Road
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GW001508
GW002501
GW002129
GW967651
GW968397
GW967849
GW967848
GW026454
0
2
4
Kilometres
Project Boundary
Roads
Rivers and Creeks
Werris Creek to Mungindi Railway
Alluvial Sediments (Aquifer)
Maules Creek Formation
Boggabri Volcanics
Tertiary Undifferentiated Volcanics
Murray - Darling Basin Porous Rock Groundwater Sources
Murray - Darling Basin Fractured Rock Groundwater Sources
Upper and Lower Namoi Groundwater Sources
Soil Fault Line
Project Affected Groundwater Boreholes
Cumulative Affected Groundwater Boreholes
Other NOW Registered Boreholes
Year 21 Zone of Influence - Project Alone
Year 21 Zone of Influence - Cumulative
Hansen Bailey
ASTON RESOURCES
Co-ordinate System: MGA 94 Zone 56
Source: Aston 2010, Department of Mineral Resources (1998),
MAULES CREEK COAL PROJECT
Groundwater Depressurisation Zones
Cad File: 07087H.dwg
Date: 05.07.11
Drawn: CP
Figure 31

Pit Inflows

The predicted cumulative inflow of groundwater over the life of the mine is approximately 11,540 ML, which is an average of 550 ML/yr over the 21 years of mining. **Table 41** shows the predicted groundwater inflows into the Project mining void for Years 5, 10, 15 and 21.

The groundwater model predicts the inflows will vary throughout the mine life, which is directly related to the mine plan. As mining progresses and enters into a new strip, groundwater inflows will rise, followed by gradual reduction in inflows. Over the life of the Project, groundwater inflows vary from a minimum of 0.2 ML per day in Year 5 up to a maximum of 2.9 ML per day in Year 15 and reduce back to 0.7 ML per day in Year 21. The peak groundwater inflow to the mine pits is Year 15 where the yearly seepage is simulated at 1,064 ML.

Table 41 Predicted Groundwater Inflows

PROJECT (YEAR)	PREDICTED INFLOW RATE (ML/DAY)
5	0.2
10	1.2
15	2.9
21	0.7

Alluvial Aquifer Water Loss

The Project, Boggabri Coal Mine and the Tarrawonga Mine are in relatively close proximity to each other. This will result in interaction between the zones of depressurisation created by each mine, creating a cumulative impact. Currently groundwater flow is from the bedrock hill areas, into the alluvial aquifers. The Project will result in a portion of this flow from the hills to the alluvium being intercepted and seeping into the pit. The amount of groundwater flow intercepted, that is drawdown attributable to the Project only, was assessed by comparing two model scenarios. The volume intercepted was assessed with all three mines were in operation, and secondly if the Project was removed. The difference between these scenarios was the volume intercepted by the Project only.

The overall decline in flow to the alluvial aquifer when all three mines are operational (realising that Tarrawonga Mine is not active beyond Year 2014) is approximately 1.5 ML/day. With the Project removed from the simulation, the predicted decline in the inflow is 1.15 ML/day. The modelling therefore indicates that the interception of flow to the alluvial aquifer due to the Project alone reaches almost 0.35 ML/day (128 ML/year) at the end of mining.

The cumulative predicted decline in inflow to the alluvial aquifer attributable to the Project over the 21 year mine life is about 1,060 ML. This is equivalent to an average annual extraction from the alluvial aquifer of about 50 ML/year, which is attributable to the Project directly. The predicted impact on the recharge to the alluvial aquifer is very low at less than 1% of both the rainfall recharge simulated by the steady state model. It is also less than 1% of the recharge to Zone 4, Zone 5 and Zone 11 as reported in the Upper and Lower Namoi Groundwater Source Water Sharing Plan (Namoi Groundwater WSP) at 43,900 ML/year.

Impact on Groundwater Users

The depressurisation and leakage of the coal seam aquifers as predicted for the Project will result in a reduction of the water levels in existing bores located within the zone of influence. Modelling indicates the zone of influence will extend to a maximum distance of 7 km beyond the open cut void at the end of mining in Year 21. Beyond this zone drawdown will be less than 1 m, which is undetectable from seasonal fluctuations.

At the end of mining, 27 registered bores fall within the zone of influence, which is defined by the 1 metre drawdown contour. Thirteen of these are within the outcrop of the Maules Creek Formation and 14 within the outcrop zone of the Boggabri Volcanics. The majority are owned by mining operations. None are registered for irrigation. Up to eight may remain in private ownership and be relied upon for stock watering and domestic purposes.

Post Mining Recovery of Groundwater Levels

The impact of two alternative final landform scenarios on the groundwater regime was simulated as part of the post closure options for the mine in the unlikely event that further approvals for the continuation of mining are not sought or granted. Option 1 involves leaving the final void open, while Option 2 requires backfilling of the spoil to a level that is above pre mining groundwater levels. Each is discussed further below.

Option 1 – Open Final Void

Once mining operations cease, dewatering will not be required, and under Option 1, groundwater levels in the area will slowly recover. A void will remain at the north-eastern extent of the mine footprint, with an area of approximately 350 ha, and a maximum depth of RL 240 m. This void would gradually fill to form a lake from rainfall and groundwater inflows until it reaches a stable water level. As the groundwater gradient between the open void and the coal seam aquifers reduces, the rate of inflow would decrease until lake levels reach a 'quasi' equilibrium.

Rate of recovery will be proportionate to rainfall rates, with wet seasons reducing the time for stabilisation. The absence of spoil within the void would result in direct recharge of the groundwater system. However, as the lake surface is exposed, recovery is likely to be impeded by the effects of evaporation and would be expected to reach equilibrium conditions at a lower than pre mining potentiometric surface elevations.

Using Option 1 will result in the groundwater levels reaching equilibrium conditions of approximately RL 225 m after about 1,000 years of pit lake recovery, indicating the final void lake will remain a sink to local groundwater flow. This is due to the high evaporation rates in the region, which slow the rate of recovery. The evaporative pumping from the open void creates a permanent zone of depressurisation in the surrounding aquifers, which indicates that the long term zone of depressurisation will be similar to that created during the mining phase, extending between about 5 km and 7 km from the Project open cut pit.

Option 2 – Backfilled Final Void

Option 2 involves backfilling the final void above pre mining groundwater levels guided by the steady state groundwater modelling. The spoil levels were assumed to be up to RL 310 m in the former void.

This level is above the pre mining groundwater level but a local topographic depression will remain within the mining footprint due to the elevation differences between pre mining topography and backfilled spoil levels.

Under this scenario, a small catchment would be present where surface water runoff would be trapped and potentially form an ephemeral perched lake, which would contribute to additional groundwater recharge in this area.

Under Option 2 where the spoil is backfilled, recovery of groundwater levels reaches equilibrium conditions between RL 307 m RL and 309 m RL, depending on the recharge rate.

These levels are reached after about 875 years for the base-case recharge of 32.8 mm/year and 420 years for the higher recharge rate of 100 mm/year. Water levels are expected to rise above the final landform elevation and pond as surface water, hence adequate surface drainage of the final landform for the backfilling option will be required. Under this scenario, a groundwater mound in the aquifer is created and there is no permanent drawdown.

Water Quality

Based on geochemical assessment conducted by RGS (2010) which assessed the overburden and potential reject materials, it is considered unlikely that leachate generated from these materials will adversely impact upon regional groundwater quality.

If Option 1 is adopted, water quality within the final void lake would be determined by the quality of rainfall, groundwater and leaching of salts from the spoil piles and CHPP waste. The final void will act as a sink and draw in groundwater from surrounding aquifers, which will prevent potentially brackish to saline water being released back into the aquifers. Under Option 2 where the final void is backfilled, the quality of the groundwater recharge is expected to be similar to that determined by RGS (2010) with relatively low salinity.

There is potential for spills and contamination by metals and hydrocarbons from mine workshop, waste disposal and fuel storage areas. However adequate bunding and immediate clean-up of spills should prevent contamination of the shallow groundwater system. Any spills from these areas are typically localised and not regionally significant.

Peer Review of Assessment

A Peer Review of the AGE Groundwater Impact Assessment was undertaken by Heritage Computing in accordance with the Murray-Darling Basin Commission's (MDBC's) Australian Flow Modelling Guideline (MDBC 2001). A copy of the Peer Review report is provided in **Appendix M**.

The Peer Review concluded that the *"groundwater model for the Project has been developed competently and is regarded as "fit for purpose" for addressing cumulative impacts for three mines, for estimating indicative dewatering rates, and for assessing regional potential groundwater impacts."* It acknowledged that the model predictions are conservative as geological structures have been excluded and there is a probable overestimation of mine inflows.

The review supported the conclusion that there will be no significant impacts external to the mined area and to the base flows of neighbouring creek systems.

7.11.4 Mitigation and Management

As part of its EMS, Aston will develop and implement a Water Management Plan in consideration of the findings from this assessment. It will ensure that an adequate monitoring network is put in place and is well maintained so that the modelled predictions and assumptions can be verified and any potential unforseen groundwater impacts can be quickly identified and managed.

The Water Management Plan will incorporate:

- The existing water monitoring program that will not be disturbed during the life of the mine to monitor for depressurisation in the Permian strata and water level drawdown in the alluvial aquifer on an ongoing basis;
- Development of a water management system in consultation with Boggabri Coal Mine and Tarrawonga Mine, as far as practical;

- Installation of at least six additional monitoring bores around the mine to monitor groundwater levels and quality in the Namoi Valley alluvial aquifer, the Permian coal seam and overburden aquifers in accordance with the Australian guidelines;
- Installation of at least eight vibrating wire sensors to monitor for depressurisation in the bedrock underlying the alluvial sediments;
- Installation of further electronic water level loggers in key bores sites, to record groundwater fluctuations and salinity on a daily basis; and
- Monitoring of seepage rates and water quality in the open cut mining void.

In the unlikely event that it is demonstrated that water levels in existing landholder bores decline as a consequence of the Project, leading to an adverse impact on water supply, the supply will be substituted by Aston in consultation with the landholder either by deepening the bore, construction of a new bore or providing comparable water from an external source.

7.12 GEOCHEMICAL

7.12.1 Background

RGS Environmental Pty Ltd (RGS) conducted a geochemical impact assessment for the Project. This is presented in full in **Appendix N** with a summary provided below. This work has involved a geochemical characterisation and assessment of overburden and potential coal reject materials associated with the mining of the 15 coal seams by open cut mining methods. The results of the characterisation have been used to develop and recommend any necessary environmental management measures related to overburden and coal reject emplacement and the Project's rehabilitation program.

7.12.2 Methodology

RGS completed a review of available geochemical and geological data associated with the Project to assist in the formation of a suitable overburden and coal reject sampling and testing program. Technical guidelines for the geochemical assessment of mine waste in Australia (AMIRA 2002; DITR 2007) and worldwide (INAP 2009) were used as the framework for developing the sampling (and geochemical testing) program for the Project.

Drill core materials available as part of the 2010 exploration program were selected from four drill holes at locations within the Project Boundary, with sufficient spread to enhance the lateral coverage of areas of the Project that were not specifically covered by the three drill holes sampled during previous geochemical assessment programs (Dames & Moore 1983a and Dames & Moore 1983b). The sampling strategy was based on the expected geological variability and complexity in rock types; potential for significant environmental or health impacts; size of the operation; sample representation requirements; material volumes; and level of confidence in predictive ability.

A total of 138 samples were collected by Aston personnel from the four drill holes at various depth intervals. This supplemented the 47 samples from the three previously sampled holes. The samples represented the range of overburden (and interburden) lithologies (40 samples) found within the Project Boundary and also the potential coal rejects materials taken from the coal seam, roof and floor materials within the target coal seams (98 samples).

Samples were subjected to a series of static and kinetic geochemical tests at ALS Brisbane. The geochemical testing program was designed to assess the degree of risk from the oxidation of pyrite, acid generation, and leaching of soluble metals and salts. The static geochemical assessment test program also included characterisation of standard soil parameters including salinity, cation exchange capacity, sodicity, potential nutrients and major metal compositions.

7.12.3 Impact Assessment

Overburden

Overburden materials at the Project are likely to have negligible (< 0.1%) total sulphur content and are therefore classified as Non Acid Forming (NAF) barren. Overburden also appears to have excess acid buffering capacity typical of a moderate Acid Neutralising Capacity (ANC) value, which should more than compensate for any acid that could potentially be generated from the small amount of overburden materials with uncertain acid generating classification.

The concentration of total metals in overburden solids is well below applied guideline criteria for soils and is unlikely to present any environmental issues associated with revegetation and rehabilitation.

Most overburden materials were predicted to generate slightly alkaline and relatively low-salinity runoff and seepage following surface exposure. The major ion chemistry of initial surface runoff and seepage from overburden materials is likely to be dominated by sodium, bicarbonate, chloride and sulphate.

The concentration of dissolved metals in initial and ongoing runoff and seepage from overburden materials is unlikely to present any significant environmental issues associated with surface water and groundwater quality as a result of the Project. Overburden materials have been predicted to be non-sodic (and as such non-dispersive) and may be suitable for revegetation and rehabilitation activities (in final surfaces or as a growth medium). Conglomerate and sandstone overburden materials have a marginally more favourable nutrient balance than siltstone and therefore may be more amenable to revegetation and rehabilitation activities.

Coal Rejects

Most potential coal reject materials are likely to have negligible total sulphur content (< 0.1%) and are therefore classified as NAF-barren. These materials have a high factor of safety with respect to potential acid generation.

A small proportion of the potential coal reject materials located near the Braymont, Flixton, Herndale and Onavale seams (roof and some floor samples) have a relatively high total sulphur content and negligible buffering capacity (and hence a low factor of safety) and are classified as Potentially Acid Forming - High Capacity (PAF). These findings correlate well with the findings of previous geochemical assessments both on this site and at adjacent mining operations.

The concentration of total metals in potential coal reject solids is well below the applied guideline criteria for soils and is unlikely to present any environmental issues associated with the rehabilitation and the final closure of the mine.

Most NAF potential coal reject materials will generate slightly alkaline and relatively low salinity runoff and seepage following surface exposure. However, PAF potential coal reject materials may generate acidic and more saline runoff and seepage if exposed to oxidising conditions.

The major ion chemistry of initial surface runoff and seepage from NAF potential coal reject materials is likely to be dominated by sodium, bicarbonate, chloride and sulphate. For PAF materials, calcium, magnesium and sulphate may become more dominant.

For PAF materials, the initial concentration of soluble sulphate in surface runoff and seepage is expected to remain within the applied water quality guideline criterion. Although increased exposure to oxidising conditions could lead to increased sulphate concentrations.

The concentration of dissolved metals in initial surface runoff and seepage from NAF potential coal reject materials is unlikely to present any significant environmental issues associated with surface water and groundwater quality as a result of the Project. For PAF materials, there is some potential for the concentration of dissolved metals in surface runoff and seepage to increase over time.

7.12.4 Mitigation and Management

Overburden

The ongoing management of overburden will consider the geochemistry of these materials with respect to its potential risk to cause harm to the environment and their suitability for use in construction and revegetation. Aston will undertake:

- Pre stripping topsoil from areas to be mined for use in final rehabilitation activities (surface cover or vegetation growth medium) consistent with that described in **Section 7.15**;
- Placement of overburden within the OEAs in a manner that limits the risk of surface erosion; and
- Field trials to identify the most appropriate topsoil and overburden materials for the revegetation and rehabilitation of final landforms.

Further to the above, runoff or seepage from OEAs will be monitored on a regular basis for pH, EC, TSS and dissolved metals (including arsenic, molybdenum and selenium) (see **Section 7.10.4**).

Potential Coal Reject

The ongoing management of coal rejects materials will consider the geochemistry of the materials with respect to their potential risk to cause harm to the environment and their suitability for use in construction and revegetation.

Aston will implement the following management measures:

- Placement of NAF coal reject materials in the open pit and / or co-disposal with overburden;
- Deep (inpit) burial of PAF coal reject materials from the Braymont, Flixton, Herndale and Onavale seams. Out-of-pit co-disposal of PAF rejects in overburden encapsulated cells may need to be considered until sufficient capacity in the open pit becomes available;
- Deep (inpit) burial of PAF roof and floor materials from the Braymont, Flixton, Herndale and Onavale seams that does not report as dilution to the CHPP. Out of pit co-disposal of PAF roof and floor materials in overburden encapsulated cells may need to be considered until sufficient capacity in the open pit becomes available;
- Covering of PAF coal reject and PAF roof and floor materials as soon as practical with at least 5 m of NAF overburden material to minimise the length of exposure time to oxidising conditions (and minimise the potential for AMD); and
- Confirmation of the geochemical characteristics of the coal reject materials when bulk samples become available from the CHPP.

Further to the above, runoff / seepage from OEAs containing coal reject will be monitored on a regular basis for pH, EC and TSS and dissolved metals (including arsenic, molybdenum and selenium) (see **Section 7.10.4**).

7.13 WASTE

7.13.1 Background

Waste will be managed in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the POEO Act along with other relevant legislative requirements including the *Waste Classification Guidelines* (DECCW 2008).

Waste streams that are likely to be generated for the Project will include general waste, hazardous waste and sewage.

7.13.2 Impact Assessment

Under the POEO Act, Aston is required to monitor, remove, track and report wastes on a regular basis. Activities associated with the Project will generate a range of wastes which will require management. Likely predicted waste seams associated with the Project are described in the following sections.

General Waste

General waste may include a range of materials appropriate for reuse or recycling, for example scrap metal, batteries, empty drums, paper and cardboard, plastics, glass, wooden pallets, timber, green waste, bricks, cladding and aluminium cans.

Aston will develop an effective recycling program whereby wastes are separated into designated recyclable waste bins and transported to an appropriate recycling centre. Any waste that is classified as no longer useable or recyclable will require appropriate disposal. These wastes will be collected by an appropriately licensed contractor for disposal in a landfill site.

Tailings and Reject Material

Coarse rock and fine tailings waste products will be produced in the coal preparation process. These wastes will be reprocessed or co-disposed in the OEA. Rejects, tailings and overburden waste and management measures for this waste is described in **Section 3.3.3**.

Hazardous Waste

The Project will require the use of a range of hazardous materials as discussed in **Section 7.18**. Hazardous material will be disposed of in accordance with the *Waste Classification Guidelines* (DECCW 2008) and the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Division 2007).

Contaminated materials generated at the workshop and wash down bay such as grease and bulk waste oil will be held in storage tanks in a bunded area prior to removal from the site by a licensed contractor for recycling or disposal at a licensed facility. Any spills that occur within collection areas will be contained within bunds and managed appropriately.

Water runoff from the hardstand areas will be diverted to a sediment dam located adjacent to the MIA. Water from the workshop areas will be diverted to the oil / water separation unit to be treated prior to being reused within the site water management system.

Oils and greases collected from this water will be collected for disposal or reuse by a suitably licensed waste contractor.

Sewage Material

Aston proposes to manage effluent in accordance with environmental procedures and any relevant legislation. Sewage will be managed via an onsite sewerage treatment plant to collect and treat effluent to a quality suitable of being utilised in areas of rehabilitation or being reused within the mine water management system or pumped out regularly by a licensed contractor.

The sewerage treatment facility will be designed in accordance with the relevant Australian Standards and to comply with the various regulatory requirements.

7.13.3 Mitigation and Management

Regular inspections and monitoring will be conducted by qualified personnel to ensure adequate maintenance and operation of the waste facilities and to ensure management practices are sufficient to manage any waste products.

Waste will be classified and managed as recommended by relevant legislation, with all handling of waste and hazardous materials conducted by suitably qualified personnel.

Aston will ensure that each major waste stream is segregated in the appropriate receptacles for recycling, reuse and / or disposal. The following measures will be implemented to minimise the production of waste onsite including:

- Training designed to improve efficiency in the minimisation of waste streams, reuse and recycling options and management strategies for each major waste stream relevant to key work areas;
- Maximising the recycling of suitable materials where possible into designated bins;
- Treated wastewater will be monitored in accordance with the Environmental Guideline for the Utilisation of Treated Effluent (DEC 1995);

- An internal spill response procedure will be developed to describe the measures to be followed in the event of a spill incident. Any spills that occur within collection areas will be contained within bunds and managed by Aston's pollution control systems, whilst regular inspections of the waste facilities will ensure compliance with regulatory requirements; and
- New improved technologies will be used in conjunction with the water management system to ensure wastes are minimised and reused within the mining activities.

As part of its EMS, Aston will develop an internal Environmental Procedure in consultation with NSC to ensure the minimisation, storage, transport, disposal, tracking and reporting of all waste and hazardous materials generated onsite is in accordance with all relevant legislative requirements and in consideration of the management and mitigation measures proposed above.

7.14 TRAFFIC AND TRANSPORT

A Traffic and Transport Impact Assessment (TTIA) has been undertaken for the Project by Hyder Consulting Pty Limited in accordance with the RTA's Guide to Traffic Generating Developments (2002). The TTIA aimed to make accurate predictions of the road and rail traffic generated by the Project, assess any potential impacts of this traffic on the capacity, efficiency and safety of the road and rail network and in particular the road / rail crossings located at Gunnedah, Breeza and Curlewis and to recommend any possible management and mitigation measures to reduce the impacts on the regional road and rail network.

A summary of the report is provided below and the full report is presented in **Appendix O**.

7.14.1 Background

The regional transport network in the vicinity of the Project is shown on **Figure 32**.

The main access to the Project Boundary will be via Manilla Road, Therribri Road and the proposed Mine Access Road. The Mine Access Road will not have been constructed during the initial construction period and a preliminary access route will be required. This preliminary access route will be via Manilla Road, Leard Forest Road and access tracks within the Leard State Forest including, the East Link Road and / or the Northern Loop Road. This interim access route is not considered to be of a significant concern to traffic impacts as the majority of construction generated traffic will occur once the Mine Access Road is completed.

Aston proposes to transport around 90% of its employees in both the construction and operational phases of the Project using a shuttle bus system. The access route for this shuttle bus to the Project will be as described above.

The nominated heavy vehicle route to and from the Project Boundary is proposed to be via Blue Vale Road, Braymont Road, Barbers Lagoon Road and Manilla Road and prior to the Mine Access Road being constructed will be via Leard Forest Road and the East Link Road or Northern Boundary Road. Once the Mine Access Road has been constructed, heavy vehicles would continue along Manilla Road onto Therribri Road and up the Mine Access Road to the Project Boundary. The reason for this heavy vehicle route along Blue Vale Road, Braymont Road and Barbers Lagoon Road is due to the width and weight limits of the Iron Bridge located on Manilla Road west. Light vehicles (including shuttle buses) will utilise the Manilla Road and Iron Bridge crossing for access to the Project Boundary.

The Mine Access Road will be constructed from Therribri Road and continue towards the north-east to the MIA, generally following the alignment of the rail spur. The Mine Access Road will be approximately 15 km in length and will be designed in accordance with the *Road Design Guide* (RTA 1999).

It will have an asphaltic seal suitable of withstanding vehicles that will be required during the development and operation phases of the Project. In addition, the Project also proposes sealing and upgrade of approximately 3 km of Therribri Road which will be undertaken in consultation with the NSC.

Product coal will be transported entirely via rail facilities and as a result there will be no traffic generated on public roads by coal transportation. The proposed rail spur will connect to the Werris Creek to Mungindi Railway Line, which travels to the south-east and connects with the Main Northern Railway Line at Werris Creek where it continues to the Port of Newcastle.

7.14.2 Methodology

The TTIA for the Project comprised of the following:

- A review of the existing traffic data, assessments and reports completed in the vicinity of the Project Boundary;
- Forecasts of the road and rail traffic volumes generated by the Project;
- An assessment of the likely traffic impacts during the construction and operational phases of the Project;
- Predicted potential impacts on traffic conditions, level of service and intersection operation;

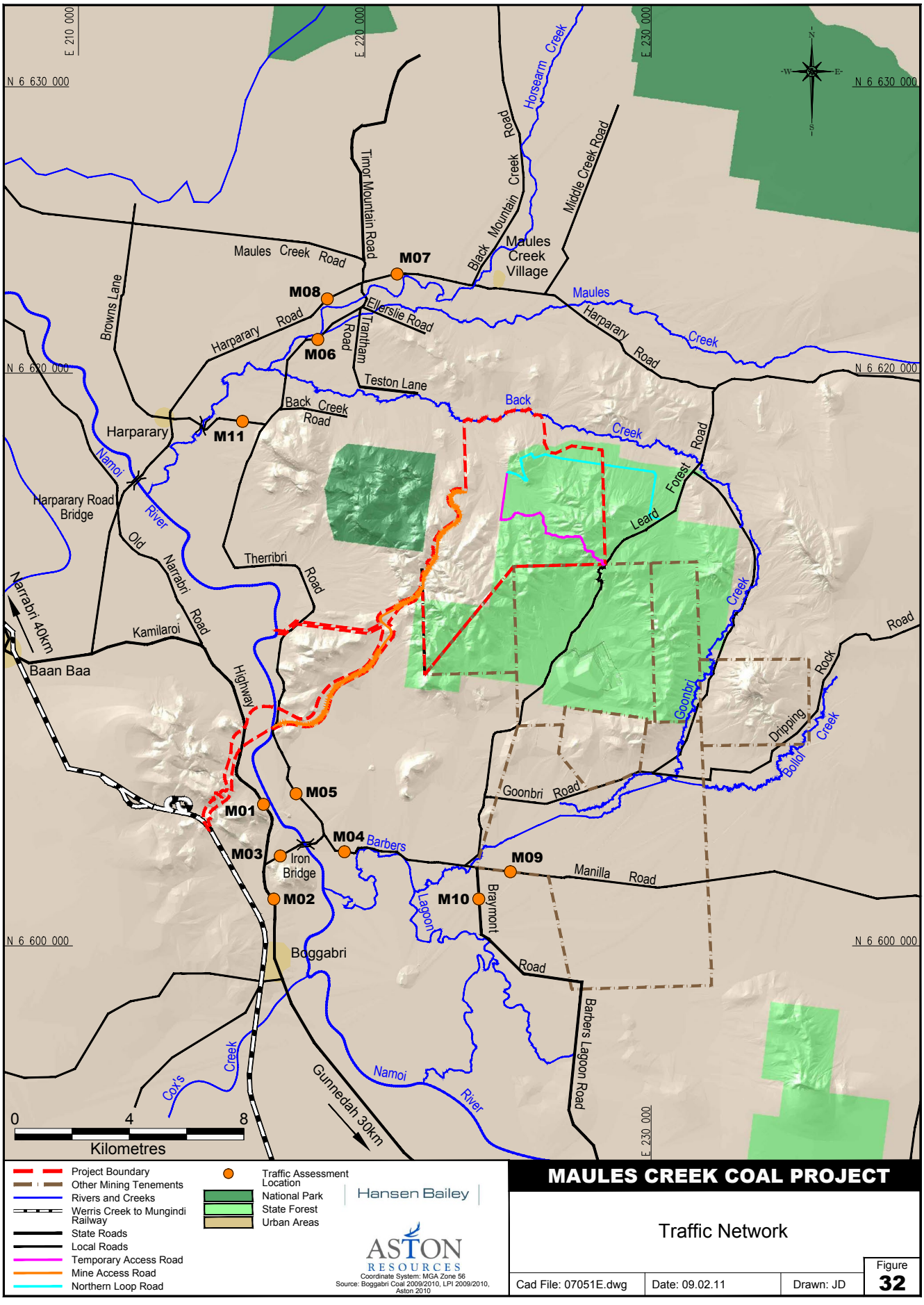
E 210 000
E 220 000
E 230 000
N 6 630 000
N 6 620 000
N 6 600 000
Maules Creek Road
Timor Mountain Road
Horsearm Creek Road
Black Mountain Creek
Middle Creek Road
Maules Creek Village
M07
M08
M06
Browns Lane
Harparary Road
Ellerslie Road
Tranthams Road
Maules Harparary Road Creek
Teston Lane
Back Creek Road
Back Creek
Forest Road
Leard Forest
Harparary
M11
Namoi River
Harparary Road Bridge
Old Narrabri Road
Therribri Road
Narrabri 40km
Kamilaroi Highway
Baan Baa
M01
M05
M04
Barbers
M03
Iron Bridge
M02
M09
Manilla Road
M10
Braymont Lagoon
Boggabri
Goonbri Road
Goonbri Creek
Rock Road
Dripping Rock Creek
Bollol Creek
Barbers Lagoon Road
Cox's Creek
Gunnedah 30km
Namoi River
0
4
8
Kilometres
Project Boundary
Other Mining Tenements
Rivers and Creeks
Werris Creek to Mungindi Railway
State Roads
Local Roads
Temporary Access Road
Mine Access Road
Northern Loop Road
Traffic Assessment Location
National Park
State Forest
Urban Areas
Hansen Bailey
ASTON RESOURCES
Coordinate System: MGA Zone 56
Source: Boggabri Coal 2009/2010, LPI 2009/2010, Aston 2010
MAULES CREEK COAL PROJECT
Traffic Network
Cad File: 07051E.dwg
Date: 09.02.11
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Figure 32

- An assessment of the cumulative impacts (considering neighbouring mining operations) of future traffic, and increased rail movements due to increased coal production within the region;
- An assessment of the potential road safety issues of relevant parts of the road network surrounding the Project;
- An assessment of the increase in demands for rail movements;
- A detailed assessment of the potential impacts on the road / rail level crossings located at Gunnedah, Breeza and Curlewis; and
- Identification of any management and mitigation measures that may be necessary for the Project.

Road Network Conditions

As part of this assessment, existing traffic volumes recorded between 1980 and 2004 were reviewed from RTA counting stations located on the Kamilaroi Highway and Manilla Road. Using this data, a traffic growth rate of 2.1% per year was calculated on the Kamilaroi Highway and a 0.8% per year growth rate for Manilla Road. The 0.8% growth rate as calculated for Manilla Road was also assumed in the TTIA to apply to Therribri Road, Harparary Road and Barbers Lagoon Road.

The annual growth rates calculated were used to determine forecast increases in background traffic on these roads for future case scenarios to determine more accurate predictions of the Project on the road network.

Traffic counts were undertaken across the road network at 10 locations in September 2010 (as shown on **Figure 32**) and an additional location in November 2010 to establish existing traffic conditions.

Traffic counts were undertaken continuously for a seven day period, providing traffic volumes which were classified into heavy and light vehicles, hour of the day and direction of travel.

Four key intersections that are likely to be utilised for the Project were modelled for performance using SIDRA 4.0 (SIDRA) and include: Manilla Road / Barbers Lagoon Road, Manilla Road / Therribri Road, Therribri Road / Mine Access Road and Kamilaroi Highway / Manilla Road. These intersections were modelled for the three key scenarios, including:

- Traffic conditions (2010);
- Peak construction period (2012); and
- Peak operational period (2020).

The investigation of the four key intersections was undertaken considering the following indicators of intersection performance:

- Level of service (LoS) which is a criteria related to the average intersection delay (see **Table 42**). The LoS categories describe the conditions in terms of factors including speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety;
- Degree of saturation (DoS) which is the ratio of demand flow to capacity and therefore the closer to 1.0, the greater the delays and queue length;
- Average intersection delay, which is the difference between interrupted and uninterrupted travel times through the intersection including deceleration, static delays and acceleration; and
- Maximum queue length is the greatest number of vehicles waiting at the hold line at any point in time.

Table 42 Intersection Levels of Service Performance Categories

LEVEL OF SERVICE	AVERAGE DELAY PER VEHICLE (SECONDS)	DESCRIPTION
A	Less than 14	Good
B	15 to 28	Acceptable
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to70	At capacity
F	Greater than 71	Unsatisfactory

Source: RTA Guidelines for Traffic Generating Developments (2002).

Existing Rail Network Conditions

The Project will transport around 225 Mt of product coal to the Port of Newcastle over the 21 year mine life utilising the existing rail network as described in **Section 7.14.1**. In recognition of the potential future capacity issues on the Hunter Valley rail network, ARTC prepared the 2009-2018 Hunter Valley Corridor Capacity Strategy Consultation Document (ARTC 2009).

This document identifies current issues within the rail network and the possible future demands and associated issues that will require upgrades to the infrastructure. The more recent publication prepared by ARTC, 2011-2020 Hunter Valley Corridor Capacity Strategy – Consultation Document (ARTC, 2011) has also been reviewed and contains consistent information from that provided in the earlier version.

For the purposes of the TTIA, ARTC (2009) was used to establish base line data for the Hunter Valley rail corridor, including assumptions to determine the number of train movements likely to be generated by the Project. The base line data considered the current and future rail demands provided by other industrial enterprises and passenger trains. It was estimated that the Project and the Boggabri Coal Mine will together result in 24 trains movements per day, equating to approximately one train every two hours for each direction.

The potential impacts on the Werris Creek to Mungindi Railway Line, and in particular, potential impacts on road traffic at the level crossings situated at Boggabri, Gunnedah and Curlewis, were assessed.

Cumulative Impacts

Approved and proposed projects in the surrounding area were also taken into consideration in the assessment of possible future traffic and rail network volumes. Mining operations which are most likely to contribute to cumulative traffic and transport impacts include Boggabri Coal Mine, and to a lesser extent Tarrawonga Mine, Goonbri Coal Project, Narrabri Coal Project and other mining projects further to the south.

Additional traffic generation from any proposed or existing mining activities were included in the assumptions to assess the future volume and impacts of traffic and transport.

The assessment of the likely worst case impacts on the road network considered the cumulative impacts due to neighbouring mining projects. The assessment looked at the capacity of the road network as predicted for the Project and confirmed if in conjunction with neighbouring mining projects there would be any possible impacts.

The cumulative worst case traffic impact assessment for the rail crossings with respect to queue dissipation was assessed by completing a sensitivity analysis of the rail crossing at Curlewis, which contains the greatest number of road traffic movements per hour intersecting this rail line. The assessment considered the likely increase in background rail and road traffic flows and considered the additional train movements where capacity would start to be an issue.

The potential queue spillback effect was also considered at several railway level crossings, including:

- Currabubula Road, Breeza;
- Hogarth Street, Breeza;
- Kamilaroi Highway, Curlewis;
- Carroll Street, Gunnedah;
- Marquis Street, Gunnedah;
- New Street, Gunnedah; and
- Boston Street, Boggabri.

The assumed duration of a red signal, coupled with the arrival rates of traffic approach either side of the crossing, and the available storage length indicated that there would be a short stacking queue risk at some railway level crossings.

7.14.3 Impact Assessment

Road Traffic Volumes

Table 43 shows the predicted traffic volumes on the key roads for the Project, showing the volumes recorded during the 2010 surveys and future predicted flows as a result of the Project and other sources. The RTA traffic counts completed from 1980 to 2004 were used to determine the background growth rates for the key roads to calculate future background traffic flows.

Possible impacts resulting from the neighbouring mining operations have also been considered in the prediction of future road traffic volumes.

Road Intersection Performance

As part of the TTIA, road intersection performance was assessed using SIDRA by calculating the performance indicators for intersections, including: LoS, DoS, average intersection delay and queue lengths for each intersection and turning movement.

As displayed in **Table 44**, there is currently a low traffic demand at all the intersections as all turning movements were modelled to have good LoS ratings (LoS A), less than 14 seconds delay, and negligible queuing lengths as indicated by the DoS of 0.06 (6%) or less.

The peak construction period has been determined as the worst case scenario as the road network will be relied upon for the transport of equipment and materials to the Project Boundary.

During this period, the impacts on these intersections are not likely to be significant as the highest LoS is a rating of LoS B, indicating acceptable delays with DoS remaining less than 0.07 (7%). The anticipated construction schedule is short term, with the peak period assessed scheduled for only 4 weeks.

The peak operational period would have similar intersection performance to the existing base scenario. This was expected as the majority of the transport generation (i.e. coal transportation) would be by rail and the peak operational period would no longer have traffic generated by construction activities.

All intersection approaches were modelled to have good LoS ratings of (LoS A) as found in the existing conditions. It is predicted that there will be negligible queue lengths as there is a maximum DoS of 0.18, indicating that traffic volumes in the peak operational period will only use no more than 18% of the road capacity available.

Road Safety

A Road Safety Audit of the primary access routes for the Project was undertaken as part of the TTIA. **Table 45** includes a detailed list of the safety deficiencies identified on the existing road network during the Road Safety Audit.

Appendix O provides further detail on the areas that require attention on the existing road traffic network. The majority of the identified road safety deficiencies in the existing road network were caused by existing traffic and were not expected to deteriorate further as a result of the Project. However, current deficiencies may put the safety of current and future traffic at risk if they are not addressed by the relevant roads authority.

Proposed Road Works

The proposed rail spur will require a bridge to pass above the Kamilaroi Highway. The construction of this bridge may require lane / road occupancy during the placement or installation of the bridge deck and supports. As the bridge will pass over the highway, Aston will enter into a relevant Agreement (equivalent of a **Section 138** Permit under the Roads Act) with the RTA.

As part of this Agreement, detailed designs of the bridge will be required for the review and approval of the RTA. This design will meet the relevant RTA design criteria such as minimum vertical clearance, design life and load capacity.

Aston will upgrade a 3 km section of Therribri Road from Manilla Road to the proposed Mine Access Road, which will take place during the initial construction period. As recorded during the 2010 traffic surveys, approximately 40-80 vehicles per day currently use this road and may potentially be affected by the roadwork. There are a range of acceptable measures that can be adopted during the construction period that will help manage the traffic related impacts through or around the proposed road works.

Railway Level Crossing Performance

All coal produced by the Project will be railed to the Port of Newcastle via the Werris Creek to Mungindi Railway Line, with no coal to be hauled on public roads except in the case of an emergency and prior agreement with DP&I, RTA and NSC. An assessment was made of the potential rail network impacts, including a capacity assessment on railway level crossings and a network wide deficiency assessment.

It was estimated that there will be up to 12 trains per day required for the transport of product coal at peak production from the Project and from the Boggabri Coal Mine. In addition to this, there are other rail movements expected along the railway line at key railway level crossings. A total of 19 trains per day per direction were used as a conservative number for use in the assessment of the railway level crossing at Curlewis. This railway level crossing is considered to provide the worst case impact as it has the interaction with the most traffic, with an estimated 2,380 vehicles per day travelling across this rail crossing.

Table 43 Predicted Total Road Traffic Volumes

SITE	ROAD	LOCATION	DIRECTION	DAILY TRAFFIC VOLUMES (WEEKDAY AVERAGES)		
				EXISTING (2010)	PREDICTED PEAK CONSTRUCTION (2012)	PREDICTED PEAK OPERATIONS (2020)
M01	Kamilaroi Highway	North of Manilla Road	Northbound	948	1,148	1,391
M01	Kamilaroi Highway	North of Manilla Road	Southbound	984	1,061	1,284
M02	Kamilaroi Highway	South of Manilla Road	Northbound	1,079	1,222	1,521
M02	Kamilaroi Highway	South of Manilla Road	Southbound	1,106	1,147	1,467
M03	Manilla Road	East of Kamilaroi Highway	Eastbound	233	323	392
M03	Manilla Road	East of Kamilaroi Highway	Westbound	226	335	385
M04	Manilla Road	East of Therribri Road	Eastbound	203	305	411
M04	Manilla Road	East of Therribri Road	Westbound	198	282	386
M05	Therribri Road	North of Manilla Road	Northbound	40	141	84
M05	Therribri Road	North of Manilla Road	Southbound	39	137	80
M09	Manilla Road	East of Braymont Road	Eastbound	85	84	15
M09	Manilla Road	East of Braymont Road	Westbound	80	79	86
M10	Braymont Road	South of Manilla Road	Northbound	25	73	67
M10	Braymont Road	South of Manilla Road	Southbound	29	77	76

Table 44 Key Intersection Performances

INTERSECTION	APPROACH	EXISTING (2010)		PREDICTED PEAK CONSTRUCTION (2012)		PREDICTED PEAK OPERATION (2020)	
		AVERAGE DELAY (sec) / LoS	MAX QUEUE LENGTH (m) / DoS (V/C)	AVERAGE DELAY (sec) / LoS	MAX QUEUE LENGTH (m) / DoS (V/C)	AVERAGE DELAY (sec) / LoS	MAX QUEUE LENGTH (m) / DoS (V/C)
Manilla Road / Barbers Lagoon Road	South on Barbers Lagoon Road	10.9 / LoS A	0.1 / 0.002	16.0 / LoS B	1.0/ 0.019	10.9 / LoS A	0.9 / 0.030
	East on Manilla Road	1.4 / LoS A	0.0 / 0.004	2.7 / LoS A	0.0 / 0.002	0.8 / LoS A	0.0 / 0.007
	West on Manilla Road	3.1 / LoS A	0.3 / 0.008	13.7 / LoS B	1.0 / 0.0341	5.5 / LoS A	0.0 / 0.001
Manilla Road / Therribri Road	South on Manilla Road	10.3 / LoS A	0.0 / 0.005	10.3 / LoS A	0.0 / 0.011	9.3 / LoS A	0.0 / 0.006
	North Therribri Road	5.4 / LoS A	0.0 / 0.001	12.0 / LoS A	0.3 / 0.053	5.5 / LoS A	0.0 / 0.001
	West on Manilla Road	11.1 / LoS A	1.3 / 0.041	11.6 / LoS A	0.1 / 0.020	11.2 / LoS A	6.9 / 0.181
Therribri Road / Mine Access Road	South on Therribri Road	Mine Access Road to be constructed		12.8 / LoS B	3.3 / LoS A	0.1 / 0.002	10.8 / LoS A
	East on Mine Access Road			10.6 / LoS A	3.7 / 0.089	9.2 / LoS A	
	North on Therribri Road	14.0 / LoS A 5.0 / LoS A		5.0 / LoS A	0.0 / 0.001	5.0 / LoS A	
Kamilaroi Highway / Manilla Road AM Peak	South on Kamilaroi Highway	2.3 / LoS A	0.6 / 0.061	6.0 / LoS A	2.8 / 0.070	6.0 / LoS A	3.1 / 0.084
	East on Manilla Road	13.5 / LoS A	0.4 / 0.012	13.8 / LoS A	0.4 / 0.012	14.1 / LoS A	0.5 / 0.013
	North on Kamilaroi Highway	5.5 / LoS A	0.0 / 0.020	6.6 / LoS A	0.0/ 0.020	5.5 / LoS A	0.0 / 0.025
Kamilaroi Highway / Manilla Road PM PEAK	South on Kamilaroi Highway	1.2 / LoS A	0.2 / 0.039	4.5 / LoS B	1.6/ 0.039	1.0 / LoS A	0.2 / 0.047
	East on Manilla Road	12.2 / LoS A	1.7 / 0.051	12.3 / LoS A	1.7 / 0.052	12.4 / LoS A	1.9 / 0.057
	North on Kamilaroi Highway	1.0 / LoS A	1.7 / 0.051	1.0 / LoS A	0.0 / 0.050	1.3 / LoS A	0.0 / 0.061

An assessment was carried out to determine whether the queue build up on the road approaches of the railway level crossings could dissipate effectively. This assessment focused on the Kamilaroi Highway railway level crossing at Curlewis as this carries the highest road traffic volumes of all crossings reviewed. By considering the total red signal display time, and the arrival rate of vehicles, this assessment showed that the queue could effectively dissipate. That is, the service (release) rate of the queue would be higher than the arrival rate.

A sensitivity analysis was undertaken to confirm how many additional train movements could be generated before the average delay per vehicle exceeds the adopted threshold of 20 seconds (used as a conservative assumption for LoS D – normally given to an average delay of 43 to 56 seconds (see **Table 42**)). This confirmed that an additional three train movements could be generated per hour before the average delay per vehicle exceeds the adopted threshold of 20 seconds. This analysis suggests that there is spare capacity in the rail network with respect to maintaining reasonable operation of the railway level crossings. Future growth beyond this (i.e. where the additional train paths required exceeds four per hour) would require improvements to be made.

A similar first principle capacity assessment was carried out for the other railway level crossings. Although queue dissipation is not likely to be a problem, the queue spillback potential could lead to short stacking risk due to proximate intersections.

The Marquis Street and New Street railway level crossing facilities at Gunnedah were noted as having the highest short stacking queue risk. However, these risks are present under the current rail and road traffic conditions. **Appendix O** provides further detail of this assessment and the possible management and mitigation measures that should be implemented by the appropriate roads authority.

Railway Network Impacts

The 2009-2018 Hunter Valley Corridor Capacity Strategy Consultation Document (ARTC 2009) provides a detailed review of the existing deficiencies in the Hunter Valley coal corridor which includes the rail network up to Narrabri. The movement of product coal from the Project may be affected by these deficiencies at any point in this supply chain, which may also impact on a number of neighbouring coal mining related projects.

Consultation with the adjacent mining companies, ARTC and the relevant roads authorities within the area (RTA and GSC) will continue to occur to ensure that the timing of the production levels proposed by the Project align with the proposed rail infrastructure upgrades and port capacities to ensure capacity impacts are minimised.

Table 45 Road Safety Audit Findings

ROAD	EXISTING DEFICIENCY
Manilla Road – between Kamilaroi Highway and Therribri Road	■ Insufficient signage ■ Potential clear zone crash hazards ■ Iron Bridge contains substandard bridge parapets and approach safety barriers ■ Flood waters resulting in depositing of sediment and debris on road surfaces and water pooling in culverts
Therribri Road – between Manilla Road and the future location of the Mine Access Road	■ Culverts identified with runoff road crash protection ■ Large mature trees located within close proximity to the road
Leard Forest Road – between Manilla Road and the Temporary Mine Access Road	■ Leard Forest Road contains a bend with a side road extending in a straight alignment which may be misinterpreted ■ Poor visibility leading into the Temporary Mine Access Road
Temporary Mine Access Road – between Leard Forest Road and the Project Boundary	■ Insufficient width for safe passing ■ Uneven road surface with corrugations and localised depressions
Barbers Lagoon Road - between Manilla Road and Kamilaroi Highway	■ Unprotected culverts ■ Sudden narrowing of the road without signage ■ Poor interface between unpaved and paved sections of road ■ Uneven and corrugated road surface with frequent depressions ■ Large mature trees located within close proximity to the road ■ Culverts containing water increasing the risk of aquaplaning

7.14.4 Mitigation and Management

Results from the TTIA have identified that the Project will not have any significant road and rail traffic and transport impacts. There are few areas within the existing road network, excluding the impacts from the Project, that require certain enhancements in order to bring these roads up to a level safe for use by the public.

As part of its EMS, Aston will prepare a Traffic and Transport Management Plan to firstly manage possible impacts resulting from construction and to ensure the traffic network can be managed throughout the Project in consideration of the management and mitigation measures discussed below.

Roads and Intersections

In order to control and minimise any impacts on the road network surrounding the Project, Aston has specific access routes (as discussed in this section) with other roads prohibited from access by employees and contractors. Appropriate signs will be erected for the nominated route including signs prohibiting access to the sections, as following:

- Heavy vehicle access route: Mine Access Road, Therribri Road South, Manilla Road, Barbers Lagoon Road, Braymont Road, and Blue Vale Road to access the Kamilaroi Highway to the north of Gunnedah;
- Roads prohibited from Heavy Vehicle access (excluding buses): the section of Manilla Road between the Kamilaroi Highway and Therribri Road, which contains the load limited and narrow Iron Bridge; and
- Light vehicle access route (including buses): Mine Access Road, Therribri Road, Manilla Road, and then either Manilla Road West to the Kamilaroi Highway, or alternatively, Manilla Road East towards Braymont.

Roads restricted from access, unless they are travelling to a specific destination along that route (i.e. residence, monitoring location, near neighbour etc) would include:

- Harparary Road between Leard Forest Road and the Kamilaroi Highway;
- Leard Forest Road between Northern Loop Road and Harparary Road;
- Therribri Road between the Mine Access Road and Harparary Road; and
- The entire length of Browns Lane.

The following traffic management measures will also be implemented:

- Consultation with the NSC, GSC, RTA and other local authorities as necessary prior to the movement of oversize loads on public roads;
- Consultation with NSC, GSC, RTA and the local community prior to the proposed upgrades on Therribri Road;
- Provision of shuttle buses for the transport of approximately 90% of the construction and operation workforce to minimise traffic on the road network; and
- Continued encouragement of car pooling amongst the mine workforce not utilising the shuttle system.

Road Safety

The Road Safety Audit identified a number of existing deficiencies within the existing road network. Aston has committed to working with the neighbouring mining operations and the relevant roads authorities in providing the appropriate funding commensurate to the Project's impacts for the following management and mitigation measures to address the existing safety issues including:

- Installation of additional signage where relevant on the Kamilaroi Highway, Manilla Road, Therribri Road, Leard Forest Road, and Barbers Lagoon Road / Braymont Road / Bluevale Road including; reduced speed, curve and culvert advanced warnings, floodway and causeway warnings, give way and T intersection warnings;
- Installation of retro reflective taping or guidepost to augment the presence of large trees;
- Removal of sediment and / or debris from road surfaces if deemed unsafe particularly following high rainfall or flood events; and
- Regular audits to ensure compliance with road usage restrictions, speed limits, load limits and give way requirements.

Rail Transport

The assessment has concluded that it is unlikely there will be any significant impacts on the railway level crossings located at Boggabri, Gunnedah or Curlewis. Aston will continue to ensure that all feasible and reasonable measures to minimise blockages of the level crossings are implemented. The Project will encourage management strategies to ensure the rail network can continue to handle the additional train movements by collaborating with surrounding mines, industry and the ARTC. This may include scheduling the timing of the rail spur being constructed to the Project Boundary and maintaining involvement in any future required network wide improvements and upgrades.

The construction of the rail spur overpass within the easement of the Kamilaroi Highway has the potential to result in possible impacts to the flows of traffic on the existing road network. Aston will develop a Construction Management Plan for the works (including traffic control and management) in consultation with the RTA and the relevant regulatory authorities.

7.15 SOILS AND LAND CAPABILITY

7.15.1 Background

GSS Environmental (GSSE) completed a soil and land capability assessment for the Project which is reproduced in full in **Appendix P**.

The major objectives of this assessment were to:

- Define the soil types present within the Project Boundary;
- Determine alluvial soil boundaries along Back Creek;
- Provide a description of the pre and post land capability within the Project Boundary;
- Provide a description of the pre and post agricultural land suitability within the Project Boundary; and
- Provide selective topsoil and subsoil management recommendations.

7.15.2 Methodology

A soil and land capability survey was undertaken in July and August 2010 by GSSE and included soil mapping and profiling, a soil field assessment and soil laboratory testing to:

- Classify and determine the soil profile types within the Project Boundary;
- Assess the suitability of the current topsoil materials for future rehabilitation; and
- Identify any potentially unfavourable soil material for rehabilitation.

An initial soil map was developed utilising aerial photography, topographic maps and previous soil survey results.

Soil profiling was undertaken with the development of 21 soil test pits which were assessed in accordance with Elliot and Veness (1981) and additionally observed through the use of surface exposures located in existing erosion gullies, creek banks, roadway cuttings, dams and disused quarries.

Samples were analysed to establish the suitability of surface and near surface soil horizons as potential growth media, and identify high value soils and, conversely, soils that may have properties that are deleterious to vegetation establishment.

Land capability was determined in accordance with the OEH (formerly the NSW Soil Conservation Service) Systems Used to Classify Rural Lands in New South Wales (Cunningham et al. 1988) which is comprised of eight classes, classified on the basis of an increasing soil erosion hazard and decreasing versatility of use.

Agricultural suitability was also determined in accordance with I&I NSW's (formerly NSW Agriculture and Fisheries) Agricultural Suitability Maps – uses and limitations (Agriculture & Fisheries 1990) which consists of five classes, providing a ranking of lands according to their productivity for a wide range of agricultural activities, with the objective of determining the potential for crop growth within certain limits.

7.15.3 Impact Assessment

Table 46 provides an overview of each soil type and the quantitative distribution of each. **Figure 33** provides an illustration of the spatial distribution of soil types and agricultural land capability within the Project Boundary. Nine soil types were identified within the Project Boundary which are described further below.

Table 46 Project Soil Types and Area

SOIL TYPE	AUSTRALIAN SOILS CLASSIFICATION NAME	PROJECT SOIL NAME	AREA (%)	AREA (ha)
1	Leached Brown Lithic Tenosol	Shallow Gravelly Brown Sandy Loams	42	1,489
2	Leached Yellow Kandosol	Gravelly Fine Brown Sandy Loams	9	321
3a	Red Chromosols	Gravelly Red Duplex Sandy Clay Loams over Rhyolite	8	292
3b	Brown and Grey Vertosols	Self - mulching Brown and Grey Clays over Andersite	3	94
4a	Red and Brown Lithic Tenosols	Shallow Bleached Reddish Brown Sandy Loams	16	565
4b	Brown and Grey Chromosols	Brown and Grey Duplex Sandy Loams	7	260
4c	Black and Grey Vertosols	Self - mulching Black Clays over Andersite	8	289
5	Sodic Brown Sodosols and Dermosols	Sodic Duplex and Gradational Brown Loams	3	103
6	Self mulching Brown Vertosols	Brown Clays and Red Brown Earths	4	137
TOTAL			**100**	**3,550**

Soil Types

Soil Type 1

Soil type 1 is a shallow gravelly brown sandy loam and covers approximately 42% or 1,489 ha of the area within the Project Boundary. They are moderately poorly drained soils which range from slightly acidic to neutral in the upper layer becoming strongly acidic to neutral at depth. These soils are non saline with poor to moderate fertility characteristics. They are non sodic throughout the profile.

The topsoil is unsuitable for stripping and reuse as topdressing in rehabilitation due to high stone content. The subsoil is not recommended for rehabilitation due to the limiting factors of high stone content and moderate acidity at depth.

Soil Type 2

Soil type 2 is a gravelly fine brown sandy loam and covers approximately 9% or 321 ha of the area within the Project Boundary. They are poorly drained soils which range from strongly acidic to neutral in the upper layers to neutral at depth. The soils are non saline with poor to moderate fertility characteristics. They are non sodic throughout the profile. The topsoil is marginally suitable for stripping and reuse as topdressing in rehabilitation due to high stone content. The subsoil is not recommended for reuse in rehabilitation due to the limiting factors of stone content and dispersiveness at depth.

Soil Type 3a

Soil type 3a is a gravelly red duplex sandy clay loam and covers approximately 8% or 292 ha of the area within the Project Boundary. They are moderately well drained soils and are alkaline throughout the profile. These soils are non saline with moderate fertility characteristics. They are non sodic throughout the profile. The topsoil is marginally suitable for stripping and reuse as topdressing in rehabilitation due to high stone content. The subsoil is not recommended for reuse in rehabilitation due to the higher clay content and alkalinity at depth.

Soil Type 3b

Soil type 3b is a self mulching brown and grey clay and covers approximately 3% or 94 ha of the area within the Project Boundary. These are moderately well drained soils and are alkaline and become very alkaline at depth. The soils also become saline and slightly sodic at depth. The topsoil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to the sodicity, alkalinity and salinity at depth.

Soil Type 4a

Soil type 4a is a shallow bleached reddish brown sandy loam and covers approximately 16% or 565 ha of the area within the Project Boundary. They are moderately poorly drained soils and are slightly acidic to neutral throughout the profile. The soils are non saline with poor to moderate fertility characteristics. They are non sodic throughout the profile. The topsoil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to the limiting factors of poor fertility at depth.

Soil Type 4b

Soil type 4b is a brown and grey duplex sandy loam that covers approximately 7% or 260 ha of the area within the Project Boundary. They are moderately well drained soils and are neutral but can become very acidic at depth. Soils in lower lying areas become saline with and slightly sodic at depth. The topsoil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to the highly dispersive subsoil.

Soil Type 4c

Soil type 4c is a self mulching black clay that covers approximately 8% or 289 ha of the area within the Project Boundary. They are moderately poorly drained soils and are alkaline and can become very alkaline at depth. The soils also become slightly sodic at depth. The topsoil is suitable for stripping and being reused as topdressing in rehabilitation.

The subsoil is not recommended for reuse in rehabilitation due to the sodicity and alkalinity at depth.

Soil Type 5

Soil type 5 is a sodic duplex and gradational brown loam that covers approximately 3% or 103 ha of the area within the Project Boundary. They are moderately poorly drained soils and are alkaline and can become increasingly alkaline at depth. Sodicity and salinity increases down the profile. The topsoil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to its sodic subsoil.

Soil Type 6

Soil type 6 is a brown clay and red brown earth soil that covers approximately 4% or 137 ha of the area within the Project Boundary. These soils are moderately well drained self mulching brown clays or poorly drained red-brown earths or imperfectly drained self-mulching red clays.

The topsoil is generally non-saline increasing to strongly alkaline at depth. Sodicity and salinity increases down the profile. The topsoil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to its fine texture.

Topsoil Availability and Suitability

Recommended topsoil stripping depths for each of the soil types are shown in **Table 47**. A figure showing the spatial distribution of the recommended topsoil stripping depths is presented in **Appendix P**.

The estimated total volumes of suitable topdressing materials available from areas proposed to be disturbed within the Project Boundary are 2.8 Million cubic metres. When a handling loss of 10% is allowed the quantity decreases to 2.5 Million cubic metres. Selective stripping practices are proposed to ensure the higher quality soils are not mixed with the lower quality soils.

Back Creek Alluvial Investigation

An assessment of the presence and extent of alluvial soils within the vicinity of Back Creek was undertaken in July 2010. Back Creek is a small ephemeral creek, which is cutting down into the footslopes of the area within the Project Boundary. The field inspection confirms that there is no evidence of alluvial soils associated with Back Creek, and those that are present are predominately located on the northern side of this creek.

The majority of the cleared areas to the south of Back Creek consist of very gently undulating footslopes, composed of material deposited from sandstone conglomerates, rhyolites, and from a small outcrop of basalt and andesite further upslope. The Project will not impact upon this area.

Land Capability

The land capability classification within the Project Boundary ranges from Class III to Class VII with Class VII being the dominant class in the existing environment. The pre mining and post mining rural land capability classifications of the Project Boundary is shown on **Figure 33**. The percentage area of each class prior to and following mining is indicatively shown in **Table 48**.

All areas which are not proposed to be disturbed by mining will remain the same land capability as the pre mining class. This includes all Class II and Class III land which is not proposed to be disturbed by mining activities.

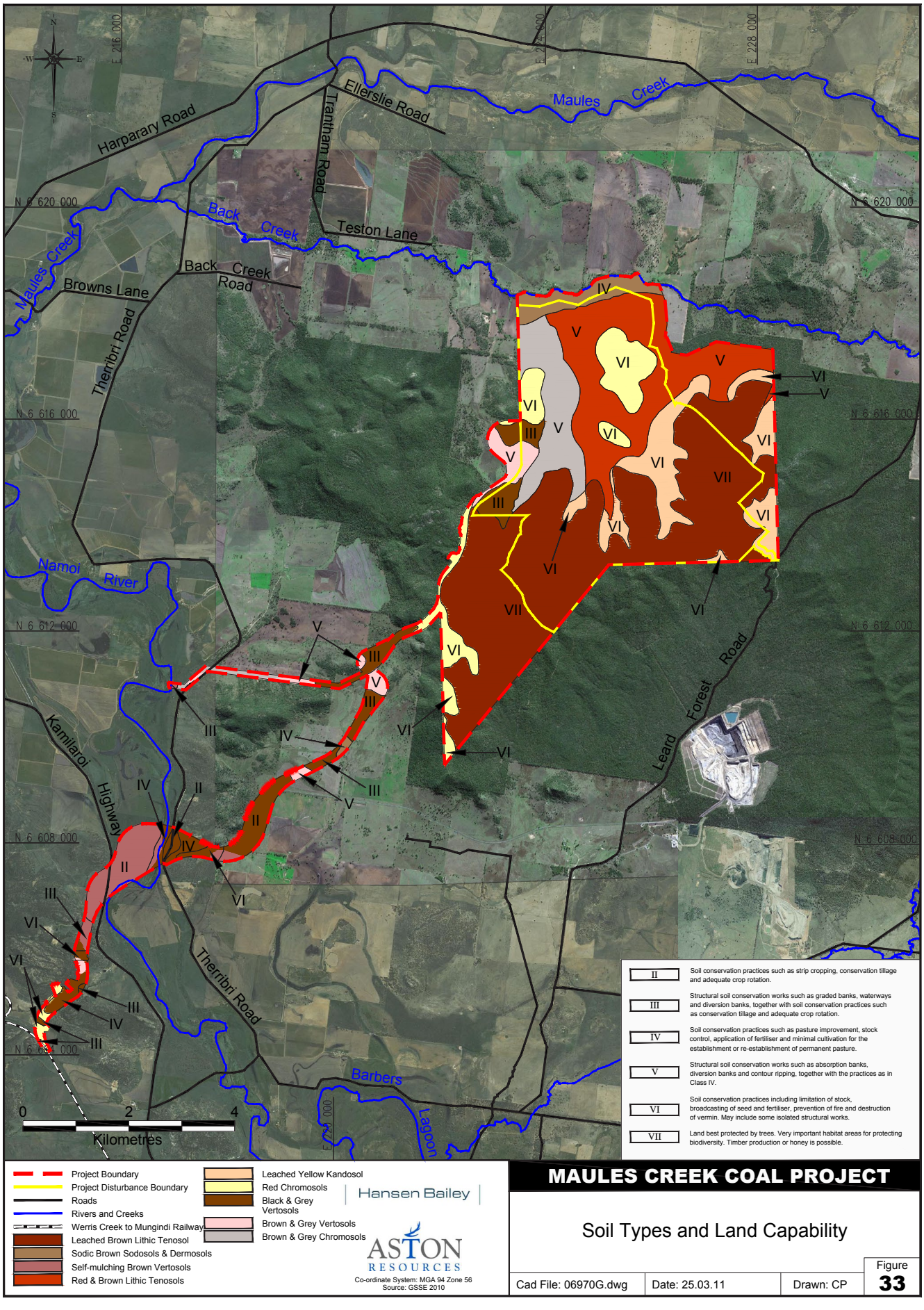
The majority of the disturbed post mining landform consists of slopes of 10 degrees and will be covered in low to moderate quality topdressing.

Table 47 Recommended Topsoil Stripping Depths

SOIL TYPE	RECOMMENDED STRIPPING DEPTH (m)	DISTURBED AREA (ha)	VOLUME (m^3)	VOLUME (10% HANDLING LOSS) (m^3)
1	Stripping not recommended	865	0	0
2	0.25	198	495,000	445,500
3a	0.20	175	350,000	315,000
3b	0.30	17	51,000	45,900
4a	0.30	393	1,179,000	1,061,100
4b	0.20	241	482,000	433,800
4c	0.40	49	196,000	176,400
5	0.20	36	72,000	64,800
6	0.20	0	0	0

Table 48 Pre and Post Mining Land Capability

LAND CLASS	PRE MINING		POST MINING	
	ha	%	ha	%
Class III	425	12	425	12
Class IV	103	3	76	2
Class V	920	26	375	11
Class VI	613	17	725	20
Class VII	1,489	42	1,804	51
Class VIII	0	0	145	4
Total	**3,550**	**100**	**3,550**	**100**



MAULES CREEK COAL PROJECT

Soil Types and Land Capability

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These factors should result in a land capability of around Class VII. As such, Class VII land will continue to dominate the site after cessation of mining. The flatter slopes should result in rehabilitation to Class V land. The steep highwalls and voids would be class VIII.

Agricultural Suitability

The pre mining and post mining agricultural suitability classification of the Project Boundary is shown in **Appendix P**. The percentage area of each class prior to and following mining is indicatively shown in **Table 49**.

Overall, the percentage area of each class of agricultural suitability will remain relatively similar to that of the existing environment. No Class 2 land is proposed to be disturbed by the Project and following cessation of mining and completion of all rehabilitation works, all disturbed areas will be returned to a combination of Class 3, 4 and 5 land that is similar to the existing environment.

7.15.4 Mitigation and Management

In order to reduce the potential for degradation within the Project Boundary and adjoining lands, the following strategies will be implemented during operations and rehabilitation to achieve the desired post mining land capability and agricultural suitability:

- Materials will be stripped to indicated levels in a moist condition and placed directly onto reshaped areas where practical;
- Where topsoil must be stockpiled, efforts will be made to reduce compaction by keeping soil in as coarsely textured a condition as possible; stockpiles will be a maximum of 3 m in height and if stored for greater than 12 months, seeded and fertilised and treated for weeds prior to respreading;
- An inventory of designated areas and available soil will be maintained to ensure adequate topsoil materials are available for planned rehabilitation activities;
- Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation with all topsoiled areas lightly contour ripped to create a *"key"* between the soil and the spoil. Ripping will be undertaken on the contour, preferably when soil is moist. The respread topsoil surface will be scarified prior to, or during seeding, to reduce runoff and increase infiltration via tilling with a fine tyned plough or disc harrow;
- Regrading will be undertaken where required to produce slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. This will be done in integration with drainage structures and dams capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation (including contour furrows or contour banks at intervals down the slope, contour ripping across the grade, and graded banks where required); and
- Engineered waterways, spillways and sediment control dams (using erosion blankets, ground cover vegetation and / or rip rap) will also be implemented to capture sediment laden runoff prior to offsite release and designed and located so as to safely convey the maximum anticipated discharge.

As part of its EMS, Aston will develop an internal Soil and Land Capability procedure for management of its soil resources, in consideration of the above mitigation and management measures.

Table 49 Pre and Post Mining Agricultural Suitability

LAND CLASS	PRE MINING		POST MINING	
	ha	%	ha	%
Class 2	425	12	425	12
Class 3	457	13	451	13
Class 4	565	16	725	20
Class 5	2,102	59	1,949	55
Total	**3,550**	**100**	**3,550**	**100**

7.16 REHABILITATION AND FINAL LANDFORM

7.16.1 Rehabilitation Objectives

Aston has developed detailed mine plans to obtain the maximum area of rehabilitation available throughout the life of the Project, whilst recognising that a further coal resource is known to exist beyond 21 years for future mining.

Reafforestation will be undertaken consistent with the surrounding landscape, aiming to relink remnant native vegetation communities with reestablished habitat areas. The rehabilitation strategy for the Project will focus on biodiversity and the establishment of habitat for Threatened flora and fauna species as described in Sections 7.6 and 7.7.

Objectives

Aston's key rehabilitation objective is to ensure that all processes undertaken are consistent with SEWPaC's National Recovery Plan for Box Gum (DEWHA 2010) and will include:

- The rehabilitation of disturbed areas to form part of a regional East-West wildlife corridor created as part of the Biodiversity Offset Strategy. This will create a linkage to remnant vegetation between the Namoi River to the west through the Leard State Forest to the Nandewar Range to the east;
- Revegetation of the post mine landscape with native vegetation, comprising a mixture of native grassy woodland, shrubby woodland / open forest, riparian forest vegetation types and Box Gum Woodland with fauna habitat for Threatened species to encourage the reestablishment of pre mining biodiversity values; and
- Ensuring the sustainability of the post mining ecological values of the landscape.

Strategic Framework

Rehabilitation processes will be undertaken generally in accordance with the Strategic Framework for Mine Closure (ANZMEC MCA) and the 'Mine Rehabilitation' and 'Mine Closure and Completion' Handbooks both developed as part of the Leading Practice Sustainable Development Program by the Department of Industry, Tourism and Resources. Planning objectives will include:

- The development of a Rehabilitation Management Plan during the planning phase which can evolve with further research;
- Early characterisation of materials to avoid future material issues; and
- Understanding the external environment and how it may affect the success of rehabilitation.

Objectives for the operations include the:

- Management of site water to reduce potential erosion or pollution;
- Development of stable and safe landforms that are well integrated and where possible will incorporate some relief with the surrounding environment;
- Establishment of effective covers for stability and hazardous material containment within landforms where required;
- Management of topsoil to conserve nutrients and encourage native seed and micro-organisms; and
- Establishment of dynamic and resilient flora and fauna communities.

The key objectives for mine closure include:

- Enabling all stakeholders to have their interests considered within the mine closure process;
- Ensuring the mine closure process is timely, cost effective and orderly;
- Ensuring the cost of mine closure is reflected in the budget adequately and that the community is not left with a liability;
- Ensuring there is effective implementation of the mine closure process including adequate resources and clear accountability;
- The establishment of a set of indicators and a rehabilitation monitoring program to ensure mine closure can be demonstrated as a successfully completed process where completion criteria are met;
- Establishing a point where all agreed criteria is deemed successfully met by the relevant Authorities;
- Ensuring future public health and safety, environmental resources, post mining land use and socio-economic assets are not affected in any negative way and enhanced where possible; and
- The implementation of sustainable development considerations in corporate decision making processes and the reduction of risk through management strategies based on sound data.

Relevant Planning Instruments

The Project Boundary is entirely located within land zoned under the Narrabri LEP as 1(a) – General Rural Zone. The objectives of 1(a) – General Rural zoning with regard to rehabilitation are the proper management and utilisation of resources by:

- *"protecting, enhancing and conserving:*
  - *agricultural land in a manner which sustains its efficient and effective agricultural production potential,*
  - *soil stability by controlling and locating development in accordance with soil capability,*
  - *forests of existing and potential commercial value for timber production,*
  - *trees and other vegetation in environmentally sensitive areas where the conservation of the vegetation is significant to scenic amenity or natural wildlife habitat or is likely to control land degradation,*
  - *water resources for use in the public interest,*
  - *areas of significance for nature conservation, including areas with rare plants, wetlands and significant habitats, and*
- *ensuring that any allotment created for an intensive agricultural pursuit is potentially capable of sustaining a range of such purposes or other agricultural purposes."*

The conceptual final landform and rehabilitation strategy will provide consideration of all of the above objectives from the Narrabri LEP.

7.16.2 Rehabilitation Techniques

The following broad rehabilitation techniques will be applied to all rehabilitation areas for the Project.

Rehabilitation techniques and strategies will have a particular focus on the establishment of the Box Gum Woodland community using endemic species.

Land Clearance Protocol

Prior to the clearing of any native vegetation, in particular pre strip clearing activities in advance of mining, the Land Clearance Protocol as described in **Section 7.7** will be followed.

Rehabilitation

Vegetation and topsoil will be removed prior to mining activities occurring. The topsoil will contain a valuable native vegetation seedbank that will enhance the rehabilitation works. Where practical, topsoil will be immediately spread over rehabilitation areas to enhance the rehabilitation outcomes. Where stockpiling is required, measures to protect its quality by retaining soil microbes and maintaining a viable soil seedbank will be implemented (see **Section 7.15.4**).

The geochemical impact assessment undertaken for the Project has confirmed that with the appropriate management implemented, there is a low risk of acid bearing overburden material forming (**Section 7.11**). Overburden materials that are most suitable for plant growth will be spread over the surface areas of the OEAs prior to the application of topsoil where possible. Topsoil will be spread and managed consistent with **Section 7.15.4**. These measures will ensure that rehabilitation will meet the overall objectives mentioned above for rehabilitation and mine closure.

Revegetation

Revegetation works will generally be carried out when climatic growth conditions are optimal. Revegetation works will involve direct native seeding and / or supplementary tube stock planting.

Native groundcover vegetation will be established to prevent raindrop and sheet erosion from occurring.

In the event that native grass cover is initially insufficient to stabilise sloped areas due to slow growth rates, introduced sterile ground covers such as a sterile millet species may be used to supplement plantings. Natural seed germination from the soil seed bank will be assisted with direct seeding and where applicable, seed will be treated to enhance germination rates. Planting of tubestock will supplement areas of low success rates from the natural regeneration from the seedbank and direct seeding.

A Rehabilitation Management Plan will be developed in consultation with the relevant regulatory departments to accommodate the objectives of the rehabilitation management strategy and findings from this EA.

7.16.3 Final Landform

Aston will maximise opportunities for a post mining landscape that is generally consistent with pre mining land use biodiversity. Rehabilitation will be designed to achieve a standard whereby rehabilitation lands can be classified as offset land. All mine areas will be rehabilitated except for the final void which will be shaped appropriately.

Four key rehabilitation domains have been identified in the rehabilitation strategy based on the Project impacts, post mine landform, future land use and biodiversity values. These are discussed below.

Mine Disturbance Area

The final landform has been developed to promote visual characteristics that generally conform to the existing landscape. To ensure long term stability and sustainability, the slopes of the final landform within the mine disturbance area will have a maximum slope of 10 degrees. It is expected that the steeper slopes will develop greater biodiversity than the more easily accessible sites.

The conceptual final landform will be free draining and designed to integrate with the surrounding catchments by channelling water towards natural drainage lines of Back Creek.

The final landform will aim to provide relief with the surrounding environment and contain gentle slopes to allow drainage to preferential paths on the slopes (see **Figure 34**).

The final land use of this area will comprise a mixture of the native vegetation communities, including grassy woodland (70%), shrubby woodland / open forest (25%) and riparian forest (5%) for conservation and forestry purposes.

The OEAs will be progressively rehabilitated over the life of the mine as soon as practical. This process will be in accordance with DTIRIS requirements for Rehabilitation Completion Criteria.

This staged approach will minimise the mine disturbance area at any one time and reduce the environmental impacts from the open cut operations. The rehabilitation strategy will be reviewed on a regular basis to ensure disturbed areas are kept to a minimum.

Mine Infrastructure Area

This domain generally comprises of land that has previously been cleared for agricultural purposes. It incorporates the CHPP, tailings drying area, site administration offices, equipment and maintenance sheds, loading facilities, and entrance roads. These will be decommissioned and the landscape rehabilitated as part of the mine closure strategy. The final land capability of these areas following the decommissioning of infrastructure will be mainly of class VII with flatter slopes comprised of class V.

Mine Access Road / Rail Spur Corridor

This domain comprises the proposed transport corridors including the rail spur between the MIA and the proposed Boggabri rail spur and the Mine Access Road between the MIA and Therribri Road.

The majority of this domain contains cleared agricultural land, woodlands and isolated pockets of remnant vegetation and derived grassland. This domain also incorporates the area of the Namoi River floodplain that will be impacted by the Project.

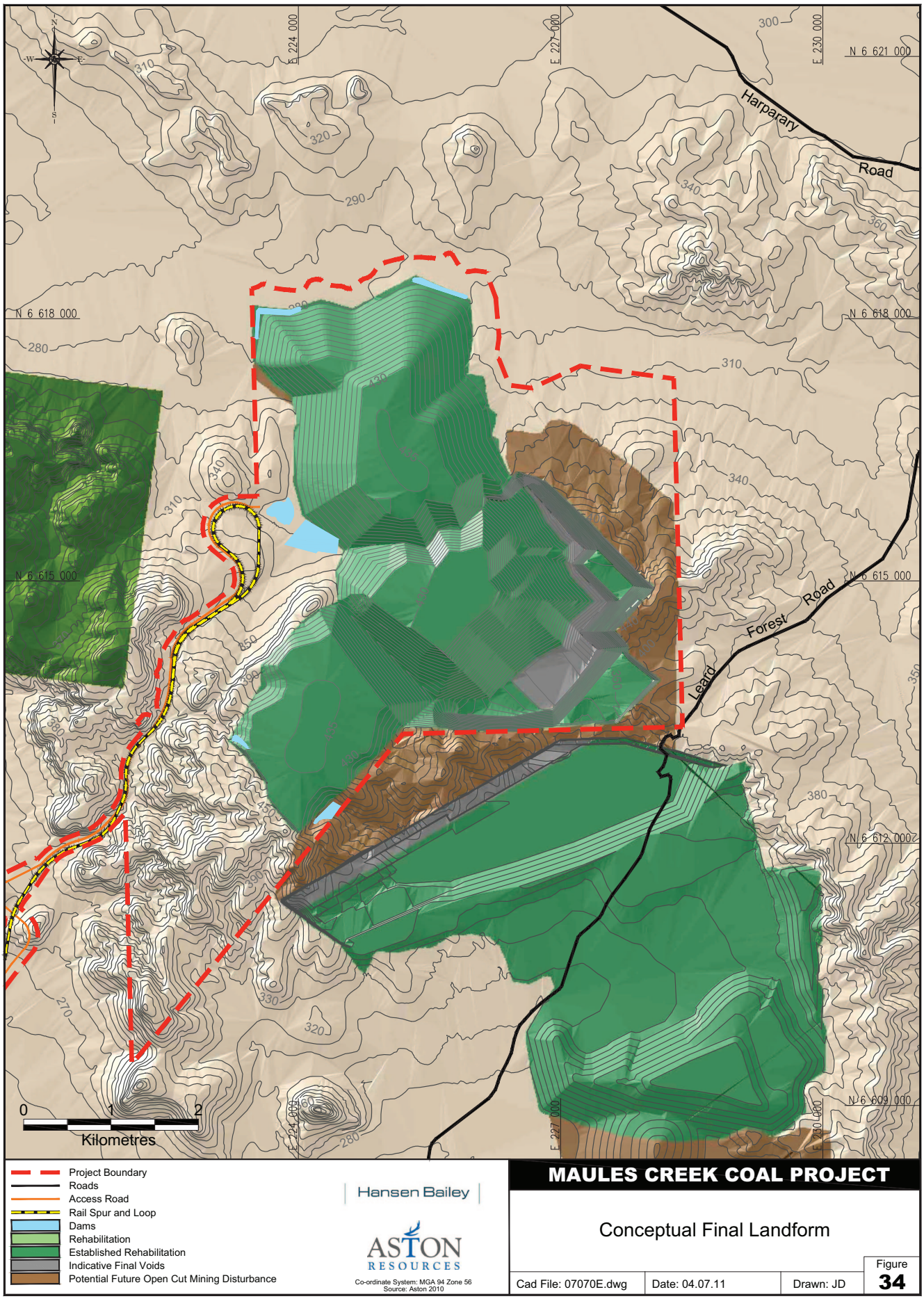
The final land capability will incorporate a mixture of classes including class V and VII lands. A substantial area of this domain adjoins remnant native vegetation, the proposed regional wildlife corridor or is identified in the proposed Offset Strategy for the reestablishment of native vegetation communities.

The rehabilitation strategy will, where practical, revegetate the Mine Access Road and rail spur corridor to maximise its ecological contribution to the proposed East-West wildlife corridor offsets.

Final Void

Should mining not continue beyond the 21 Year Mining Limit, this EA presents a conceptual final landform that has been developed based on the indicative mine plan at Year 21. This final landform illustrates that a final void will remain in the southern and eastern portion of the Project Boundary (**Figure 34**). The final void will have a catchment area of approximately 887 ha with an approximate surface area of 170 ha (WRM 2011).

In the event that open cut or highwall mining does not proceed beyond this point, the final void will be blasted to a slope of approximately 37 degrees to ensure that the land form is safe, stable, non erosive and revegetated as is practical.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Harparary Road
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Roads
Access Road
Rail Spur and Loop
Dams
Rehabilitation
Established Rehabilitation
Indicative Final Voids
Potential Future Open Cut Mining Disturbance
Hansen Bailey
ASTON RESOURCES
Co-ordinate System: MGA 94 Zone 56
Source: Aston 2010
MAULES CREEK COAL PROJECT
Conceptual Final Landform
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Figure 34

Catchment areas that are not free draining will report to the final void, as will any drainage from disturbed areas. A discussion of the post mining management of surface water and final voids is presented in **Appendix L** and **Appendix M**.

It should be noted that there is at least a further nine years of mining within Aston's mining authorities beyond the Project Disturbance Boundary. Should a further Project Approval be granted in the future for mining to continue, the proposed final void would be significantly reduced in size and potentially could be rehabilitated with limited void remaining in the landscape.

7.16.4 Cumulative Final Landform

As mentioned above, the conceptual final landform for the Project has been produced in realisation that mining would continue beyond 21 years as well as with the consideration of the adjacent Boggabri Coal Mine and Tarrawonga Mine.

The recent Boggabri EA (Hansen Bailey 2010) provides that there is further mining potential beyond Boggabri Coal's current proposal for 21 years of mining. This future mining activity, when combined with potential mining operations at Maules Creek beyond 21 years, would provide the opportunity for the ultimate final landform to be integrated across the regional landscape.

An indicative cumulative final landform after 21 years of mining at Maules Creek and Boggabri Coal Mine is shown in **Figure 35** and an accompanying cross sectional view shown in **Figure 36**.

As shown in **Figure 35**, a corridor of natural landform will remain in situ between each of the three mining operations at the end of 21 years.

Figure 35 and **Figure 36** illustrate the footprint and an indicative final landform should the Boggabri Coal, Tarrawonga and Maules Creek mines continue beyond 21 years, which would be reliant upon separate planning approvals at the appropriate time(s).

As illustrated in **Figure 35**, Maules Creek's mining operations would progress to the east and then towards the north enabling overburden emplacement to occur along the southern mining lease boundary. Boggabri Coal's mining operations would continue to the north, meeting with the common section of mining lease boundary. This provides an opportunity for Boggabri Coal to extract the coal from within the barrier pillar (subject to a commercial agreement).

Further, the progression of mining at both operations will assist these operations to develop a consistent final landform that blends in with the surrounding natural terrain. **Figure 36** illustrates the Year 30 final landform in comparison with the Year 21 landform and pre mining landscape.

The final landform and rehabilitation for the Project will seek to merge into the surrounding landscape, reducing potential adverse cumulative impacts with adjoining operations.

Aston will continue to liaise with the adjacent mining operations to ensure that any potential deleterious final landform issues are mitigated. Should conditions leading up to Year 16 of the Project prove uneconomical for the continuation of mining, Aston will prepare a Mine Closure Plan in consultation with the neighbouring mining operations, community stakeholders, and the relevant Government authorities that will provide further detail in relation to the final landform and associated final void.

7.16.5 Decommissioning

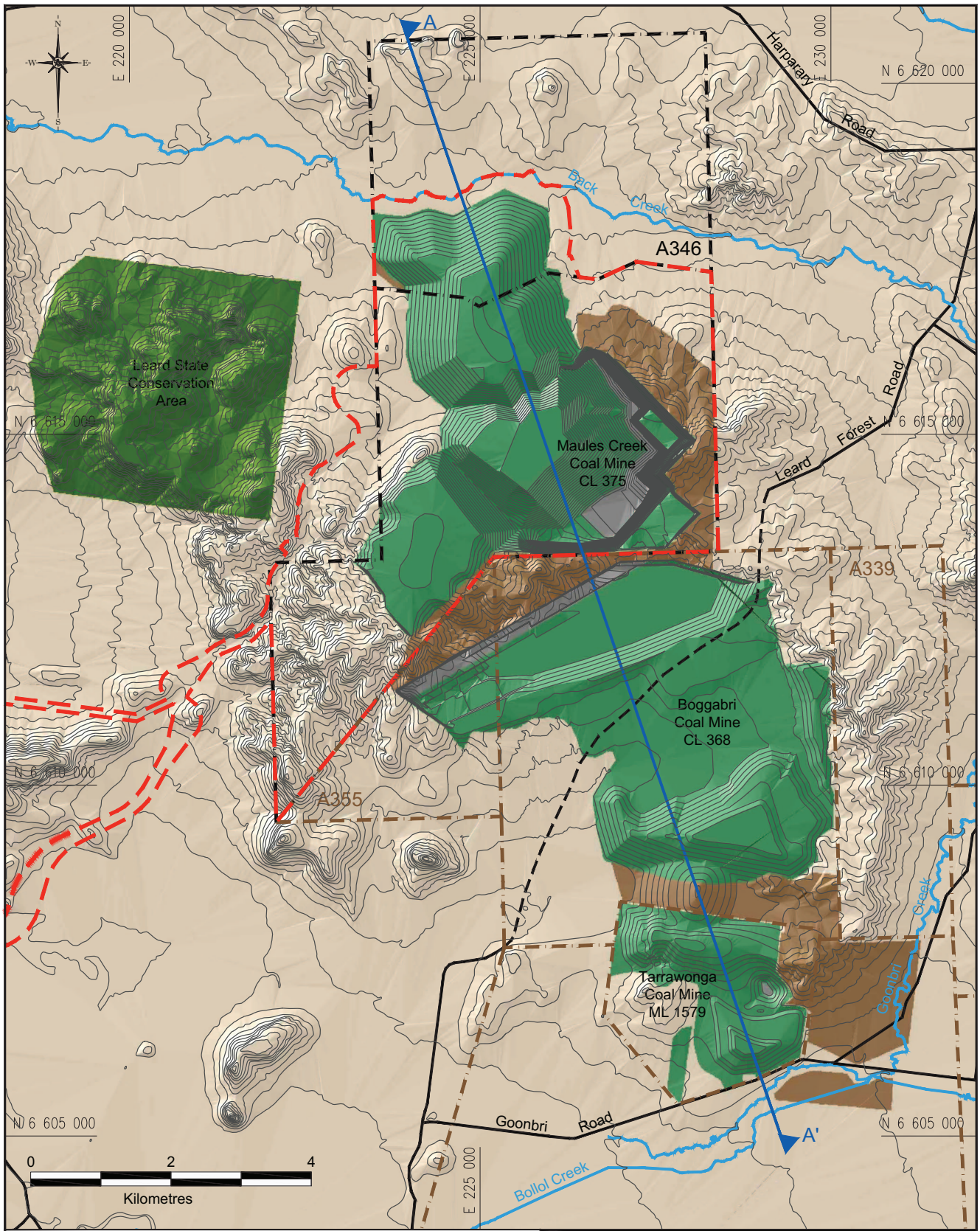
A Mine Closure Plan will be prepared within five years of closure and shall reflect contemporary expectations including changes to the final mine plan, regulatory requirements, new technologies and stakeholder expectations.

The final void will be blasted to a 37 degree slope. The final void will also be screened with native vegetation and fenced for public safety. Overflow and diversion structures will be put in place for proactive management of large hydrological events.

All OEAs will be sloped to 10 degrees or less. Drainage berms will be designed to limit effective slope lengths. The drainage berms will be constructed with gentle cross fall for drainage control. Reshaped areas will be topsoiled and deep contour ripped. Planting will follow after erosion control is achieved. Drains and ponds will collect runoff.

Decommissioning and removal from the site of all infrastructure items will take place if that infrastructure is not required post mining or sold on for other industrial purposes. Any infrastructure including dams, levee banks, roads and buildings, which is beneficial for future use by post mine landowners, will be left in place in accordance with the relevant stakeholder or landowner agreements.

Decommissioning of the MIA will include removal, remediation of any land contamination, ripping, topsoiling (if necessary) and seeding.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Back Creek
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Leard State Conservation Area
Maules Creek Coal Mine CL 375
Leard Forest Road
A339
Boggabri Coal Mine CL 368
A355
Tarrawonga Coal Mine ML 1579
Goonbri Creek
Goonbri Road
Bollol Creek
0
2
4
Kilometres
Project Boundary
Maules Creek Mining Tenement Boundary
Other Mining Tenements
Indicative Road Re-alignment
Roads
Creeks
Indicative Final Rehabilitation
Indicative Final Voids
Potential Future Open Cut Mining Disturbance
Cross Section Location
Hansen Bailey
ASTON RESOURCES
Co-ordinate System: MGA 94 Zone 56
Source: Aston 2010, Tarrawonga Modification 2010
Boggabri Coal 2009/2010, LPI 2009/2010
MAULES CREEK COAL PROJECT
Indicative Cumulative Final Landform
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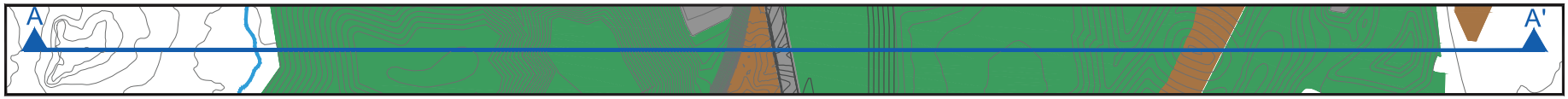
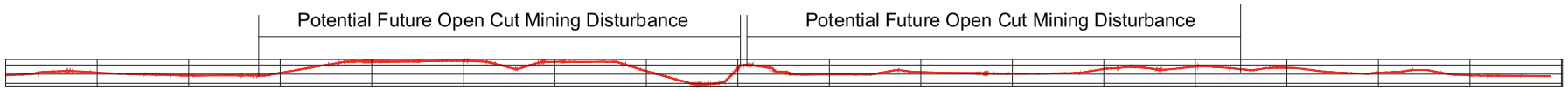
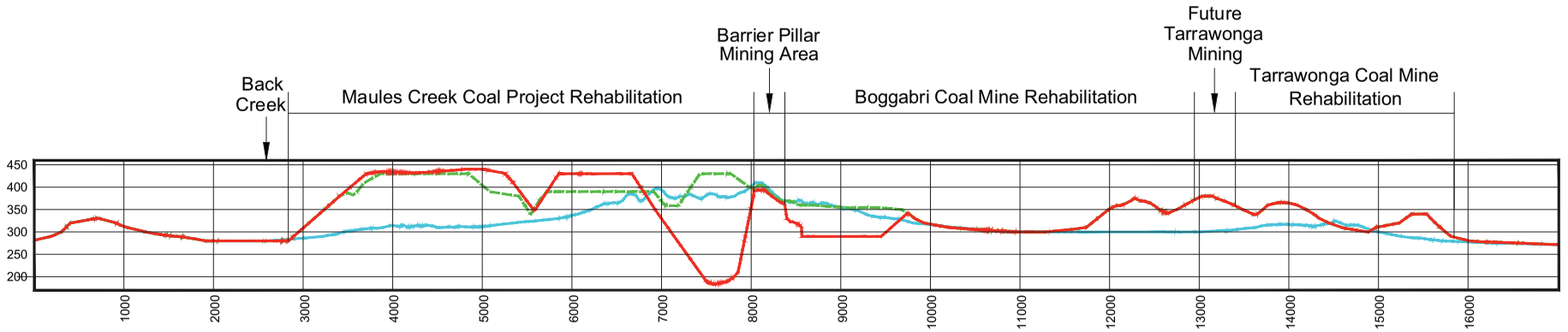
Date: 26.05.11
Drawn: CP
Figure 35





Section AA'
Vertical Exaggeration 1:1



Section AA'
Vertical Exaggeration 5:1

Existing Natural Surface
Proposed Year 21 Final Landform
Possible Future Final Landform

Hansen Bailey

ASTON RESOURCES

Co-ordinate System: MGA 94 Zone 56
Source: Aston 2010, Tarrawonga Modification 2010 Boggabri Coal 2009/2010, LPI 2009/2010

MAULES CREEK COAL PROJECT

Cumulative Landform Cross Section

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7.16.6 Rehabilitation Completion Criteria

Completion criteria for mine closure will be developed and agreed in consultation with the relevant government agencies and community. These criteria will continue to be revised and developed to demonstrate that the rehabilitation objectives have been achieved. The achievement of the completion criteria will be monitored and reported to relevant stakeholders.

Aston is committed to the achievement of leading practice completion criteria, as this will ensure the long term protection and management of the post mine landscape and its biodiversity conservation values. A list of preliminary rehabilitation completion criterion is outlined in **Table 50**.

7.16.7 Management and Mitigation

In accordance with the Rehabilitation Management Plan to be developed for the Project, rehabilitation areas will be monitored on a regular basis to ensure that rehabilitation objectives are being met and that sustainable revegetation and long term landform sustainability is achieved. Rehabilitation monitoring will include regular inspections of rehabilitated areas to assess:

- Structural stability;
- The effectiveness of erosion and sediment control measures;
- Revegetation success and the establishment of Box Gum Woodland understorey and fauna habitat; and
- The effectiveness of weed and pest management measures.

Maintenance works in rehabilitation areas will be completed as required to address any issues of concern identified during monitoring. Maintenance activities may include a range of responses, including:

- Supplementary seeding of vegetated areas;
- Weed and pest control;
- The application of fertiliser;
- Desilting or repairing drainage structures and sedimentation dams; and
- The infill and regrading of any eroded areas.

Aston will undertake ongoing rehabilitation maintenance works as required. The results of rehabilitation and landform monitoring and the effectiveness of any maintenance activities required for the Project will be assessed and utilised in the continual refinement of rehabilitation techniques and reported against in the Aston Annual Review.

Table 50 Preliminary Rehabilitation Criteria

ASPECT	DOMAIN		
	MINE DISTURBANCE AREA	MINE INFRASTRUCTURE AREA	MINE ACCESS ROAD / RAIL SPUR
	CRITERIA		
Landform	■ Final slopes of the OEAs will be formed at 10 degrees or less ■ Erosion channels or bare areas will be managed and eliminated where possible ■ Contour banks will be stable and uniform ■ The surface layer will be free from hazardous materials ■ All drill holes will be sealed	■ Plains will be relatively flat with no slopes ■ Erosion will be managed to ensure the final land use is not compromised ■ Contour banks will be stable, revegetated and uniform ■ Surface layer will be free from hazardous materials ■ Riparian areas will be managed to prevent instability and erosion where possible and to ensure similar pre mining flows	
Soil	■ Topsoil will be spread on all rehabilitation surface areas as soon as possible to prevent the requirement for stockpiling and will include weed infestation assessment prior to this ■ Soil shall be suitable for reestablishing vegetation and lightly contour ripped to create a key between the soil and spoil ■ pH will be monitored to encourage acceptable ranges for plant growth and similar quality to analogues sites ■ Erosion and sediment control will be achieved through the construction of contour furrows or contour banks at intervals down slopes		
Water	■ Runoff water quality from rehabilitated areas will be managed to reduce any possible threat to downstream water quality ■ Catchment areas will be free draining with low velocity to minimise surface erosion		

ASPECT	DOMAIN		
	MINE DISTURBANCE AREA	MINE INFRASTRUCTURE AREA	MINE ACCESS ROAD / RAIL SPUR
	CRITERIA		
Vegetation	■ Rehabilitated areas will be designed to attract the desired flora species characteristic of the pre mining vegetation assemblages ■ Rehabilitated vegetation will be designed to develop the desired structure (i.e. shrubby forest or grassy woodland) ■ Rehabilitated vegetation will include viable timber species for future use in the forestry resource industry ■ Second generation seedling production will be encouraged ■ The health of trees will be monitored for the long term to ensure high survival rates ■ Significant weed infestations or noxious weeds will be removed in accordance with relevant guidelines and NSC Weed Management plans ■ The highest percentage soil surface cover possible will be maintained	■ Rehabilitated areas will contain pastures characteristic of pre mining land capability ■ Rehabilitated creek lines will be designed to contain the desired vegetation structure (i.e. shrubby forest or grassy woodland) and characteristic species	■ Rehabilitated areas will contain characteristics of pasture associated with land capability pre mining ■ Rehabilitated areas adjoining Biodiversity offsets or regional wildlife corridors will contain native vegetation with the desired structure and floristic characteristics of adjoining remnant areas
Fauna	■ Vertebrate pests will be managed to ensure effective control ■ Rehabilitated areas will be designed to contain a range of habitat structures for native fauna (e.g. eucalypts, shrubs, ground layer, developing litter) ■ Rehabilitated areas will be designed to support stable populations of native fauna and will be monitored long term	■ Vertebrate pests will be managed to be absent or kept under control and monitored on an annual basis	■ Vertebrate pests will be managed to be absent or kept under control and monitored on an annual basis ■ Rehabilitated riparian areas and areas adjoining biodiversity offsets will be designed to contain a range of habitat structures for native fauna (e.g. eucalypts, shrubs, ground layer, developing litter) ■ Rehabilitated areas will support regional wildlife corridors and where possible reduce barrier effects
Land Capability	■ Rehabilitated areas will be designed to be of a land capability class of SF for sustainable forestry and biodiversity conservation	■ Rehabilitated areas will be designed to be representative of a suitable land capability class of VII for the majority of areas and class V for flatter slopes ■ All sites which are not disturbed by mining activities will remain the same land capability as the pre mining class ■ Native flora species typical of the local area will be used in the establishment of native forest land in areas of pre mining land capability class of VII	■ Rehabilitated areas will be designed to be representative of a suitable land capability class of VII or V for flatter slopes ■ All sites which are not disturbed by mining activities will remain the same land capability as the pre mining class ■ Native flora species typical of the local area will be used in the establishment of native forest land in areas of pre mining land capability class of VII

7.17 BUSHFIRE

7.17.1 Background

The mining area of the Project is partly located within the Leard State Forest which is dominated by dry eucalypt woodlands and open forests. The Leard State Forest is an 8,134 ha remnant patch of native vegetation.

7.17.2 Impact Assessment

Due to the relatively low rainfall and dry nature of the landscape, combined with the build up of high fuel loads (leaf drop and tinder) over time, a significant risk of bushfire presents itself to the Project.

The bushfire season experienced in the North West Region of NSW occurs predominantly during the hotter months from September to April. Depending on factors such as temperature, available fuel loads and rainfall, the frequency and intensity of bushfires will vary.

The area surrounding the Project Boundary and the Leard State Forest is predominantly agricultural land, dominated by grazing and cropping activities which present a much lower bushfire hazard. The Leard State Conservation Area lies to the west of the Project boundary consisting of dense forest vegetation and consequently is a higher bushfire hazard.

7.17.3 Mitigation and Management

Onsite bushfires and potential bushfire hazards will be managed in accordance with the *Rural Fires Act 1999* and regulated by the NSW Rural Fire Service.

Fire controls and emergency systems will be put in place in accordance with the *Coal Mines Health and Safety Act 2002* (CMHS Act).

As part of its EMS, Aston will develop a Bushfire Management Plan which will aim to:

- Monitor and maintain areas and equipment where bushfire hazards are present to prevent and minimise the potential outbreak of bushfire;
- Control the outbreak of fires in an effective manner; and
- Minimise the risk of bushfires spreading from the Project to adjacent private properties.
- Other fire control strategies and management methods will include:
- Issuance of 'hot work permits' for welding and other potential fire risk activities;
- Provision of water tankers available to fire fighting;
- Ensuring general purpose fire extinguishers are available on all mobile equipment and at other appropriate locations;
- Segregate and store all flammable materials in accordance with WorkCover Dangerous Goods licences; and
- Maintain access tracks and fire breaks around surface facilities and the mining area.

7.18 HAZARD ANALYSIS

7.18.1 Introduction

Hansen Bailey has completed a relevant hazard assessment for the Project, which is summarised below. This study aimed to identify any potential hazards associated with the Project and develop possible management and control procedures as specified in the relevant legislation.

This assessment was undertaken in accordance with SEPP 33 – Hazardous and Offensive Development Application Guidelines (DUAP 1994) (SEPP 33 Guidelines), and the Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (Planning NSW 1997).

7.18.2 Methodology

The hazard impact assessment required the key components of the Project to be reviewed against the threshold values and screening procedure as provided within the SEPP 33 Guidelines. The key components of the Project were also risk assessed and relevant controls developed in order to keep risk to a minimum.

Aston proposes to develop environmental management procedures including management plans for the storage and transport of substances.

7.18.3 Impact Assessment

A number of potential hazards were identified and assessed utilising the SEPP 33 Guidelines screening procedure. This confirmed that no aspect of the Project is considered to be hazardous or offensive.

Despite this, the risk assessment process has identified typical management measures that will be implemented to ensure operations are undertaken safely.

The Project will require the transport and storage of diesel, materials for explosives and other substances which may be considered to be potentially hazardous and are discussed further below.

Diesel Fuel Storage and Transport

Diesel fuel is listed in the NSW Occupational Health and Safety (Dangerous Goods Amendment) Regulation 2005 as a Class C1 Dangerous Good. Diesel fuel will be stored onsite in tanks. On average a total of 2.0 Million Litres of diesel will be stored onsite over a 14 day holding period.

The storage facilities will be designed in accordance with the relevant Australian Standards to comply with the various regulatory requirements and will be located a sufficient distance from the Project Boundary to ensure that in the case of a fire or explosion there will be no offsite impacts. All diesel storage facilities will be located in a bunded area in accordance with the NSW Occupational Health and Safety (OH&S) Regulations and AS1940-2004.

No other flammable liquids will be stored in the vicinity of these diesel storages and specifically no significant quantities of petroleum will be stored onsite (some may be required for mowers, generators etc), which will significantly minimise the severity of an explosion or fire in the unlikely event it should occur. The transport of diesel to the site will be undertaken by licensed contractors which will comply with the OH&S standards and procedures.

As such, in accordance with the SEPP 33 Guidelines this component is not considered to be hazardous or offensive.

Explosives Storage and Transport

Aston will utilise initiating products, detonators, and emulsion explosives for blasting activities to facilitate open cut coal mining. These commonly used materials will be stored in a storage magazine that is constructed in accordance with the NSW OH&S regulations.

All storage facilities will be located a minimum of 200 m from onsite facilities such as offices and a sufficient distance from the Project Boundary to ensure that in the case of a fire or explosion there would be no offsite impacts.

These products will be generally sourced from Newcastle and transported by trucks via Blue Vale Road. Vessels used to transport explosives will be appropriately designed and licensed.

Other Hazardous Material

Activities associated with the Project will utilise a number of other chemicals and substances. Aston will develop a database to assist in the recording and management of chemicals.

This chemical management system will contain a Material Safety Data Sheet (MSDS) for all chemicals used onsite.

The Project will utilise a number of gaseous substances including Oxygen, Ethyne, Nitrogen, Argon, Butane-Propane, Tetrafluoroenthane and Carbon Dioxide.

A maximum of 100,000 L of oil, 8 t of grease and 30,000 L of coolant will be stored onsite. Other materials frequently utilised and stored in the proposed workshop areas may include sealing and adhesive compounds, water dispensing compound, contact cleaner, vasoline, spray paint, fly spray, inox Spray, CRC silicon spray and degreaser.

These substances will be stored onsite in above ground facilities in the MIA, at a suitable distance from any diesel or explosive storage areas to minimise any potential risks. These substances will be located in a bunded area in accordance with the NSW OH&S Regulations which will minimise the risk and severity should fire or explosion occur and prevent any toxic contamination of the surrounding environment.

Conclusions

A review of the relevant components of the Project has confirmed that the Project is not considered to be potentially hazardous or offensive.

As such, a further more detailed hazardous analysis is not required.

7.18.4 Mitigation and Management

It was concluded that the Project is not considered hazardous or offensive, and no offsite impacts are anticipated, however management procedures will be implemented to ensure any potential hazards are minimised and their likelihood of occurrence decreased by ensuring compliance with relevant legislation, regulations and guidelines.

The hazard management measures for the Project are summarised below:

- Aston will develop a Hazard Management Plan to support an application for a Notification from WorkCover under the Occupational Health and Safety Regulation 2001. This will outline procedures for transport and storage of substances, storage location with respect to the Project Boundary, quantity of material and detailed procedures should an event such as fire, explosion or spill occur;
- Aston will develop a database to assist in the recording and management of chemicals. This chemical management system will contain a MSDS for all chemicals used onsite;
- All hazardous materials associated with the Project will be transported by a licensed contractor in accordance with the relevant Australian Standard and legislation;
- Storage facilities, vehicles and transport vessels will be regularly inspected for leaks, spills and other damage or faults;

- All storage facilities for explosives, diesel, oil and other hazardous materials identified above will be designed in accordance with applicable Australian standards to minimise any offsite impacts, toxic contamination of the surrounding area and minimise the severity of an incident in the case of fire, explosion or hazardous substance spills;
- Explosive storage facilities will be located a minimum of 200 m from Project facilities such as offices;
- Storage areas will be located at a sufficient distance from the Project Boundary to ensure there will be no offsite impacts;
- All explosives will be stored in a purpose built magazine built to appropriate standards; and
- Magazines will be designed and maintained in accordance with the Dangerous Goods Amendment Regulations 2005 and NSW Department of Mineral Resources regulations.

7.19 ECONOMICS

An Economic Impact Assessment was undertaken for the Project by Gillespie Economics and is reproduced in **Appendix Q**. A supplementary assessment to this was also undertaken to compare the simple economic principles between mining and agricultural industries on a State and regional level. A summary of this supplementary report is also discussed below as relevant, with the full report included as an addendum to **Appendix Q**.

7.19.1 Background

The economic impact assessment was primarily concerned with the determination of the following two issues:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits); and
- The economic impacts of the Project (i.e. the economic stimulus that the Project will provide to the regional or State economy).

The economic assessment provided a comparison of the economic efficiencies of coal mining and the agricultural industry, including the consideration of the use of land and water resources. A description of this comparative assessment is provided below.

7.19.2 Methodology

The DP&I (formerly Planning NSW) commissioned the development of the Draft Guidelines for Economic Effects and Evaluation in Environmental Impact Assessment in 2002 (Economic EIA Guidelines) (James and Gillespie 2002). The Economic EIA Guidelines identifies economic efficiency as the key consideration of economic analysis.

Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The Economic EIA Guidelines identify BCA as an essential component to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The Economic EIA Guidelines indicate that an economic impact assessment may provide additional information as an adjunct to an economic efficiency analysis. Predicted economic stimulus to the regional and State economies can be estimated using input output modelling.

BCA involves the following key steps:

- Identification of the base case or *"without"* Project case;
- Identification of the *"with"* Project scenario;
- Physical quantification and valuation of the Project's incremental benefits and costs;
- Consolidation of values using discounting to account for the different timing of costs and benefits;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non quantified benefits and costs, where applicable.

Regional economic impact assessment is primarily concerned with the effect of an impacting development on an economy in terms of a number of specific indicators, such as gross regional output, value added, income and employment. These indicators can be defined as follows:

- Gross regional output – the total business turnover;
- Value added – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- Income – employee's wages including imputed wages for self employed and business owners; and
- Employment – the number of people employed (including full time and part time).

For the purposes of the economic impact assessment for the Project, a new Maules Creek Coal Mine sector was inserted into the regional input output tables. This reflected peak production levels of up to 13 Mtpa of ROM coal for the Project. The direct and indirect impacts of the Project on the local region (i.e. Narrabri and Gunnedah LGAs) and NSW on a whole was assessed.

The supplementary report provides a discussion of the key economic parameters for agriculture and coal mining on both State and regional economies for comparison. This supplementary report investigated the economic values of land, how agricultural activity promotes economic growth in regional areas, the potential for any conflict in the use of prime agricultural lands for other uses to threaten food production within NSW, the limited availability of prime agricultural land in economic terms, and the impact of mining on water resources compared to other uses.

7.19.3 Impact Assessment

Benefit Cost Analysis

The results of the BCA for the Project are summarised in **Table 51**. The main decision criterion for assessing the economic desirability of a Project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs, which is calculated via the BCA. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole would obtain net benefits from the Project.

The BCA confirms that when production costs (acquisition costs for affected land, opportunity cost of land, operating costs, decommissioning costs, etc) and production benefits (revenues from production, residual values of land, etc) are considered, the Project will have net production benefits of $8,728 Million.

This net production benefit is distributed amongst a range of stakeholders including:

- The local community, in the form of donations and community support programs;
- Aston Resources and its shareholders;
- The NSW Government via royalties; and
- The Commonwealth Government in the form of Company tax.

The tax and royalty income derived from the Project is significant. Royalty payments to the NSW government over the first 21 years of production are expected to total $2.8 Billion. In addition to the production costs and benefits, the Project will have a number of potential external costs that need to be considered.

The external economic costs associated with the Project were estimated as: greenhouse gas generation at $115 Million and Aboriginal heritage impacts at $188 Million. Air quality and noise and vibration impacts were incorporated into the estimation of net production benefits via acquisition costs for nearby affected properties.

The economic effects resulting from the disturbance of sensitive ecology were not considered significant as these are compensated as part of the proposed Biodiversity Offset Strategy discussed in **Section 7.7**. Transport costs have also been included in the estimation of net production costs via incorporation of the costs of upgrading Therribri Road.

Table 51 Benefit Cost Analysis

CATEGORY	COSTS	BENEFITS
Production	■ Opportunity cost of land (State Forests land, agricultural land owned by Aston Resources and other agricultural land required for the Project) ■ Opportunity cost of capital ■ Capital costs associated with coal production and ancillary works ■ Operating costs, including administration, mining, processing, transportation and rehabilitation (excluding royalties) ■ Decommissioning costs	■ Sale value of coal ■ Residual value of capital and land at the cessation of the Project
Potential Externalities	■ Air quality impacts ■ Greenhouse gas impacts ■ Noise and vibration impacts ■ Ecology impacts ■ Groundwater impacts ■ Traffic and transport impacts ■ Aboriginal archaeology and cultural heritage impacts ■ Non-Indigenous heritage impacts ■ Visual impacts ■ Surface water impacts and sediment / erosion control	■ Economic and social benefits of employment provided by the Project

The external benefits associated with the employment provided by the Project have been estimated at $194 Million. These external benefits associated with employment provided by the Project were estimated based on benefit transfer.

Overall, the BCA estimated that the Project will have net benefits to society of $8,618 Million. Based on this outcome the Project is considered desirable and justified from an economic efficiency perspective.

Regional and State Economic Impact Assessment

Table 52 provides the calculated regional and State economic contributions from the Project in terms of specific economic parameters.

The regional sectors are most impacted by output, value added and income flow-ons that would be felt across a range of sectors in the economy. Sectors that would be impacted include: the coal mining sector, wholesale trade sector, retail trade sector, technical services sector, road transport sector, electricity supply sector and hotels, cafes and restaurants sector.

The impacts on the NSW State economy are substantially greater than for the regional economy, as the NSW economy is able to capture more mine and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

Land and Water Resources for Different Uses

The supplementary report undertaken to compare the use of land and water resources between coal mining and agricultural activities confirmed that there is no obvious justification for new policy implementation that disadvantages the proposition of mining versus that of agricultural pursuits.

Whilst mining and petroleum authorities are held across more than 70% of the State, there is very little similarity between the lands typically utilised for mining areas and the key areas of prime agricultural land. Mining areas are generally located on the elevated areas away from prime agricultural land. Mining and its extensive economic benefits was shown to be of a greater economic significance to the NSW economy than all of the agriculture, forestry and fishing industries combined together.

Recent trends have shown that the agriculture industry is leading to improved productivity with the mechanisation and consolidation of farming lands. This has resulted in a reduced economic stimulus in regional areas as the demand for economic inputs such as labour decline and expenditure leaves the region to more specialised service providers for new technically advanced machinery.

The conversion of land to be used by higher value production activities such as mining offers the greatest potential for regional growth. This is because it helps to stimulate the economy with regional spending for production related costs and with wages for labour which generally enter the regional economy.

The consideration of the price of land and water (reflecting the value of these resources for competing land uses) is the best means of allocating the scarce land and water supplies between competing land uses, subject to planning laws to address environmental externalities.

The existing planning approvals framework under Part 3A of the EP&A Act provides a mechanism for considering the external impacts of development proposals on a case by case basis, including potential impacts upon prime agricultural land.

A case study was undertaken specific to the Project based on the Gunnedah and Narrabri Statistical Local Areas (SLAs). Statistics show that there is a declining trend in population within the Gunnedah and Narrabri SLAs, which is expected to be the result of changes in farming practices.

Currently, extractive industries are conducted on less than 1% of the land area within the Gunnedah and Narrabri SLAs, while agriculture accommodates around 68% of the land area.

Table 52 Project Regional and State Economic Contributions

REGION	STATE
$1.9 Billion in annual direct and indirect regional output or business turnover	$2.8 Billion in annual direct and indirect output or business turnover
$1.0 Billion in annual direct and indirect regional value added	$1.6 Billion in annual direct and indirect value added
$54 Million in annual household income	$303 Million in annual household income
753 direct and indirect jobs	4,029 direct and indirect jobs

The output value of existing coal production within the Gunnedah and Narrabri SLAs is greater than all agricultural production within the region. The annual output value of the Project is over four times the annual output value of all agricultural production within this region. Direct and indirect employment provided by the Project will be more than 27 times that provided by continued agricultural use of the land and water resources. The net production benefits ($8.7 Billion) of the Project are more than 345 times those of the continued agricultural production and use of the required water for the Project within the region.

7.19.4 Mitigation and Management

At the end of the Project (in 21 years), and assuming no further planning approval is granted for its extension, a range of economic impacts and a reduction in economic stimulus will occur. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region;
- The economic structure and trends in the regional economy at the time; and
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Nevertheless, given the uncertainties about the circumstances within which Project cessation will occur, it is important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project will bring to the region, to strengthen and broaden the region's economic base.

Mitigation measures for the specific environmental issues are addressed within other sections throughout this EA.

7.20 SOCIAL

7.20.1 Background

Hansen Bailey completed a SIA for the Project which is presented in full in **Appendix R**. This study developed a social profile for the Narrabri and Gunnedah LGAs (the local area) and identified the future socio-economic impacts that may result from the Project (including the cumulative impacts from existing and possible future mining operations). The SIA also considered issues raised by stakeholders during the EA consultation program described in **Section 5.2**. Management and mitigation measures have been developed in consideration of the findings.

7.20.2 Methodology

The SIA methodology included the following key tasks:

- Description and analysis of the existing local socio-economic setting based on a review of existing information (both statistical and anecdotal);
- Development and analysis of two scenarios for the Project workforce profile and a workforce accommodation strategy for the construction and operational phases. These scenarios present the two most extreme social impact scenarios that could arise as a consequence of the Project;
- Assessment of potential social impacts of the Project on the local area, including the social impacts associated with the workforce under the two most extreme scenarios. This assessment included consultation with neighbouring landowners.
- Assessment of potential social impacts associated with the Project with reference to existing and conceptual surrounding industry;
- Development of appropriate mitigation and management measures for any adverse social impacts, followed by consultation with stakeholders on these proposed mitigation and management measures;
- Analysis of the potential cumulative impacts of the Project and surrounding industry. This analysis assumes that current early stage coal exploration projects proceed through technical feasibility into planning, construction and operation; however, it should be noted that not all pre-feasibility projects currently being assessed are likely to reach full operation. The purpose of the cumulative impact analysis is simply to evaluate, at a high level, the potential longer-term impacts of additional mining projects in the local area;
- Identification of areas for infrastructure development and growth in community services to support the local area in the future (having regard to both the modelled impacts of the Project and potential cumulative impacts); and
- A description of the likely outcomes of the Project under the 'Mitigated Case' once proposed mitigation and management measures have been implemented by Aston. The 'Mitigated Case' recognises that Scenarios 1 and 2 represent extremes of the possible social impacts and seeks to demonstrate the more moderate impacts likely to result after the application of Aston's proposed mitigation and management measures and preferred accommodation and relocation strategy.

Sensitivity Analysis

Two scenarios have been assessed as described below in order to:

- Identify and appropriately assess the potential social impacts linked to the Project; and
- Develop strategies that will adequately mitigate impacts on the local area and the community.

These scenarios have been selected as they represent two *"extremes"* of the potential spectrum of social impacts. Both assume that 20% of the workforce is sourced locally and 80% is non-local. The key differentiating factor is that Scenario 2 will result in no direct permanent population increase, where Scenario 1 will result in a large population increase.

Scenario 1

Scenario 1 assumes that:

- Of the Project construction workforce:
  - 20% is sourced from the local area; and
  - 80% is sourced from outside the local area and will utilise accommodation supplied through the MAC Group workers' accommodation village to be located at Boggabri.
- Of the Project operational workforce:
  - 20% is sourced from the local area; and
  - 80% is sourced from outside the local area and will re-locate to the local area.

This first *"extreme"* assumes that the local area will absorb the maximum number of new residents (i.e. the full operational workforce and their families) virtually immediately.

Scenario 2

Scenario 2 assumes that:

- Of the Project construction workforce:
  - 20% is sourced from the local area; and
  - 80% is sourced from outside the local area and will utilise accommodation supplied through a MAC Group workers' accommodation village to be located at Boggabri.
- Of the Project operational workforce:
  - 20% is sourced from the local area; and
  - 80% is sourced from outside the local area and will utilise accommodation supplied through the MAC Group workers' accommodation village to be located at Boggabri.

This second *"extreme"* assumes that there is no integration of the non-local workforce into the local community. The social impacts associated with this scenario are related to the utilisation of a remote workforce and the workers' accommodation village.

7.20.3 Socio-Economic Environment

Local Area Setting

Narrabri LGA

According to the Narrabri National Regional Profile (ABS 2010), the Narrabri LGA had a 2008 population of 13,507 persons. The main township in the LGA is Narrabri which in 2006 had a population of 6,102 persons which equates to 45.2% of the LGA population.

The next largest settlements are Boggabri and Wee Waa which have 6.9% and 12.8% of the total LGA population respectively (Edge Land Planning 2009).

Also located within the Narrabri LGA is the Maules Creek Village. The Maules Creek Village consists of a small community based in the foothills of the Nandewar Ranges. Located in the village is a 100 year old single teacher school, a community hall and some recreational facilities. The community hall is generally used for community meetings and social gatherings.

Based on the latest available statistical data, the Narrabri LGA is characterised is characterised by a(n):

- Declining population, with the LGA population decreasing by 711 people (5.1%) between 2001 and 2006;
- Declining growth in the number of private dwellings across the LGA, but increased growth in the number of private dwellings in the three main towns of Narrabri, Boggabri and Wee Waa;
- Ageing population, with the median age increasing from 36 years in 2001 to 38 years in 2006;
- Larger Indigenous population, made up of a large proportion of youth (32.8%) with a relatively high unemployment rate (28.4% of youth labour force unemployed);
- Relatively high unemployment rate, although this has dropped marginally from 8.1% in 2001 to 7.1% in 2006;
- Changing employment patterns in industry, with a reduction in employment in the agricultural and forestry industries, significant reduction in the manufacturing and wholesale trades and a corresponding significant increase in employment in the mining industry, with minor increases in employment in the education, health care and administrative services industries;

- High youth unemployment rate (15 – 19 years) with 16.8% of the overall youth labour force unemployed;
- Declining labour force size, with the size of the labour force reduced by 7.1% from 2001 to 2006, with a corresponding reduction of 8.3% in the number of people employed full time in the workforce for the same period; and
- Median individual, family and household income levels lower than average NSW income levels with the median household weekly income of $792 being 23.6% less than the NSW median household income of $1,036.

Anecdotal reports and information provided by NSC suggest, however, that economic conditions in the Narrabri LGA are improving – evidenced by increasing rental prices and tightening job and housing markets (NSC 2011).

Gunnedah LGA

According to the Gunnedah National Regional Profile (ABS 2010), the Gunnedah LGA had a 2008 population of 11,985 persons. The main township in the LGA is Gunnedah and in the 2006 census, approximately 75% of the LGA population lived in either the Gunnedah township or the largest outlying village of Curlewis.

The Gunnedah LGA is characterised by a(n):

- Declining population, with the LGA population decreasing by 451 people (3.8%) between 2001 and 2006;
- Ageing population, with the median age increasing from 37 years in 2001 to 40 years in 2006;
- Decreasing number of occupied private dwellings (from 5,145 in 2001 to 5,015 in 2006);
- Stable labour force size, with little change between 2001 and 2006 and only a marginal increase in the number of people employed full time;
- Relatively high unemployment rate which has dropped marginally from 9.3% in 2001 to 8.3% in 2006;
- High youth unemployment rate (15 – 19 years) with 14.8% of the youth labour force unemployed;
- Stable employment patterns in industry with the agricultural industry continuing to be the largest employment sector;
- Indigenous population made up of a large proportion of youth (27%) with a relatively high unemployment rate (18.5% of youth labour force unemployed); and
- Median income levels substantially lower than average NSW income levels. In 2006, median weekly household income levels in Gunnedah LGA were 31% less than the median NSW household income.

Consultation carried out with GSC suggests, however, that (as for the Narrabri LGA) economic conditions in the Gunnedah LGA are improving – evidenced by increasing rental prices and tightening job and housing markets.

Labour Force and Skill

Table 53 provides an indication of the available labour in the local area. Labour skills in the local area are primarily driven by agriculture.

Through statistical analysis and stakeholder consultation it has been established that there is a skills shortage in the local area, with the expansion of mining considered to be a catalyst for skills growth.

Table 53 Available Labour in Gunnedah and Narrabri LGAs

	GUNNEDAH LGA	NARRABRI LGA	AUSTRALIA
Unemployment Rate %	8.3%	7.1%	5.7%
Participation Rate %	57.2%	61.3%	65.5%
Total Labour Force	5,108	6,198	10,793,100
Labour Surplus*	312	462	-
Unemployed	426	440	501,200
Not in Workforce or Labour Force	3,397	3,378	6,310,093
Part Time Workforce	1,592	1,338	3,150,000
% Part time	31%	22%	29%

Source: ABS Census data 2006 and ABS 6202.0.

* A labour surplus is where the number of employed residents of an area exceeds the number employed within the area. This means, in net terms, the difference is employed people who went elsewhere to work (e.g. next LGA).

As can be seen in **Table 53**, the local area has a relatively high unemployment rate compared to the Australian average and also a lower rate of workforce participation. Both the unemployment rate and the below average participation rate support the conclusion that, with appropriate ongoing education and training initiatives, there is potential for the local area to absorb a proportion of the jobs created by the Project.

This higher level of unemployment and lower level of workforce participation are marked issues for the local area but can be significantly addressed with specific training and education opportunities.

Aston has already committed to providing these opportunities (to date one scholarship, two full time apprenticeships and two school apprenticeships directly associated with the Project) and intends to increase these programs during construction and operation (as outlined in more detail in **Section 7.20.9**).

Housing Market and Affordability

The median house price in Narrabri was $235,000 compared to $206,250 for Gunnedah in 2009. Although the housing market (both purchase and rental) appears to be tight, there is considered to be adequate land available for significant new housing development.

A comparison of median household income and median housing loans indicates that housing in the local area is more affordable on a debt to income basis when compared to other areas such as the Hunter Statistical Division or Capital cities.

Also available in the local area are a number of short term accommodation options including hotels, motels and caravan parks. However, these are, with the recent increase in mining related activities, regularly at full utilisation.

A workers' accommodation village has recently been constructed in the Narrabri LGA which is targeted towards mining contractors and employees. This camp has been constructed with standard 16 sqm rooms and has approval for up to 242 rooms (Caladines Town Planning Pty Ltd, 2010). Aston does not intend to utilise this facility.

In conjunction with the MAC Services Group, Aston intends to develop an accommodation facility in Boggabri principally for the purposes of the construction phase of the Project but also for a smaller operational requirement. Aston forecasts that approximately 350 rooms will be required during the construction phase and then 200 rooms in the operational phase.

The design and preparation of the planning application for this development is underway with consultation having been undertaken with NSC and the Boggabri Community.

The accommodation will be a motel style development with large rooms (24 sqm compared to 16 sqm as is typical for a construction camp facility), significant landscaping and modern recreational facilities, including a gym, which is intended to be open for public use.

Community Services and Facilities

The local area is serviced by local hospitals in the townships of Narrabri, Gunnedah, Boggabri and Wee Waa.

The total number of beds in the local area is 126. Additional health care is provided throughout the townships including aged care facilities, community health centre, Home and Community Care and general practitioners. Many of these services include mental health care facilities.

Primary, secondary and tertiary education facilities are available in the local area. Narrabri has three primary schools and one high school; Gunnedah has four primary schools and two high schools; Boggabri has two primary schools; and Maules Creek Village has a one teacher primary school.

Narrabri Airport is serviced by Aeropelican and according to the online flight schedule, provides flights between Narrabri and Sydney (12 per week), Newcastle (1 per week) and Brisbane (10 per week). The airport service provides medical professionals, business professionals and other key service groups a convenient and accessible way to visit and service the area (NSC 2007).

7.20.4 Project Workforce Scenario 1

Labour Force Supply

Project construction is anticipated to commence in Year 1 and continue for a period of around 15 months. The anticipated peak workforce during construction is 340 equivalent full time persons. During operations, the Project will employ up to 470 people.

The Project is located approximately 18 km from the town of Boggabri and between the townships of Gunnedah and Narrabri and hence is able to attract employees from each of these locations. There will be a large number of skilled construction job opportunities job availabilities in a short space of time that the local community may have difficulty absorbing. For the purposes of this assessment it has been anticipated that:

- 20% (68 employees) of the peak construction workforce will be local hires and 80% (274 employees) non-local hires; and
- At peak production, 20% (93 employees) of the operations workforce will be local hires and 80% (373 employees) will be non-local hires, with 20% (75 employees) of these drawn from outside the Northern SD and interstate.

Labour Force Residence Location

Local hires are likely to include mine operators, maintenance workers, local ancillary staff, apprentices and graduates. Consistent with the adjacent Boggabri Mine's existing workforce (Hansen Bailey, 2011) it has been assumed that 39% of local hires will be based in Gunnedah, 25% in Narrabri, 19% in Boggabri and the remainder in other local areas.

Non-local operational hires will predominantly consist of experienced maintenance workers, mine operators and professional staff. It has been assumed that all non-local hire operational employees will relocate to the local area with the following distribution: 30% Gunnedah; 55% Narrabri; 20% in Boggabri and the remainder in other local areas.

This shall been achieved through Aston's commitment to encouraging non-local hires to relocate to the Narrabri LGA (as outlined in more detail in **Section 7.20.9**).

7.20.5 Project Workforce – Scenario 2

Labour Force Supply

During operations, the Project will employ approximately 239 persons in Year 1. The workforce will increase to approximately 398 employees by Year 5 following full production being achieved.

A peak operational workforce of approximately 470 will be utilised.

Due to the difficulty in absorbing such a large number of job availabilities in a short space of time, and the associated concentrated impact on the local economy, housing and services, a second scenario has been considered which involves the utilisation of a remote workforce.

The same assumption that approximately 80% of a construction workforce will generally be required to be sourced from outside the local area and 20% will be local hire has been maintained for Scenario 2.

For the purposes of Scenario 2, it has been anticipated that:

- 20% (68 employees) of the peak construction workforce will be local hires and 80% (274 employees) non-local hires; and
- At peak production, 20% (93 employees) of the operation's workforce will be local hires and 80% (373 employees) will be non-local hires. Of the non-local hires, it is assumed that 75% (280 employees) will be remote and travel by air and 25% (93 employees) will be remote and travel by car and bus to/from other regional centres. The 80% non-local hires will utilise the Boggabri MAC accommodation village;

As noted above, Scenarios 1 and 2 are *"extreme" scenarios modelled to assess the potential maximum social impacts. After the application of proposed mitigation and management strategies, a more moderate "Mitigated Case"* outcome is likely.

It has been assumed that non-local hires are likely to predominantly consist of highly experienced and skilled maintenance workers, mine operators and professional staff. Local hires are likely to include mine operators, maintenance workers, local ancillary staff, apprentices and graduates.

Labour Force Residence Location

The anticipated residential breakdown for the construction and operational workforce under Scenario 2 includes:

- Local hires having the same residential breakdown as the existing Boggabri Coal workforce described under Scenario 1 being: 39% of employees based in Gunnedah, 25% located in Narrabri, 19% in Boggabri and 14% from other local areas; and
- For remote workers during shifts:

350 beds within the MAC Group workers' accommodation village to be located at Boggabri for construction workers; and

200 beds within the MAC Group workers' accommodation village to be located at Boggabri for operational workers.

Of the operational workforce, for modelling purposes, it has been assumed that 75% will travel by air from areas greater than 200 km from the Project (e.g. from Newcastle, Sydney or interstate).

It is anticipated that the remaining 25% will travel by bus or car (both personal vehicles and chartered buses) from areas such as Moree, Tamworth and Muswellbrook. It is expected that this model overstates the proportion of long distance (air) travel to ensure maximum impacts are assessed.

7.20.6 Stakeholder Issues Identification

Regulators

A detailed discussion of consultation with regulators and the community and issues raised is provided in **Section 5**.

Near Neighbours

A survey was carried out with near neighbours, which aimed to identify areas of need in the community.

Improved healthcare was the most commonly raised concern, followed by education, improved roads, an additional doctor at Boggabri, improved Indigenous health facilities and improved day care facilities.

A further meeting was held with the Fairfax Public School at Maules Creek. The main concerns identified for the school included reducing pupil numbers, air conditioning, water supply to the top floor of the building and removal of redundant equipment such as gas bottles. Aston has addressed the air conditioning supply and will be addressing the concerns regarding water supply and redundant equipment. Concerns in relation to cumulative noise, dust and blast amenity impacts from Boggabri Mine, Tarrawonga Mine, Goonbri and the Project were also raised.

Media

A review of media sources was conducted in order to identify the general assumptions and concerns of the wider community. The main concerns identified included competition for land and water resources, the progression of the Namoi Water Study and coal seam gas mining.

Positive contributions which mining companies provide to the community are also regularly reported in the local community newspapers and on community radio, including details of financial contributions made to community based projects and development of education and training programs.

7.20.7 Impact Assessment

Population

The operational phase of the Project will require up to 373 non-local hires. At an average household size of 2.5 persons (average for Narrabri LGA and Gunnedah LGA (ABS 2006)) the Project, under Scenario 1, may result in a permanent population increase of approximately 932 persons across the local area.

Table 54 summarises the potential estimated population increases in the main settlements of the local area which could be attributed to the operational phase of the Project under Scenario 1 from non-local hires, which utilises the anticipated residential breakdown as described in **Section 7.20.4**.

Scenario 1 would require the relocation to the local area of a high number of non-local hire employees with their families in a relatively short period of time.

This is likely to lead to a more concentrated level of impacts to the local economy, housing and community services and facilities than Scenario 2.

Under Scenario 2, the anticipated temporary population increase to the local area associated with the Project will be 373 people (**Section 7.20.5**).

In addition to the above potential population increases there is potential for population increase as a result of indirect employment opportunities generated by the Project and the associated workforces. Given the anticipated growth in coal mining in the Gunnedah Coal Basin, it is likely that there will be growth in the population base which can be attributed to the provision of indirect employment opportunities.

Housing

Under Scenario 1, the Project will draw approximately 932 people to the local area. This permanent population increase will generate demand for approximately 373 dwellings across the local area, assuming an occupancy rate of 2.5 (Census 2006).

Table 54 Potential Estimated Population Increase from the Project

WORKFORCE PROFILE*	TOTAL PERSONS**	NARRABRI TOWNSHIP**	GUNNEDAH TOWNSHIP**	BOGGABRI TOWNSHIP**	OTHER AREAS**
Total Workforce	466	256	140	47	23
Non-local hires	373	205	112	37	19
Total incoming population	932	513	280	93	47
Estimated Adults (18+ yrs) – (73.9%)	689	379	207	69	34
Estimated children (<18 yrs) – (26.1%)	243	134	73	24	12
Estimated children <5 yrs – (6.6%)	62	34	18	6	3
Estimated primary school children – (10.2%)	95	52	29	10	5
Estimated secondary school children – (10.5%)	98	54	29	10	5

Notes: * Population breakdown is based on NSW Northern Statistical Division 2006 ABS Census Age Profile.
** Discrepancies in breakdown of numbers is due to rounding.

When compared to the available dwellings in both the rental and purchase markets, there does not appear to be adequate existing housing to accommodate the predicted increase in demand. Given the historical populations exceeding 15,000, there is expected to be scope for possible future increases in population.

Sufficient land is available for residential subdivision and therefore construction of new dwellings in Narrabri and Gunnedah. One such area is proposed to be developed in Narrabri, providing up to 83 lots for residential housing.

Under Scenario 2, the population increase of 373 is not considered to be permanent and it is anticipated that the workers will be accommodated by the proposed MAC Group workers' accommodation village to be located at Boggabri. Scenario 2 would have less of an impact on the local housing market than Scenario 1.

Labour Pool and Skills

The total number of people potentially available for employment across the local area is approximately 1,640 people (unemployed and labour surplus).

In addition, if the participation rate (61.3% and 57.2% for Narrabri and Gunnedah LGAs respectively) were increased to the Australian average of 65.5%, then there would be an additional (1,506) workers available.

At a high level, this potentially indicates that there is a sufficient labour pool to supply the needs of the Project. However, the skills of these people are unknown and there is a high probability that many of them will require training and education to work within a mining operation.

The local area has a relatively small pool of skilled labour that would be suitable for work at a mining operation. As such, there is the potential for the Project to place some strain on the skilled labour force in the region, particularly during construction and the earlier operational years. During the initial construction and ramp-up stages of the Project, this will necessitate a significant number of non-local hires to fill skilled labour positions.

Community Services and Facilities

The local area is currently serviced by a range of facilities and services. There is available capacity in local infrastructure, services and facilities to accommodate the population increases associated with the Project.

Education and health services have the capacity to meet the demand generated by the additional population, although it should be noted that these two areas were identified by the community as being areas of need (**Section 7.20.6**).

Under Scenario 1, the Project has the potential to place additional strain on services such as education, child care and health services. Under Scenario 2, impacts on many community services and facilities would be minimised. There would be a significant increase in demand for the Narrabri airport to accommodate the remote employees associated with the Project.

7.20.8 Cumulative Impacts

There are a number of existing and proposed mining developments at various stages of development in the local area. The assessment included a high level review of the potential impacts of additional mining projects or expansions and other industry being developed in the local area.

It is important to note that early stage exploration projects have been included in the cumulative assessment for the Project. For such projects, it is difficult to assess if they will be feasible from an economic or technical perspective let alone from an environmental and planning perspective.

Whilst some projects are awaiting planning approval, other projects are at pre-feasibility stage with minimal or no publically available information relating to residential assumptions, timing, number of employees or proportion of remote employees. As such broad assumptions have been made regarding these 'potential future projects'.

For the purpose of assessing cumulative impacts, the SIA has reviewed two years in the Project's life against the two Scenarios. These are Year 2 when the Project will be operationally ramping up with 'existing approved mines'; and Year 10 when the Project may be operating with 'potential future projects'. Further detail is provided in **Appendix R**.

When considering the cumulative workforce numbers of currently planned mining projects and 'potential future projects', a significant number of the skilled workforce will likely need to be recruited from outside the local area. It should be noted that the construction of the Project is likely to occur prior to a number of other 'potential future projects'. As such, the skilled workforce in the local area will have already benefited from the mitigation measures proposed by the Project as outlined in **Section 7.20.9**.

Potential areas of cumulative impacts in the local area include:

- Housing affordability and accessibility;
- Skill shortages and competition for skilled personnel;
- Economic growth and stability; and
- Supply and demand for community services and facilities.

Scenario 1 - Relocation

In Year 2 of the existing approved mines, only Boggabri Coal Mine will require additional employees, which will increase the permanent population by 500 people. Combined with the Project, this may equate to a permanent population increase of 1,060. This permanent population increase will result in the need for approximately 424 houses / units / apartments. This will have limited additional cumulative impacts above the potential areas of social impact identified above for the Project.

In Year 10 of the Project, applying the assumptions modelled for the Project, noting that there is no detailed publicly available information (e.g. residential assumptions, timing, number of employees, proportion of remote employees) for Caroona, Watermark or Goonbri, a potential permanent population increase to the local areas of 5,972 (based on 2.5 average household) is possible when considering Boggabri Coal Mine Continuation, the Project, Watermark, Caroona, Goonbri and Eastern Star Gas. This permanent population increase will result in the need for approximately 2,389 houses / units / apartments.

Significant cumulative impacts on all potential areas identified above would occur, however assessments undertaken for each of these Projects will quantify accurate cumulative impacts.

Scenario 2 – Remote Workforce

In Year 2 of the existing approved mines, only Boggabri Coal Mine will require additional employees which will increase the permanent population by 500 people. This scenario will have similar impacts to the Project alone as described in **Section 7.20.7**.

In Year 10 of the Project, applying the assumptions modelled for the Project, noting that there is no detailed publicly available information (e.g. residential assumptions, timing, number of employees, proportion of remote employees) for Caroona, Watermark or Goonbri, no potential permanent population increase is predicted.

No significant cumulative impacts on areas identified above would occur, with the exception of some of the community services and facilities (e.g. Narrabri Airport, roads and healthcare). Assessments yet to be undertaken for each of these Projects will quantify accurate cumulative impacts and appropriate mitigation.

Adequately addressing the cumulative impacts outlined above is likely to require significant investment into local infrastructure, schools, colleges and hospitals.

This investment will require the combined commitment of local government authorities, stakeholders and mining companies. At this early stage, it is difficult to determine which regional centres are likely to be impacted the greatest as this will be dependent on the workforce habitation locations for future projects. The key purpose of this cumulative impact assessment is to highlight areas of infrastructure and community services that will require further planning, development and investment at the appropriate time.

7.20.9 Mitigation and Management

Aston acknowledges the potential social impacts associated with the Project and surrounding mining developments on the local community.

The two scenarios assessed in the SIA are representative of a worst case of each scenario.

In reality it is anticipated that Scenario 2 is representative of the early stages of the Project (particularly during construction). Aston will encourage the re-location of its employees to the local area and integration of workers into the community as housing and community services and facilities develop. Aston intends to encourage its non-local workforce to develop new housing in the local area through a range of targeted financial incentives. This should increase the local housing stock and reduce the potential impact of higher population on house prices. Aston intends, over the medium to long term, to assist in increasing the skilled labour force within the region through targeted training opportunities, apprenticeships, scholarships and direct investment into local schools and TAFE colleges.

Aston will employ the following management strategies to mitigate impacts from the Project on the community:

- Continue to consult and work with The MAC, NSC and the community where necessary to facilitate the approval of the MAC Group workers' accommodation village to be located at Boggabri;
- Assist The MAC to implement strategies to integrate the facilities and residents into the local Boggabri community including:
  - Employee policies regarding no tolerance for anti-social behaviour (including an accommodation village Code of Conduct);
  - No sale of alcoholic beverages onsite;
  - Developing facilities which the town of Boggabri currently does not have, e.g. function room / training facility and gym;

  - Avoiding development of facilities which the town of Boggabri already has, e.g. lap pool, medical facilities, bar, and tennis courts; and
  - Making available site facilities (e.g. the restaurant, gym and function room / training facility) to the public.
- Implement an Employee Incentive Scheme which will include policies on items such as encouraging progressive re-location to the local area by provision of financial assistance with emphasis on construction of new dwellings;
- Contribute a total of $1,500,000 to Narrabri airport paid evenly over three years (as part of the NSC Voluntary Planning Agreement), for the expansion of services and routes to include renovation of terminal and upgrade of strip infrastructure;
- Implement local labour force recruitment strategies with a focus on non-skilled positions, to facilitate improving the local labour force skill;
- Implement state wide labour force recruitment strategies with a focus on skilled positions as needed, to facilitate improving the local labour force skill;
- Utilise local suppliers where possible to support growth of other local industries;
- Focus relocation and development strategies for all non-local hires to the Narrabri LGA to mitigate against cumulative impacts on housing in the Gunnedah LGA;
- Adopt within its recruitment policies:
  - A local hire strategy for operators, ancillary staff and trade apprentices in the short to medium term, although it is noted that the commencement of other major mining projects in the region may influence this strategy;
  - As part of the local hire strategy, efforts will be made in the recruitment and training of women and local Aboriginal people;
  - Continuation of Aston's Scholarship and Apprenticeship Program. This will include the expansion of a local traineeship and apprenticeship program, including at least four onsite apprenticeships per year in the first 10 years of operation (of which at least one will be for Indigenous applicants).
- Provide an annual scholarship for a locally based student to study a child care related course as well as sponsoring a traineeship program for child care workers;
- Continue to liaise with NSC and Ochre Health (health providers in Boggabri) relating to contributions towards additional health resources and medical facilities;
- Commitment to financial contributions of up to $20,000 per year to encourage retainment of medical staff in Boggabri;
- Provide investment of approximately $100,000 per year into capital equipment for services such as the bushfire brigade, ambulance, Westpac Helicopter and other valued community services;
- Ensure timely provision of information to facility and service providers regarding potential incoming population associated with the Project;
- Encourage relevant members of the workforce's children to attend Fairfax Public School at Maules Creek and continue to consult and provide assistance to the school as appropriate; and
- Monitor housing affordability and availability in the local area and report in the regulatory required Annual Review.

Additionally, Aston will continue to consult extensively with NSC and GSC to work towards forming a VPA under Section 93F of the EP&A Act to provide in kind and monetary contributions to ensure the potential social effects of the Project are mitigated.

These discussions are ongoing with the VPA to be agreed over the coming months.

7.20.10 Summary

The two scenarios have been modelled to assess maximum potential social impacts. As a result of the application of Aston's proposed management and mitigation strategies (as outlined in **Section 7.20.9**) the intent is that the population growth impacts on the local area is likely to be in between the outcomes modelled for Scenarios 1 and 2.

Over a 5-10 year period, with targeted incentives provided to the workforce to encourage relocation to the local area, Aston considers that the 80% non-local workforce would be reduced to approximately 50%. The intent is that this would be achieved through a combination of increasing the skill base of the local area and relocation of the initially non-local workforce.

This 'Mitigated Case' provides for a more gradual relocation of workers into the local area than is contemplated in Scenario 1. Liaising with the local Councils will give Aston an opportunity to optimise the development of local housing and services.

This should reduce the concentration of the impacts that would occur under Scenario 1 whilst ensuring that there is integration with the local community and a greater flow of benefits to local industry than would occur under Scenario 2.

Under the 'Mitigated Case', there is potential for cumulative impacts, but the incentives and mitigation measures will be used to ensure that housing development progresses at a sustainable rate for the local building industry to accommodate demand. Additionally, pressures on community services such as childcare, education and health facilities will be minimised because families will move to the area once infrastructure has sufficiently developed to support the growth. Aston, through its VPA and other commitments, will support this infrastructure growth.

SECTION

8

Statement of Commitments

SECTION 8

Statement of Commitments

In addition to conditions of Project Approval, Aston commits to the operational controls outlined in Section 7 of this EA for all activities associated with the Project.

The SoC in **Table 55** summarises the major aspects of the Project as described throughout this EA and lists the key proposed management and mitigation measures.

The aim of this SoC is to ensure that any potential environmental impacts resulting from the Project are minimised and managed by implementing relevant environmental management, mitigation and monitoring strategies.

Table 55 Statement of Commitments

REF	COMMITMENT	EA SECTION
Mining Operations		
1	Aston will extract coal at a rate of up to 13 Mtpa for 21 years, generally in accordance with this EA.	3
2	Aston will seek the appropriate licences and approvals as relevant to the Project and listed in **Table 9**.	4.8
3	Aston shall surrender its existing development consent DA 85/1819 following the grant of the Project Approval.	4
Environmental Management		
4	The proponent will develop a staged EMS in consultation with relevant regulators (and the Aboriginal community where relevant) to the approval of DP&I which shall comprise: ■ Environmental Management Strategy; ■ Environmental Monitoring Program (incorporating air quality, noise, blasting, ecology, Aboriginal heritage, surface water and groundwater); ■ Construction Management Plan; ■ Air Quality Management Plan; ■ Noise Management Plan; ■ Flora and Fauna Management Plan (including Land Disturbance Protocol); ■ Biodiversity Offsets Management Plan; ■ Rehabilitation Management Plan; ■ Aboriginal Archaeology and Cultural Heritage Management Plan; ■ Water Management Plan (including groundwater and surface water); ■ Traffic and Transport Management Plan; ■ Bushfire Management Plan; and ■ Hazardous Materials Management Plan.	7
Air Quality		
5	Aston will utilise leading practice technologies and initiatives as required to seek to achieve the air quality outcomes described in this EA.	7.1.4
6	Aston will undertake regular monitoring of greenhouse gas emissions and energy efficiency initiatives to ensure that Scope 1 greenhouse gas emissions per tonne of product coal are kept to the minimum practicable level.	7.2.4
7	Aston will install a real time air quality monitoring network in consultation with OEH. Consultation will also occur with Boggabri and Tarrawonga Coal Mines in an attempt to develop an holistic network for the region.	7.1.4
8	Aston will install a real time meteorological monitoring system with predictive air quality modelling software capabilities at locations selected in consultation with OEH. Consultation will also occur with Boggabri and Tarrawonga Coal Mines in an attempt to develop an holistic network for the region. The monitoring component of this system will include a $PM_{2.5}$ monitor at a location representative of the receivers located within the Maules Creek Community.	7.1.4
Noise and Blasting		
9	Aston will implement the necessary noise control and management measures as required to seek to ensure that the EA predicted noise levels at private receivers as listed in **Table 23** are not exceeded.	7.3.4
10	Aston will install a real time noise monitoring system at locations selected in consultation with OEH. Consultation will also occur with Boggabri and Tarrawonga Coal Mines in an attempt to develop an holistic network for the region.	7.3.4
Visual		
11	Should a landholder within 7.5 km of the active mining area consider they are experiencing high visual impact as a result of the Project, Aston will carry out a specific visual assessment from the residence and develop any management and mitigation measures required in consultation with the landholder and DP&I.	7.5.4
12	Night time operations will be undertaken behind barriers, particularly in exposed areas to reduce direct night lighting impacts to neighbouring receivers.	7.5.4

REF	COMMITMENT	EA SECTION
13	Infrastructure lighting will consist of horizontal lights with hoods and louvers in elevated and exposed areas utilising low brightness lights to the level necessary for operational and safety requirements to minimise adverse night lighting impacts.	7.5.4
Ecology		
14	Aston will design and construct the CHPP, MIA and water storages within the Project Disturbance Boundary to minimise impacts upon CEEC within the constraints of cost effective engineering practicality.	7.6.4
15	Aston will progressively rehabilitate mined areas with a focus on the reestablishment of existing forest and woodland communities.	7.6.4
16	Aston will establish the Biodiversity Offset Strategy as described in this EA to initially maintain and ultimately improve the ecological values of the Bioregion.	7.7
Aboriginal Archaeology and Cultural Heritage		
17	The salvage and the protection of all known Aboriginal objects within the Project Boundary will be managed in accordance with an Aboriginal Archaeology and Cultural Heritage Management Plan to be developed in consultation with the local Aboriginal community and OEH.	7.8.3
18	Aston will consult with Boggabri Coal Mine and contribute to the establishment and ongoing funding of a keeping place for the purpose of housing salvaged Aboriginal artefacts from the local area.	7.8.3
19	Aston will provide the opportunity for one representative of the Aboriginal community to be a member of the Maules Creek CCC.	7.8.3
20	Aston will offer training packages to members of the Red Chief Local Aboriginal Lands Council in relation to site recording, artefact recording and basic analysis.	7.8.3
Non Indigenous Heritage		
21	Aston will compile an Oral History report for any landowners which are identified to be adversely impacted by the Project and who are acquired in accordance with conditions of Project Approval.	7.9.3
22	Aston will ensure that the Heritage items located on its landholdings will be adequately managed and preserved in accordance with the requirements under the Heritage Act.	7.9.3
Water Resources		
23	Aston will continue to monitor groundwater ingress and impacts on surrounding privately owned bores. In the unlikely event that it is demonstrated that water levels in existing landholder bores decline as a consequence of the Project, leading to an adverse impact on water supply, the supply will be substituted by Aston in consultation with the landholder either by deepening the bore, construction of a new bore or providing comparable water from an external source.	7.11.4
24	Aston will use reasonable endeavours to develop a groundwater monitoring network to monitor the predicted groundwater impacts from mining in consultation with Boggabri Coal Mine and Tarrawonga Mine.	7.11.4
25	Aston will conduct water quality monitoring of the seepage / runoff from the OEAs.	7.10.4
Geochemical		
26	PAF coal rejects materials and the roof and floor of these PAF coal seams will be co-disposed with overburden in pit or within encapsulated cells within the Northern OEA.	7.12.4
Traffic		
27	Reasonable endeavours will be made to ensure that Project related traffic does not utilise the following public roads unless they are travelling to a specific destination along that route (such as residence, monitoring location, near neighbour etc.): Harparary Road from Leard Forest Road to the Kamilaroi Highway; Leard Forest Road between Northern Loop Road and Harparary Road; Therribri Road between the Mine Access Road and Harparary Road and the entire length of Browns Lane.	7.14.4
28	Aston will use reasonable endeavours to work with other Gunnedah Basin coal projects and the relevant roads authorities in managing safety issues on the road network related to mining within the Narrabri LGA.	7.14.4
29	Aston will use reasonable endeavours to work with other Gunnedah Basin coal miners and the ARTC to encourage management strategies to ensure that the rail network can continue to handle the forecast additional rail movements.	7.14.4
30	Prior to the construction of the rail spur overpass within the easement of the Kamilaroi Highway, Aston will consult with all relevant regulatory authorities and will develop a Construction Management Plan for the works (including traffic control and management) in consultation with the RTA.	7.14.4
Community		
31	Aston will implement the management strategies as described within Section 7.20.9 of this EA, in order to monitor and address the possible impacts of the Project upon the socioeconomic environment.	7.20.9
32	Aston offers to enter into an appropriate VPA on terms it will seek to agree with NSC and GSC.	7.20.9
33	Aston will maintain the agricultural productivity of its landholdings that are not utilised for mining or biodiversity offsets.	7.15.4
Reporting		
34	Aston will prepare an Annual Review (which summarises monitoring results and reviews performance) and distribute it to the relevant regulatory authorities and the Maules Creek CCC.	5.5

SECTION

9

Project Justification

SECTION 9

Project Justification

9.1 OVERVIEW

This EA has assessed the potential environmental impacts of the Project as required by the specific EARs issued by the Director-General of DP&I on 6 December 2010 and by addressing the Objects of the EP&A Act.

This EA has considered the potential impacts of the Project in the terms of the existing environment, the regulatory framework that applies and stakeholder issues identified during the extensive stakeholder consultation program that was undertaken throughout the EA process.

The environmental planning assessment of the Project has been undertaken in accordance with current guidelines and standards and the adoption of leading practice initiatives.

The environmental planning assessment of the Project demonstrates compliance with the Objects of the EP&A Act and measures the social and economic benefits of the Project against its potential social and environmental costs.

With the management and mitigation measures proposed by Aston for the Project, none of the environmental impacts identified within this EA are considered unacceptable and are justifiable when considered against the need for the Project and its social and economic benefits.

9.2 PROJECT NEED

Society is reliant on coal for steel production and to meet basic energy needs. With the continuing increase in population and third world countries developing, the demand for coking coal for steel production is likely to continue to grow.

It is expected that the demand for thermal coal for energy production will continue to rise with world population growth and the development of third world countries.

The Project will:

- Assist Australia to continue to meet the international demand for metallurgical and thermal coal, for at least the next 21 years, during which time there will continue to be a need for coal to meet the world demand for coal for the production of steel and generation of electricity;
- Support Australia in continuing to be a consistent and reliable supplier of coal to its existing and expanding markets; and
- Contribute materially to sustaining the Australian economy and maintaining the economic stability and way of life of NSW and the Narrabri and Gunnedah regions.

9.3 ALTERNATIVES CONSIDERED

Options for the extraction of this internationally valuable coal resource were assessed in the context of the Objects of the EP&A Act.

The Project mine plan was then developed with reference to all of the constraints identified.

The following options were considered:

- Developing the mine as approved under DA 85/1819; which would sterilise significant metallurgical coal resources, utilise obsolete mining methods, equipment and technologies creating additional environmental impacts, and would entail a greater footprint over the 21 year period;
- Underground mine the resource; which has been confirmed to be uneconomical;
- Leave the coal resource in the ground; which would fail to respond to the need of the Project and forgo the substantial economic and social benefits from extracting this significant resource; and
- The Project mine plan; which will satisfy the need for the Project and enable the maximum and efficient recovery of this valuable coal resource with minimum environmental effects, generating highly significant economic and social benefits for the local region, the State of NSW and the Commonwealth of Australia.

9.4 ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACTS

The environmental planning assessment of the Project has adopted the following methodology:

- The consideration of the Objects of the EP&A Act, including principles of ESD and leading practice environmental and social standards in the development of Project (**Section 3.13**);
- The application of a methodical risk assessment process throughout the Project planning, design and assessment process (**Section 6**);
- Commitments for specific mitigation and management measures (**Section 7**);
- Undertaking comprehensive stakeholder consultation and addressing issues raised as appropriate (**Section 5**); and
- Optimising the social and economic benefits associated with the Project.

9.4.1 Environmental

Environmental impacts have been assessed on worst case scenarios, assuming the Project will operate at a maximum production rate of 13 Mtpa of ROM coal with all feasible and reasonable management and mitigation measures applied.

The mine plans for the Project have been designed to facilitate economic productivity within the constraints of the site, whilst complying with all relevant environmental criteria.

The EA has identified the following environmental impacts to be of most significance:

- **Air Quality:** air quality modelling showed that with the application of all feasible and reasonable management and mitigation measures that no additional receivers (who do not have a right to acquisition upon written request from a neighbouring coal mining operation or with whom Aston does not already have a purchase agreement in place) are predicted to experience air quality levels greater than the relevant criteria;
- **Noise Amenity:** noise modelling has shown that with the application of all feasible and reasonable noise management and mitigation measures that no additional receivers (who do not have a right to acquisition upon written request from a neighbouring coal mining operation or with whom Aston does not already have a purchase agreement in place) are predicted to experience adverse noise levels greater than the relevant criteria.

  An additional five properties are predicted to experience adverse noise levels greater than the relevant criteria over more than 25% of the property area. Aston is in ongoing discussions with these landholders in relation to the acquisition of these properties;
- **Biodiversity:** ecological studies have identified approximately 1,664 ha of native forest and woodland and a further 513 ha of native and exotic grasslands are located within the Project Disturbance Boundary. Of this, despite the implementation of all feasible and reasonable measures to avoid ecological impact, there is an estimated 458 ha of Box Gum Woodland and a further 86.5 ha of Derived Native Grassland to be disturbed by the Project.

  Aston has proposed an Offset Package that will be implemented to compensate for these impacts which has the potential to decrease the level of fragmentation and isolation of forested areas in the locality within the medium to long term. Areas to be used within this Offset will be strategically selected to assist in building onto existing conservation areas that have recently been proposed by Boggabri Coal Mine and Tarrawonga Mine.

  Specifically, it will assist in building upon the wildlife corridor from the Namoi River to the Leard State Conservation Area. It will also link the remaining areas of Leard State Forest to the northern and south-eastern ends of the Nandewar Ranges;
- **Groundwater:** potential impacts to the regional groundwater regime and groundwater users from the Project and neighbouring mining operations have been considered within this EA. A total of 27 registered bores fall within the zone of influence as defined by the 1 metre drawdown contour at the end of mining. A total of 13 of these were identified within the outcrop of the Maules Creek Formation and 14 within the outcrop zone of the Boggabri Volcanics. The majority are owned by mining operations. None are registered for irrigation. Up to eight may remain in private ownership and be relied upon for stock watering and domestic purposes.

  In the unlikely event that it is demonstrated that water levels in existing landholder bores decline as a consequence of the Project, leading to an adverse impact on water supply, the supply will be substituted by Aston in consultation with the landholder either by deepening the bore, construction of a new bore or providing comparable water from an external source.

In summary the application of a stringent, contemporary environmental assessment has not identified any significant adverse economic, social or environmental impacts associated with the Project.

Aston will manage and minimise its impacts through a risk based EMS which will be developed for the Project that will have a primary aim for compliance and continuous improvement. Aston will develop leading practice air and noise environmental monitoring networks surrounding the site in consultation with neighbouring mining companies and representatives of the closest sensitive receivers which shall include a real time meteorological monitoring station with predictive software capabilities and a network of real time monitors.

9.4.2 Economic

When the production costs (acquisition of affected land, opportunity cost of land, operating costs, decommissioning costs, etc) and production benefits (revenues from production, residual values of land, etc) are considered, the Project will provide net production benefits to society of approximately $8.7 Billion. Royalty payments to the NSW government over the first 21 years of production are expected to total $2.8 Billion.

With the inclusion of external costs to society such as the impacts upon Greenhouse gas generation, the Project will provide total net benefits to society of approximately $8.6 Billion. Based on this outcome, the Project is considered to be justified from an economic efficiency perspective.

The Project will deliver significant socio-economic benefits to the Narrabri and Gunnedah Regions and the State of NSW through the generation of employment, export revenue, taxes and royalties.

The Project will result in the following economic benefits to the State economy:

- $2.8 Billion in annual direct and indirect output or business turnover;
- $1.6 Billion in annual direct and indirect value added;
- $303 Million in annual household income; and
- 4,029 direct and indirect jobs.

The Project will result in the following economic stimulus to the Narrabri economy:

- $1.9 Billion in annual direct and indirect output or business turnover;
- $1.0 Billion in annual direct and indirect value added;
- $54 Million in annual household income; and
- 753 direct and indirect jobs.

9.4.3 Social

The Project will deliver substantive socioeconomic benefits to the Narrabri and Gunnedah LGAs, but in doing so will create a need for supporting infrastructure and services, traditionally in the province of NSC. To this end, Aston is in the advanced stages of discussions with NSC and GSC with the view of entering into a VPA pursuant to Section 93F of the EP&A Act.

This VPA will provide substantial funding to address the identified increased demand on local community infrastructure and services that will be associated with the Project.

The agreed components of this VPA are discussed in **Section 7.20.9** which confirms that the Project will provide ongoing contributions to the upgrade of both specified and yet unspecified infrastructure in the local area.

Aston is committed in continuing its existing relationship with the Maules Creek community. Aston has been in recent discussions with the Fairfax Public School in relation to the installation of air conditioning to the school building and other maintenance works.

A basis has been formed for an ongoing synergistic relationship that Aston intends to further develop and maintain with the Maules Creek community throughout the life of the Project.

9.4.4 Conclusion

Due to the substantial positive economic and social impacts associated with the Project and the nature of the environmental impacts resulting from the Project (in consideration of the mitigation and management measures proposed), it can be concluded that the Project is well justified on environmental, socio-economic and environmental grounds.

9.5 CONSISTENCY WITH OBJECTS OF EP&A ACT

Section 5 of Part 1 of the EP&A Act describes its objectives which are reproduced below followed by comment on their consideration as part of the assessment:

> *"To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment."*

The Project will facilitate the development of the State significant coal resource largely within the existing CL 375, utilising current leading practice environmental and operational practices. This will ensure the efficient and maximum recovery of the coal resource, whilst minimising any potential environmental and social impact.

The use of this land for mining will promote economic growth leading to a number of benefits to social welfare within the Narrabri and Gunnedah Region.

"To encourage the promotion and co-ordination of the orderly and economic use and development of land."

The Project will result in the development of a valuable coal resource in an area that has previously been identified for mining purposes by the NSW Government as part of the BNC Act.

The conversion of the land within the Project Boundary to a higher value production activity offers the greatest potential for regional growth. The Project will help to stimulate the economy with regional spending for production related costs and with wages for labour which will enter the regional economy.

The annual output value of the Project is over four times the annual output value of all agricultural production within the entire Narrabri-Gunnedah region. Direct and indirect employment provided by the Project will be more than 27 times that provided by continued agricultural use of the land and water resources. The net production benefits of the Project ($8.7 Billion) are more than 345 times those of the continued agricultural production and the use of the required water for the Project within the region.

"To encourage the protection, provision and co-ordination of communication and utility services."

The Project proposes the upgrade of Therribri Road and will construct new powerlines and communication facilities to assist the Project and neighbouring landholders. The construction of the proposed rail spur will be undertaken in close consultation and coordination with Boggabri Coal to ensure impacts on local road networks are not adversely affected.

"To encourage the provision of land for public purposes."

The Project will result in the establishment of almost 10,000 ha of Biodiversity Offset land that will be set aside for recreational and conservation purposes. This will far outweigh the loss of recreational use of part of the Leard State Forest.

"To encourage the provision and co-ordination of community services and facilities."

The net economic benefit resulting from the Project will encourage the provision and co-ordination of community services and facilities to the region.

The Project will involve a VPA which is being discussed with and will be agreed with NSC and GSC for the ongoing provision and coordination of community services and facilities and other development contributions.

"To encourage the protection of the environment, including the protection and conservation of native animals and plants, including Threatened species, populations and ecological communities, and their habitats."

The Project will result in the establishment of an extensive Biodiversity Offsets Strategy that is specifically designed to protect and conserve native animals and plants. Further to this, management and mitigation measures will be implemented to the Project to minimise, to the extent to which it is possible, the impacts to wildlife during the operation of the Project.

"To encourage ecologically sustainable development."

The Project has evolved throughout the planning, consultation and environmental assessment process to ensure that it appropriately address the principles of ESD as discussed in **Section 3.13**. The impacts of the Project have been identified with certainty and measures to address them incorporated into the Project, thus addressing the Precautionary Principle.

The maximised recovery of the in situ coal resource, the optimisation of rehabilitation activities and the establishment of the extensive Biodiversity Offset Strategy address the principles of Intergenerational Equity and Improved Valuation. Further, the extensive Biodiversity Offset Strategy proposed by the Project also addresses the principle of Conservation of Biological Diversity and Ecological Integrity.

"To encourage the provision and maintenance of affordable housing."

At a State level, the economic benefits that will flow from the Project to the NSW Government will assist in ensuring the provision and maintenance of affordable housing.

"To promote the sharing of the responsibility for environmental planning between the different levels of government in the State."

The consultation undertaken during the preparation and assessment of this EA under Part 3A of the EP&A Act demonstrates that environmental planning is shared between the different levels of government in NSW.

The preparation of this EA has followed this due process and seized every opportunity for stakeholder engagement over the Project with all levels of Government as described in **Section 5**.

> *"To provide increased opportunity for public involvement and participation in environmental planning and assessment."*

Section 5 describes the stakeholder engagement process relied upon during the preparation of this EA. This process was extensive and hence fulfils this objective of the Act.

9.6 CONCLUSION

This section of this EA concludes the environmental planning and assessment and provides the justification for the Project and shows that the environmental impact assessment of the Project:

- Has identified the need for the Project;
- Concludes that the site for the Project is suitable;
- Concludes that the Project is the appropriate alternative for the recovery of the valuable coal resource;
- Establishes that the social and environmental risks of the Project have been identified with certainty, in accordance with the relevant Guidelines and Standards;
- Identifies the proposals for the management of the environmental issues as appropriate;
- Establishes that the Project as proposed minimises environmental harm;
- Establishes that the Project proposes appropriate measures to limit and manage environmental consequences of the Project;
- Confirms that the proposals for offsets are appropriate to compensate for the environmental harm to be caused by the Project;
- Demonstrates that the Project has been developed to maximise its economic and social benefits;
- Identifies the material economic, social and environmental benefits from the Project; and
- Reaffirms that the Project has been developed to ensure consistency with the Objects of the EP&A Act.

This EA has demonstrated that the socio-economic benefits of the Project will far outweigh its social and environmental costs and will facilitate the proper management and development of the State's resources, with added benefits of improving biodiversity in region in the medium to long term.

SECTION

10

Abbreviations

SECTION 10

Abbreviations

ABBREVIATION	DESCRIPTION
A	Authorisation
ABS	Australian Bureau of Statistics
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ANC	Acid Neutralising Capacity
ANTC	Aboriginal Native Title Consultants
ANZECC	Australian and New Zealand Environment Conservation Council
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
Aston	Aston Coal 2 Pty Limited
AWBM	Australian Water Balance Model
AWS	Automatic Weather Station
BBC	Bullen Bullen Consultants
BBTP	Bigundi Biame Traditional People
BCA	Benefit Cost Analysis
bcm	bank cubic metres
Biobanking	Biodiversity Banking and Offsets Scheme
BNC Act	*Brigalow and Nandewar Community Conservation Area Act 2005*
BNC Agreement	Brigalow and Nandewar Community Conservation Area Agreement
BNC Conservation Area	Brigalow and Nandewar Community Conservation Area
Boggabri Coal	Boggabri Coal Pty Limited
Boggabri EA	Boggabri Coal Mine Environmental Assessment
BoM	Bureau of Meteorology
Box Gum Woodlands and Derived Grasslands	White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands
Brigalow Act	*Brigalow Nandewar Community Conservation Act 2005*
CALMET	A diagnostic meteorological modelling system known as California Meteorological
CC	Carrawonga Consultants

10 Abbreviations

ABBREVIATION	DESCRIPTION
CCA	Community Conservation Agreement
CCC	Cacatua Cultural Consultants
CEEC	Critically Endangered Ecological Community
CH_4	Methane
CHPP	Coal Handling and Preparation Plant
CL	Coal Lease
CMHS Act	*Coal Mines Health and Safety Act 2002*
CNA	Coal and Allied Industries Limited
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
CPRS	Carbon Pollution Reduction Scheme
CRA	CRA Limited
CRIA	Country Rail Infrastructure Authority
Crown Lands Act	*Crowns Land Act 1989*
Cumberland	Cumberland Ecology Pty Ltd
dBA	The peak sound pressure level, expressed as decibels (dB) and scales on the 'A-weighted' scale, which attempts to closely approximate the frequency response of the human ear
DCC	NSW Department of Climate Change (now Department of Environment, Climate Change and Water)
DECCW	Department of Environment, Climate Change and Water (formerly Department of Environment and Conservation)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (now Department of Sustainability, Environment, Water, Population and Communities)
DMC	Dense Medium Cyclone
DoL	NSW Department of Lands
DP&I	NSW Department of Planning and Infrastructure (formerly Department of Planning, DIPNR, Planning NSW and DUAP)
DOS	Degree of Saturation
D/S	Downstream
EA	Environmental Assessment
EARs	Environmental Assessment Requirements
EC	Electrical Conductivity
ECRTN	Environmental Criteria for Road Traffic Noise 1999
EIS	Environmental Impact Statement
EL	Exploration Lease

ABBREVIATION	DESCRIPTION
ELCHC	Elli Lewis Cultural Heritage Consultants
EMP	Environmental Monitoring Program
EMS	Environmental Management System
ENCM	Environmental Noise Control Manual
ENM	Environmental Noise Model
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPA	NSW Environment Protection Authority (incorporated in Department of Environment, Climate Change and Water)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPBC Offsets	Draft Environmental Protection Biodiversity Conservation Offsets Policy
EPI	Environmental Planning Instrument
EPL	Environmental Protection Licence
ESD	Ecologically Sustainable Development
Fisheries Act	*Fisheries Management Act 1994*
Forestry Act	*Forestry Act 1916*
GAB WSP	NSW Great Artesian Basin Groundwater Water Source Water Sharing Plan
GC	Giwiirr Consultants
GDE	Groundwater Dependent Ecosystem
GGAC	Gunida Gunyah Aboriginal Corporation
GIS	Geographical Information System
GNAC	Gomeroi Narrabri Aboriginal Corporation
GPS	Geographic Positioning System
GRC	Gunnedah Resource Centre
GSC	Gunnedah Shire Council
GSSE	GSS Environmental
GSV	Ground Surface Visibility
GWP	Global Warming Potential
ha	Hectare
Hansen Bailey	Hansen Bailey Environmental Consultants
Heritage Act	*Heritage Act 1977*
HVAS	High Volume Air Sampler
HVCC	Hunter Valley Culture Consultants
I&I NSW	Industry & Investment NSW

10 Abbreviations

ABBREVIATION	DESCRIPTION
INP	NSW Industrial Noise Policy 2000
ISCMOD	Modified version of the US EPA ISCST3 model
JORC	Joint Ore Reserves Committee
LA1	The noise level exceeded for 1% of the time
LA10	A noise level exceeded for 10% of the time
LA90	Commonly referred to as the background noise, this is the noise level exceeded 90% of the time
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period
LEP	Local Environmental Plan
LGA	Local Government Area
LOS	Level of Service
m	Metre
Maules Creek CCC	Maules Creek Community Consultative Committee
Maules Creek EIS	Maules Creek Coal Project Environmental Impact Statement
Maules Creek MD	Maules Creek Meteorological Dataset
Mbcm	Million bank cubic metres
MC	Mingga Consultants
MD	Meteorological Dataset
MIA	Mine Infrastructure Area
MIC	Maximum Instantaneous Charge
Mining Act	*Mining Act 1992*
ML	Mega litres
MMAC	Min Min Aboriginal Corporation
MNES	Matter of National Environmental Significance
MODFLOW SURFACT	A three-dimensional groundwater flow model
MOP	Mining Operations Plan
MRC	Mooki River Consultants
MSDS	Material Safety Data Sheet
Mt	Million tonnes
Mtpa	Million tonnes per annum
N_2O	Nitrous oxide
NAF	Non Acid Forming
Namoi Groundwater WSP	Upper and Lower Namoi Groundwater Water Source Water Sharing Plan

ABBREVIATION	DESCRIPTION
Namoi River WSP	Upper Namoi and Lower Namoi Regulated River Water Source Water Sharing Plan
Narrabri LEP	Narrabri Local Environmental Plan 1992
NGA	National Greenhouse Accounts
NLALC	Narrabri Local Aboriginal Land Council
NLEP 5	Narrabri Local Environmental Plan No. 5
NMP	Noise Management Plan
NOW	NSW Office of Water
NPV	Net Present Value
NPW Act	*National Parks and Wildlife Act 1974*
NSC	Narrabri Shire Council
NTSCORP Limited	Native Title Services Corporation Limited
NV Act	*Native Vegetation Act 2003*
NVCPL	Namoi Valley Coal Pty Limited
OEA	Overburden Emplacement Area
PAF-HC	Potentially Acid Forming - High Capacity
PCI	Pulverised coal injection PCI
PEA	Preliminary Environmental Assessment
PFM	Planning Focus Meeting
PM_{10}	Particulate Matter <10 microns
POEO Act	*Protection of the Environment Operations Act 1997*
Project Boundary	Project Application Boundary
PVC	Primary Viewing Catchment
RBL	Rating Background Level
RCLALC	Red Chief Local Aboriginal Land Council
Receiver	Private property adjacent to the Project Boundary containing a residence
Relics	Items of European Heritage Significance
RGS	RGS Environmental Pty Ltd
RL	Reduced Level
Roads Act	*Roads Act 1993*
ROM	Run of Mine
RTA	NSW Roads and Traffic Authority
Rural Fires Act	*Rural Fires Act 1997*
SAT	Spot Assessment Technique
SEPP	State Environmental Planning Policy

10 Abbreviations

ABBREVIATION	DESCRIPTION
SEPP 33	State Environmental Planning Policy 33 - Hazardous and Offensive Development
SEPP 44	State Environmental Planning Policy 44 - Habitat Koala Protection
SEPP 55	State Environmental Planning Policy 55 – Remediation of Land
SEPP Mining	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
SEPP Major Development	State Environmental Planning Policy (Major Development) 2005
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (formerly Commonwealth Department of Environment, Water, Heritage and the Arts)
SIA	Social Impact Assessment
SIDRA	Modelling instrument 'SIDRA 4.0'
SLA	Statistical Local Area
SO_2	Sulphur dioxide
t	Tonne
TEOM	Tapered Element Oscillating Microbalance
The Code	*Code of Practise for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b)
The Project	Maules Creek Coal Project
TP	Total Phosphorous
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSR	Travelling Stock Route
TSS	Total suspended Solids
TTIA	Traffic and Transport Impact Assessment
UHHCC	Upper Hunter Heritage and Culture Consultants
VPA	Voluntary Planning Agreement
WAC	Wiawa Aboriginal Corporation
WAL	Water Access Licence
Water Act	*Water Act 1912*
Whitehaven	Whitehaven Coal Mining Limited
WM Act	*Water Management Act 2000*
WRM	Water and Environment Pty Limited
WSP	Water Sharing Plans
WWLALC	Wee Waa Local Aboriginal Land Council
ZOA	Zone of Affectation

SECTION

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References

SECTION 11

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SECTION

12

Study Team

SECTION 12

Study Team

SECTION	EA COMPONENT / ROLE	TEAM MEMBER AND COMPANY	
Project Management			
	General Manager – Maules Creek	Lance Muir	Aston Resources
	General Manager – Technical	Ross Brims	
	General Manager – Mining	Cameron Foot	
	Environmental Manager	Daniel Martin	
EA Management			
	Project Director	James Bailey	Hansen Bailey
	Project Manager	Nathan Cooper	
	Project Coordinator	Jason Martin	
	Peer Review	Dianne Munro	
Stakeholder Engagement			
	General Manager	Lance Muir	Aston Resources
	Environmental Manager	Daniel Martin	
	Director	James Bailey	Hansen Bailey
	Senior Environmental Scientist	Nathan Cooper	
EA Sections			
ii	Executive Summary	Dianne Munro	Hansen Bailey
1	Background	Kimberley Wilkinson	
2	Existing Environment	Jason Martin	
3	The Project	Nathan Cooper	
4	Regulatory Framework	Dianne Munro	
5	Stakeholder Consultation	Belinda Hale	
6	Risk Assessment	Jason Martin	
7	Impacts, Management and Mitigation	Nathan Cooper, Jason Martin, Dianne Munro, Belinda Hale, Daniel Sullivan, Kimberley Wilkinson, Elisabeth Webster	
8	Statement of Commitments	Nathan Cooper	
9	Project Justification	James Bailey	
10	Abbreviations	Kimberley Wilkinson	
11	References	Kimberley Wilkinson	
12	EA Study Team	Elisabeth Webster	

SECTION	EA COMPONENT / ROLE	TEAM MEMBER AND COMPANY	
Appendices			
Appendix A	Schedule of Land to which this EA Applies	Nathan Cooper	Hansen Bailey
Appendix B	Mine Plan Justification	Cameron Foot Daniel Martin	Hansen Bailey
Appendix C	Regulatory Correspondence	Nathan Cooper	Hansen Bailey
Appendix D	Stakeholder Engagement	Nathan Cooper	Hansen Bailey
Appendix E	Revised Environmental Risk Assessment	Nathan Cooper	Hansen Bailey
Appendix F	Air Quality Impact Assessment	Justine Beaney Ronan Kellaghan	PAEHolmes
Appendix G	Acoustics Impact Assessment	Mark Bridges	Bridges Acoustics
Appendix H	Visual and Lighting Impact Assessment	John van Pelt	Integral Landscape Architecture and Visual Planning
Appendix I	Ecological Impact Assessment	Dr David Robertson	Cumberland Ecology
	Stygofauna Impact Assessment	Peter Hancock	ALS Environmental
Appendix J	Aboriginal Cultural Heritage Impact Assessment	Luke Kirkwood	AECOM Australia Pty Ltd
Appendix K	Non Indigenous Heritage Impact Assessment	Dr Jennifer Lambert Tracey	Archaeology Australia
Appendix L	Surface Water Impact Assessment	Dr David Newton	WRM Water & Environment
Appendix M	Groundwater Impact Assessment	James Tomlin	Australasian Groundwater and Environmental Consultants
	Peer Review	Dr Noel Merrick	Heritage Computing
Appendix N	Geochemical Impact Assessment	Dr Alan Robertson	RGS Environmental
Appendix O	Traffic and Transport Impact Assessment	Damien Chee	Hyder Consulting Pty Ltd
Appendix P	Soil and Land Capability Impact Assessment	Klay Marchant	GSS Environmental
Appendix Q	Economic Impact Assessment	Robert Gillespie	Gillespie Economics
Appendix R	Social Impact Assessment	Dianne Munro and Belinda Hale	Hansen Bailey
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