Specialist Consultant Studies

East Boggabri Joint Venture

Proposed East Boggabri Coal Mine

Surface Water Assessment

Prepared by

Department of Lands – Soil Services

May, 2005

Specialist Consultant Studies Compendium
Part 1

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Surface Water Assessment

of the

Proposed East Boggabri Coal Mine

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EXECUTIVE SUMMARY

This report details the findings of a surface water assessment undertaken on behalf of R W Corkery & Co Pty Limited for the East Boggabri Joint Venture (Whitehaven Coal Mining Limited/Idemitsu Boggabri Coal Pty Ltd).

The report will form part of a Specialist Consultant Studies Compendium accompanying an EIS for the proposed East Boggabri Coal Mine. The main aims of the assessment are to predict the likely impacts of the proposal on the surface water within the Project Site and surrounds.

The results of the assessment can be summarised as follows.

The proposal could potentially impact on:

- surface water quantity;
  - flooding
  - water usage
- surface water quality;
  - pH
  - suspended solids
  - electrical conductivity
  - heavy metal concentrations
  - oils (hydrocarbons)
- soil erosion; and
- dryland salinity.

Recommendations to mitigate these impacts include:

- diverting clean water around disturbed areas and capturing a proportion of this water within the harvestable right of the Project Site to meet the proposal water requirements;
- constructing transport routes at current ground levels and creek bed levels;
- capturing dirty water, using it for dust suppression and other environmental purposes or treating it so that it can be discharged within acceptable guidelines. There would be limitations with providing sufficient water for the suppression of dust. This can be managed by limiting dust generation practices, maximising water storages, limiting evaporative losses and by supplementing water requirements from groundwater reserves;
- by maintaining and enhancing as much vegetation on-site as possible; and
- monitoring water, soil and vegetation parameters.

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1 INTRODUCTION

1.1 BACKGROUND

This Surface Water Management Plan (SWMP) and assessment has been produced by Soil Services, a Division of the NSW Department of Lands for R.W. Corkery & Co. Pty Limited on behalf of Whitehaven Coal Mining Limited (WCM) and Idemitsu Boggabri Coal Pty Ltd (IBC) (the East Boggabri Joint Venture). This document is to form part of the Specialist Consultant Studies Compendium prepared in support of the Environmental Impact Statement for the proposed East Boggabri Coal Mine (the proposal), located approximately 15km north east of Boggabri (see **Figure 1**).

Soil Services was commissioned to describe the Project Site in relation to surface water characteristics and parameters, undertake a literature review identifying and discussing surface water studies previously undertaken, State and national legislation and best practice that is pertinent to surface water management. Soil Services was also commissioned to identify the most appropriate way to mitigate potential impacts associated with the proposed development. Recommendations are also given for the long term management of the Project Site.

Please Note: When environment is referred to within this document, it pertains to the total environment, being the interaction of the physical, biological and social environments.

1.2 OBJECTIVES

The objectives of this SWMP are to:

- divert “clean” water flows additional to the maximum harvestable right of the Project Site, around the proposed areas of disturbance within the Project Site (thus reducing the potential for erosion), and to maintain existing water flows for the environment further down the catchment;
- divert water flows on the Project Site around areas that have high potential to erode;
- disturb the least amount of vegetation as possible, particularly grasses, and enable grasses to re-establish;
- limit erosion of soils within the Project Site via structural earthworks and other management practices; and
- treat “dirty” water containing high sediment levels, contaminated or potentially contaminated water, to current acceptable guidelines before discharge into the surrounding environment.

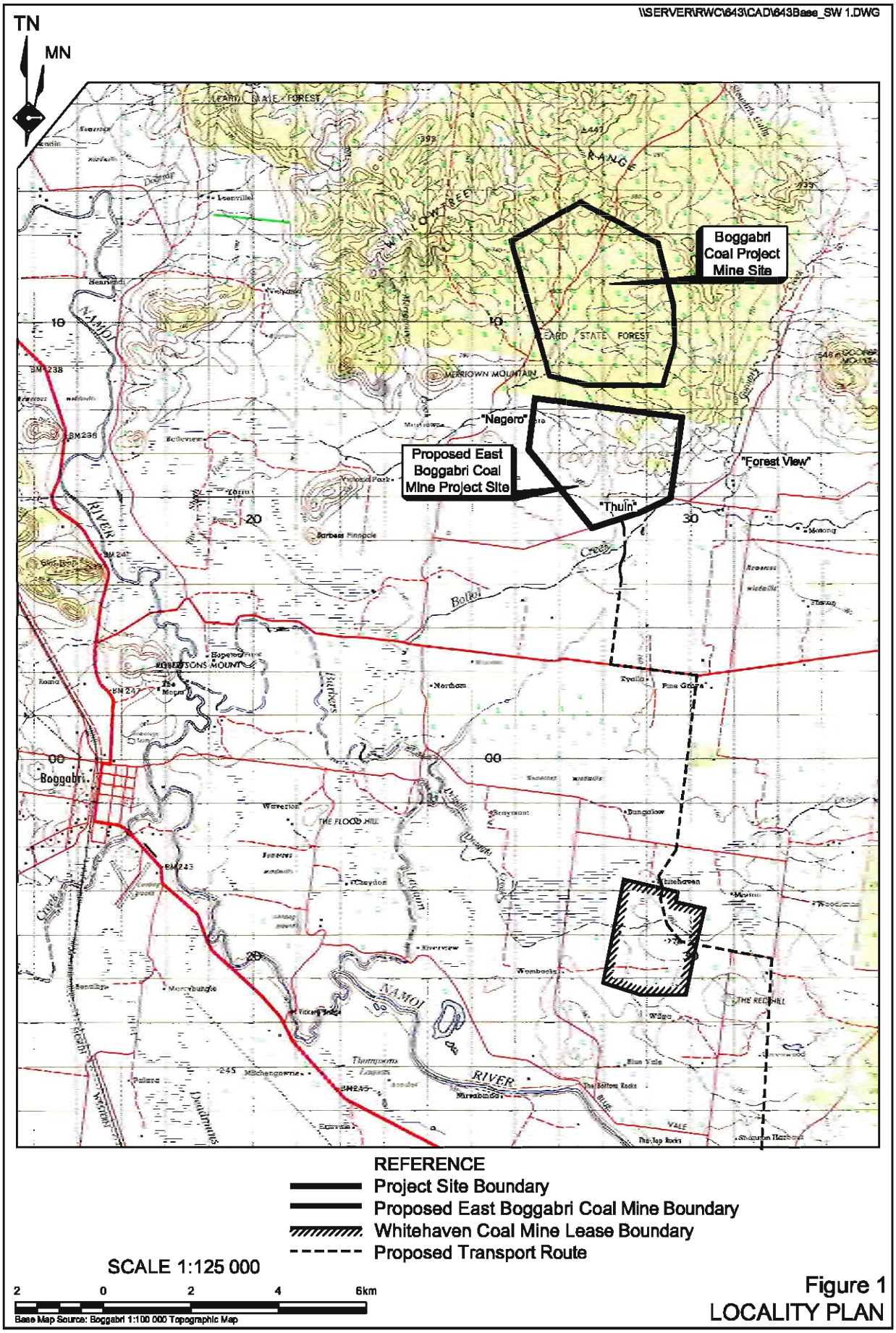

Figure 1
LOCALITY PLAN

2 PROJECT SITE

2.1 SITE DESCRIPTION

Of the total Project Site area of 726ha, approximately 225ha is contained within the Nagero Creek catchment. Surface water flows are to the west into Nagero Creek and then south-westerly into a Warrambool landscape structure referred to as The Slush Holes, before flowing into the Namoi River. The remainder of the Project Site is within the Bollol Creek catchment with surface water flows in a generally southerly direction to a flow depression named Gins Gully. This gully runs into Bollol Creek, Barbers Lagoon and then into the Namoi River. Both Nagero Creek and Bollol Creek are approximately 11km from the Namoi River as the crow flies.

The Project Site has been divided into nine separate sub-catchments with these described in **Table 1** and presented on **Figure 2**.

Table 1
Catchments of the Project Site

Catchment No.	Approximate Area	Description of Catchment
1	118	This catchment generally falls north westerly out of the Project Site then southwesterly towards Nagero Creek.
2	40	This catchment generally falls north out of the Project Site then towards Nagero Creek.
3	32	This catchment falls northerly towards Nagero Creek.
4	35	This catchment falls generally southeasterly towards Nagero Creek.
5	77	This catchment falls southwesterly towards Bollol Creek.
6	99	This catchment falls southerly towards Bollol Creek.
7	169	This catchment falls southerly towards Bollol Creek.
8	51	This catchment falls southerly towards Bollol Creek.
9	101	This catchment falls southerly towards Bollol Creek.
Total	**726ha**	

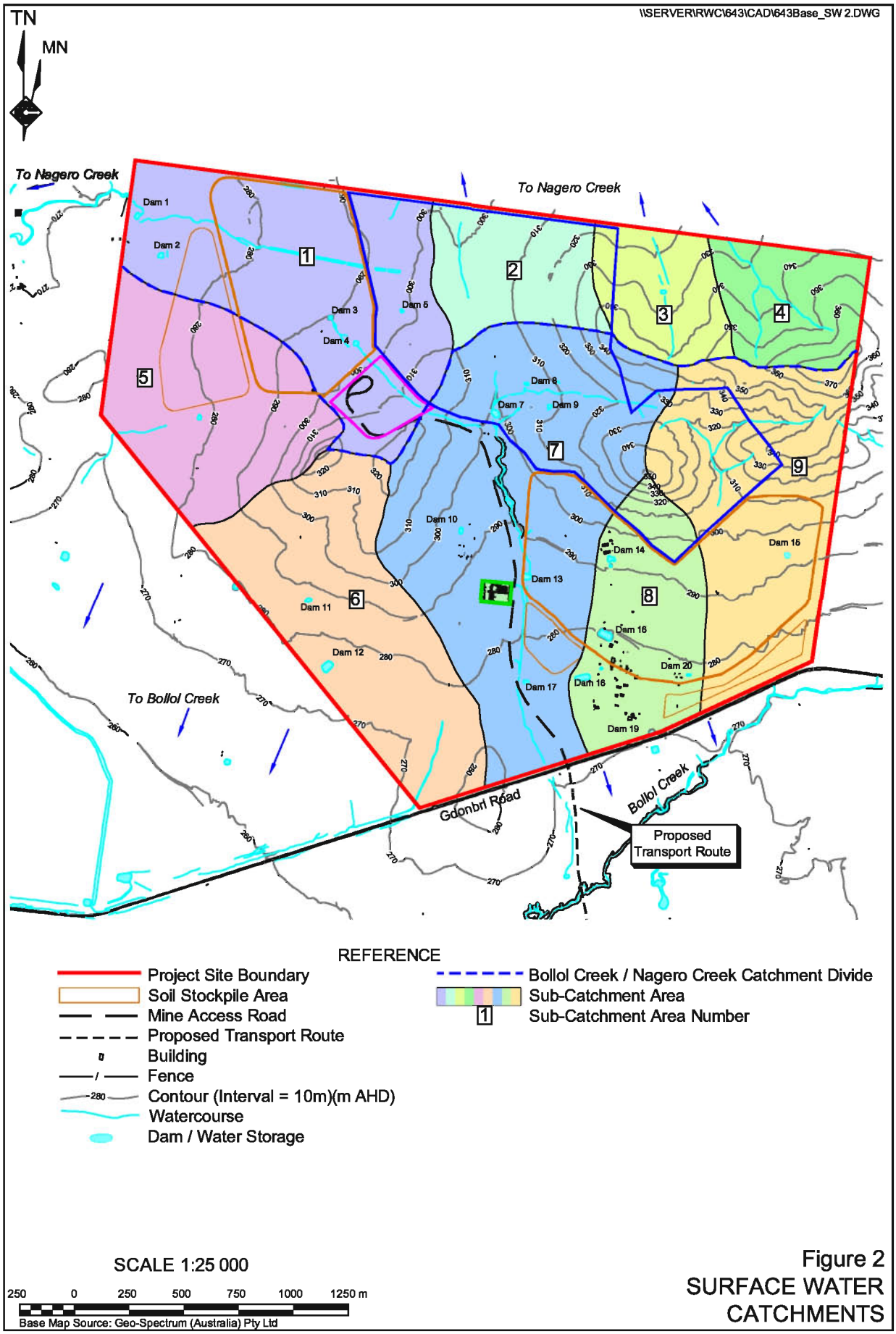

Figure 2
SURFACE WATER CATCHMENTS

2.2 EXISTING WATER STORAGE AND HARVESTABLE RIGHT

20 dams occur within the Project Site. **Table 2** lists their approximate capacity with their location presented on both **Figure 2** and **Figure 3**.

Table 2
Dam Capacities and Locations

Dam Number	Capacity (m^3)
1	1300
2	700
3	200
4	900
5	100
6	1300
7	1900
8	100
9	100
10	200
11	100
12	3200
13	4500
14	1200
15	700
16	2400
17	700
18	2100
19	200
20	200
Total	22100

The capacity of existing water storages on the Project Site is approximately 22 100m^3. Throughout the life of the proposal, 11 of these dams would be removed as they are within the open cut or overburden emplacement footprint areas. There would be approximately 9 800m^3 of water storage retained and available for use after the open cut area and overburden emplacements are at their fullest extents.

The harvestable right for the Project Site is determined by the following calculation.

Harvestable Right = Catchment Area x Multiplier Value
= 726 x 0.07
= 50.8ML

This calculation is based on the determination of the maximum harvestable rights dam capacity (MHRDC) using the folder supplied by Department of Land and Water Conservation (DLWC) now Department of Infrastructure Planning and Natural Resources (DIPNR) titled *Rural Production and Water Sharing Landholders Information Package*. Given that the MHRDC is 50.8ML, there is potential to store, through the construction of additional dams, an additional 41.0ML (50.8ML minus 9.8ML) on the Project Site. This water could be used for any purpose. Please note that the area of the “Thuin”, “Nagero” and “Forest View” properties not within the Project Site and their associated dams were not included within the MHRDC calculations.

It is noted that the maximum harvestable right does not include storages that are to be used for environmental purposes. For the proposal, environmental purposes include the capture of predominantly "dirty" or sediment-laden water for uses such as dust suppression and watering rehabilitated areas.

2.3 FLOODING

The Namoi River is approximately 13km southwest of the Project Site (as the crow flies). The height at which Bollol Creek enters the Namoi River is approximately 233m AHD while the height at which the water leaves the Project Site and flows into Bollol Creek is approximately 277m AHD. The highest recorded flood level at the gauging station just up stream of the iron bridge access across the Namoi River (Manilla Road) is 9.54m (pers. comm. - Daniel Budge, Hydrographer for Department of Infrastructure, Planning and Natural Resources). Therefore, during a flood event the highest entry point of Bollol Creek into the Namoi River would be 242m AHD. Therefore, even at the highest recorded flood levels, there is 35m difference between the two points in. As a consequence large flooding would not impinge on the Project Site.

The only flooding issue that is considered relevant for the Project Site is the water that flows from east to west along Bollol Creek. This has potential to interfere with the transportation of coal from the Project Site to the Whitehaven Coal Handling and Preparation Plant (CHPP). Bollol Creek is ephemeral and based on anecdotal evidence only runs after rainfall events and may run for approximately two days after a large rainfall event that occurs over its entire catchment.

The northwest corner of the Project Site is where Nagero Creek leaves the Project Site. It is suggested that this area be left undisturbed as it is a major flow depression from water generated both on the Project Site and flowing from Leard State Forest.

The Proponent is intending to construct roads for the proposed transport route at current ground level and wherever necessary cross any gullies via concrete causeways. This type of gully crossing and road construction would not inhibit the overland flow of water and thus would not impact on localised flooding of the area.

3 LITERATURE REVIEW

This section details literature that is pertinent to the surface water management of the proposal. It discusses State and national legislation and best management practice guidelines.

The following legislation was reviewed to ascertain how the management of surface water on the Project Site would affect the intent of each Act.

- *Fisheries Management Act 1994*;
    - This act deals with the management of fisheries and how they are regulated. Works associated with the proposed transport route and its crossing of Driggle Draggle Creek and Bollol Creek may require input and permission from NSW Fisheries.

- *Protection of the Environment Operations Act 1997*;
    - This act is concerned with the control of various polluting activities. Such activities must be licensed if they meet specified thresholds. Even if not licensed the activity may be required to comply with orders issued by the Department of Environment and Conservation (DEC) formerly Environment Protection Authority (EPA) or local council. Often the works undertaken that have potential to pollute require an exemption or at least a notification to the DEC who administer this act. An Environment Protection Licence would be required for the proposal.

- *Water Act 1912*;
    - This act principally deals with water licensing and water allocations. Sections of it have been repealed and replaced with sections of the *Water Management Act 2000*. A groundwater extractive licence from the Department of Infrastructure Planning and Natural Resources (DIPNR) may be required for the proposal.

- *Water Management Act 2000*;
    - This act deals with a whole variety of issues associated with the management of water. The issues that are pertinent here refer to the construction of water holding structures, water diverting structures and water pumping devices. Harvestable rights fall under this Act and would apply to the proposal.

- *Contaminated Land Management Act 1997*:
    - This act establishes a system in NSW for investigation and remediation of land contamination which presents significant public health or environmental risks. This would only apply if there is lingering contamination caused by the spillage of pollutants or if the nature (salinity, acidity and heavy metal contents etc) of the earth being uncovered is outside those acceptable levels as prescribed.

- *Soil Conservation Act 1938*;
    - This act covers the issues involved in soil conservation within the State. By diverting clean water onto stable ground and by treating and capturing dirty water, soil erosion would be minimised. The issue of development consent and the grant of a mining lease would supersede the requirements of this act.

- *Environmental Planning and Assessment Act 1979* ;
    - The principal objectives of this act are to co-ordinate policies, programs and activities as they relate to total catchment management, and to achieve active community participation in natural resource management. The Namoi Catchment Blueprint produced by the Namoi Catchment Management Board has been reviewed and its issues and targets have been considered within this document.

- *Local Government Act 1993*
    - The principal objectives of this act are to provide the legal framework for an effective, efficient, environmentally responsible and open system of local government in New South Wales. To regulate the relationships between the people and bodies comprising the system of local government in New South Wales. To encourage and assist the effective participation of local communities in the affairs of local government. The issues raised by both Gunnedah and Narrabri Shire Councils have been considered in the development of the SWMP.

- *Rivers and Foreshore Improvement Act 1948*;
    - An act to provide for the carrying out of works for the removal of obstructions from and the improvement of rivers and foreshores and the prevention of erosion of lands by tidal and non-tidal waters. Works involved with the construction of the proposed transport route would require the application for a Part 3A permit issued by DIPNR.

A number of other documents have been reviewed and issues that have been collated from them relating to surface water on the Project Site and the ramifications that has for the receiving waters environment are:

- water quantity;
- water quality;
- soil erosion; and
- dryland salinity.

These identified issues are discussed in Section 5.

4 OVERVIEW OF THE PROPOSAL

The Proponent's objectives for the development and operation of the proposed East Boggabri Coal Mine are to:

(i) develop and operate a safe mine producing low ash, thermal and/or semi-soft coking coal;

(ii) commence production by early 2006 to achieve an initial combined production from the proposed East Boggabri Coal Mine and Whitehaven Coal Mine of approximately 2 million tonnes per annum (2Mtpa), ie. within the approved limit of the Whitehaven CHPP and rail loading facility;

(iii) develop and operate the mine in a manner that complies with all statutory requirements;

(iv) undertake all activities in an environmentally responsible manner, employing a level of control and integrating safeguards that would ensure compliance with appropriate criteria/goals or reasonable community expectations at all times;

(v) establish and/or maintain international and domestic markets for the coal produced;

(vi) provide a boost to the local economies of Boggabri and Gunnedah and their surrounding districts through employment opportunities and the supply of services required for the operation of the coal mine;

(vii) create a final landform amenable to a combination of agricultural and native vegetation conservation activities; and

(viii) achieve the above objectives in a cost-effective manner and thereby ensure the ongoing viability of the proposed mine.

The proposal, if approved, would involve the following activities.

(i) Construction of a mine entrance on Goonbri Road and a mine access road from Goonbri Road to the coal processing area.

(ii) Coal mining by open cut mining methods over an area of approximately 160ha referred to as the "open cut area". The open cut area has been defined by drilling and a review of economic, geological and environmental considerations.

(iii) Programmed placement of overburden and interburden materials from the open cut area to a combination of out-of-pit and in-pit overburden emplacements.

(iv) On-site crushing and temporary stockpiling of the mined coal within a defined coal processing area southwest of the open cut area.

(v) Establishment of a transport route between the Project Site and the Whitehaven CHPP and rail loading facility with the importation of road construction materials from the Whitehaven Coal Mine.

(vi) Transportation of coal from the Project Site to the Whitehaven CHPP for washing and/or despatch to export markets via rail to the Port of Newcastle.

(vii) Backloading of coarse reject material from the Whitehaven CHPP for placement in the mined out areas of the proposed East Boggabri Coal Mine.

(viii) Installation of a range of services, structures and transportable buildings.

(ix) Progressive shaping and rehabilitation of the mine area and other areas of disturbance.

Figure 3 presents the proposed components of the Project Site.

5 WATER MANAGEMENT ISSUES

5.1 INTRODUCTION

When considering the potential impacts that the proposal could have on the surface water of the Project Site and surrounds, water quantity and quality must be considered. Substantial changes in either of these factors beyond what are recognised to be natural variations in both would potentially be detrimental to the Project Site and/or surrounding environment. There are a number of potential sources associated with the proposal that could change the Project Site's surface water characteristics. The sources that can affect both quantity and quality of surface water on-site and ultimately affect the water entering the surrounding environment include:

- run-off from any area that has been denuded of vegetation;
- run-off from stockpiles of topsoil, subsoil, overburden and raw and processed coal;

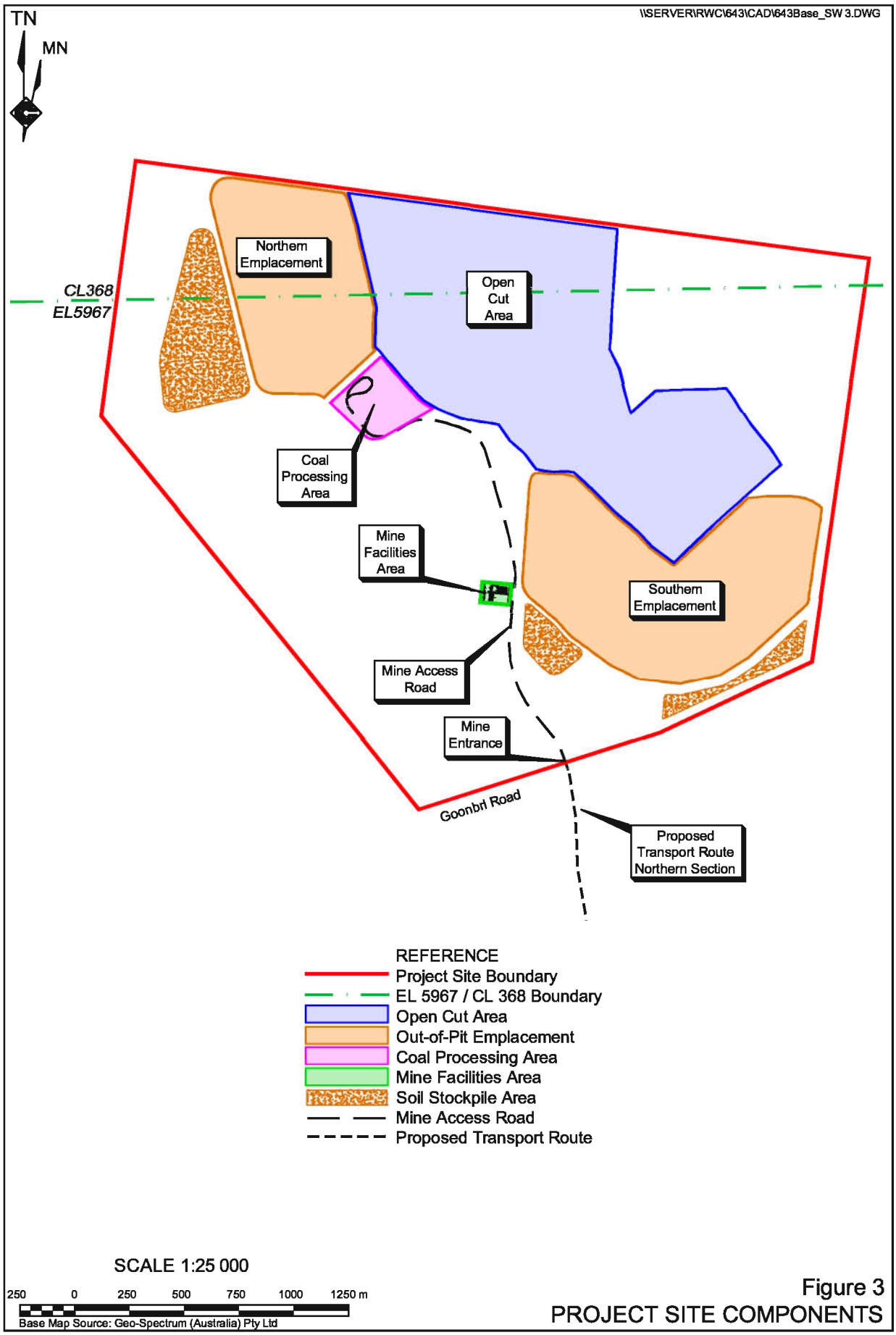

Figure 3
PROJECT SITE COMPONENTS

- discharge of mine waters;
- run-off from hardstand areas including roads, processing areas, site facilities and load-out facilities; and
- leaking or spillage of hydrocarbon products.

5.2 WATER QUANTITY

The proposal could potentially increase the amount of run-off leaving the site due to the disturbance of vegetation and increases in hardstand areas. This increase in water quantity could increase the soil erosion of the Project Site and surrounding environment.

5.3 WATER QUALITY

Parameters that may be affected by the potential sources identified in Section 5.1 include:

- pH;
- suspended solids;
- electrical conductivity;
- heavy metal concentrations; and
- hydrocarbon products (fuel, oil and lubricants).

Water that has a suspended solids concentration equal to or lower than that specified within **Table 3** is referred to as "clean water". Water that has a suspended solids concentration greater than those specified within **Table 3** is referred to as "dirty water". Water that displays substantial changes in pH, electrical conductivity or contains concentrations of heavy metals or hydrocarbons above nominated levels is referred to as "contaminated water".

Table 3
Discharge Parameter Limits

Parameter	**50th Percentile Limit**	**70th Percentile Limit**	**100th Percentile Limit**
pH	-	-	6.5 to 8.5
Suspended Solids (mg/L)	≤ 20	≤ 35	≤ 50
Grease and Oil (mg/L)	-	-	≤ 10
Source: (Department of Environment and Conservation 2004 - pers. comm., 11 May 2004)			

URS (2005) performed geochemical testing on five representative composite samples of overburden and interburden from one drillhole on the Project Site. All samples were slightly alkaline (approximately pH 8), exhibited low salinity (average EC 345 μS/cm) and contained low sulfur contents (average 0.12%). Consequently, URS (2005) classified all samples as Non-Acid Forming (NAF).

GCNRC (2005a and b) undertook comprehensive soil sampling and analysis of chemical and physical properties on the Project Site and northern section of the proposed transport route. The results of the sampling and laboratory analyses indicated, with the exception of Soil Mapping Unit (SMU) 2, identified towards the northwest of the Project Site (GCNRC, 2005a), the majority of Project Site soils were non-saline and non-sodic.

Coincidentally, this area corresponds to that of higher flooding potential and reinforces the recommendation that disturbance to this area should be minimised.

Assuming disturbance to the potentially saline and sodic soils is minimised and/or managed as recommended by GCNRC (2005a), the soil and overburden/interburden sampling indicates the impact on water quality from changes in acidity, electrical conductivity and heavy metal concentrations is likely to be low. The parameters that are of particular importance are therefore suspended solids and hydrocarbon products.

The current water quality parameters that are appropriate for assessment of activities proposed within assessment of impacts of activities proposed within the Project Site and their current acceptable guidelines are presented in **Table 3** (as prescribed by the Department of Environment and Conservation (DEC)).

5.4 SOIL EROSION

Surface water flows can cause sheet, rill and gully erosion, all of which have been identified within a number of reference documents as of significance. Wind may lead to soil erosion or transportation from its origin. Although erosion is a natural occurrence, changes in vegetative cover and concentration of water accelerates its occurrence and its severity. The lost soil reduces the productive capacity of the land and in addition changes the environmental characteristics of receiving waters and catchments. The proposal would alter the vegetative cover and concentrated flow of water so it could potentially lead to increased erosion. The SWMP (see Section 6) addresses this issue via a variety of management practices.

5.5 DRYLAND SALINITY

Dryland salinity is the accumulation of salts within the soil profile that hinder plant growth and ultimately denude areas and increase the salt concentration in surface water flows into creeks and rivers. Dryland salinity has been identified as an issue within the Namoi Valley (NCMB, 2003). The acceleration of dryland salinity is a result of a reduction in the number of deep rooted vegetation species that keep the water table lower within the soil profile and thus not allow the salts to accumulate. Vegetation would be disturbed by the proposal although it is recognised that a substantially greater number of trees are to be planted on the Project Site than are to be removed. This additional planting of vegetation could also be planned so as to provide wind breaks particularly over bare earth areas so as to reduce the likelihood of wind erosion. The management of vegetation would aid in reducing any dryland salinity issues that may develop as a result of the proposal.

6 SURFACE WATER MANAGEMENT PLAN

6.1 INTRODUCTION

Section 6 provides a series of recommendations against the potential negative consequences outlined in Section 5.

When managing water around any proposal that would disturb vegetation and soil, the key principles are to:

- divert "clean" water away from the disturbed area;
- capture "dirty" water and treat it so that it can be discharged to meet accepted guidelines; and
- maintain as much vegetation (particularly grass), on the Project Site as possible.

The SWMP firstly considers management of water quantity (see Section 6.2) followed by the water quality aspects (see Section 6.3), contingency plans (see Section 6.4), monitoring and long term management of the landforms within the Project Site (see Section 6.5). The SWMP has been designed on the basis of the worst case scenario, that being the proposed mine being in full operation with the overburden emplacements at their fullest extent and without any vegetative cover. The design criteria, design procedures and data sources are shown in **Appendix 1**. The specification of dam positions and sizes provided is indicative, these specifications may vary with specific mine management requirements and a desire to capture all dirty water that is generated by the proposal.

6.2 WATER QUANTITY

6.2.1 Project Site Catchment Yields

Based on the harvestable rights for the Project Site, there is provision to capture and use 50.8ML of clean surface water. This water storage would lengthen the time of concentration thus reducing any localised flooding impact associated with the increase in peak discharge that may occur with the increased surface water flows from the denuded and hardstand areas. Larger flooding issues for the Project Site and proposed transport route have been discussed within Section 2.3.

It is proposed that the water required annually by the proposal would be between 73ML and 89ML. Once the Project Site is fully committed in capturing its harvestable right there would be 50.8ML available annually (subject to availability) to use. **Table 4** summarises the catchment yield calculations for the Project Site and individual sub-catchments.

Based on the calculations of Project Site sub-catchment yields, the maximum harvestable right of 50.8ML/yr could be easily obtained through the construction of appropriately placed storage dams. The remaining water requirement for the proposal (37.6ML i.e. 89ML – 50.8ML) could be obtained from one of three sources:

(i) capture of dirty water which flows over exposed surfaces within the Project Site;

(ii) extraction of groundwater from one or more existing or constructed bores; and

(iii) from groundwater and surface water retained within the mine void.

None of these sources would be assessed as part of the Project Site maximum harvestable right. It would also be possible for the Proponent to obtain a licence to capture and use additional clean water and thereby increase the maximum harvestable right, however, given the other opportunities available to obtain the required volume of water, this is not considered necessary.

Table 4
Annual Catchment Yield for the Project Site and Individual Catchments

Rainfall Event (mm)	Decile 1 Rainfall (373.6mm)	Mean Rainfall (616.4mm)	Decile 9 Rainfall (843.4mm)
Catchment 1 Yield (ML/year)	28.21	46.54	63.68
Catchment 2 Yield (ML/year)	9.71	16.03	21.93
Catchment 3 Yield (ML/year)	5.23	8.63	11.81
Catchment 4 Yield (ML/year)	5.6	9.25	12.65
Catchment 5 Yield (ML/year)	11.77	19.42	26.51
Catchment 6 Yield (ML/year)	14.2	23.42	32.05
Catchment 7 Yield (ML/year)	25.59	42.22	57.77
Catchment 8 Yield (ML/year)	8.78	14.49	19.82
Catchment 9 Yield (ML/year)	18.49	30.51	41.75
TOTAL	127.58	210.5	288.02

6.2.2 Water Balance

The site water balance calculates the volume of water that would be captured within each of the site water catchments created following the development of the mine area. The site water balance has been prepared for dry years (10^{th} percentile rainfall), wet years (90^{th} percentile rainfall) and for the Median Year (50^{th} percentile rainfall) to assess the following:

(i) whether sufficient surface water is available for capture onsite during dry years for the water requirements outlined; and

(ii) if significant discharge would be required in wet years.

Table 5 outlines the catchment yields under varying rainfall events, the type of water captured and the water storages associated with these catchments. These catchments reflect the surface water management controls proposed by the Proponent and presented on **Figure 4**.

Even during dry years (10^{th} percentile rainfall), sufficient water would be available from a combination of dirty water (including the open cut area) and clean water sources to meet operational water requirements. Given the catchment yields exceed water storage volumes in the average years (50^{th} percentile) and wet years (90^{th} percentile), a discharge of surface water may occur from those locations identified on **Figure 4**.

Table 5
Annual Catchment Yields

Catchment with approximate area	Yield (10^{th} percentile)	Yield (50^{th} percentile)	Yield (90^{th} percentile)	Associated Water Storage and volume
"Dirty" Water from around the northern emplacement (60 ha)	11.2ML	18.6ML	25.3ML	15ML
"Dirty" Water from around the southern emplacement (90ha)	16.8ML	27.9ML	37.9ML	20ML
Open Cut Area (160ha)	28.7ML	47.7ML	64.9ML	
Total Dirty Water	**56.7ML**	**94.2ML**	**128.1ML**	**35ML**
"Clean" from around the northern emplacement (51ha)	9.5ML	15.8ML	21.5ML	21.8ML
"Clean" from around the southern emplacement (179ha)	33.4ML	55.4ML	75.5ML	26ML
Total Clean Water	**42.9ML**	**71.2ML**	**97ML**	**47.8ML**
TOTAL WATER	**99.6ML**	**165.4ML**	**225.1ML**	**82.8ML**

6.3 WATER QUALITY

6.3.1 Diversion of Clean Waters

The diversion of clean waters away from disturbed areas would reduce erosion and its potential for contamination. This would be achieved by constructing diversion banks and storage dams. The positions of these structures are shown on **Figure 4** and their specifications listed in **Tables 6** and **7**.

Table 6
Diversion Bank Specifications

Structure ID	Catchment Area (ha)	Channel Bottom Width (m)	Channel Grade (%)	Bank Height (m)	Sill Width (m)	Slope Below Sill (%)
Northern Emplacement						
DB1	10	3	0.2	0.8	6	4
DB2	5	3	0.2	0.8	6	4
DB3	8	3	0.2	0.8	6	4
DB4	10	3	0.2	0.8	6	4
DB5	12	6	0.2	0.8	9	4
DB6	21	8	0.2	1.0	12	3
Southern Emplacement						
DB7	15	8	3.5	0.8	12	4

The dimensions for each diversion bank are based on the upslope catchment area and topography. Generally the following should be followed for each bank, namely:

- the channel of the bank is to be trapezoidal;
- bank batters between 1:3 to 1:6 (Vertical : Horizontal);
- channel batters are to be 1:6 (V:H);
- channel grade 1 : 400 (5cm/20m) if channel is bare;

- channel grade 1 : 200 (10cm/20m) if channel is to kept well grassed;
- level sill outlet to each channel;
- stable grass cover to be maintained below sill outlets; and
- sill width approximately 1.5 x channel base width.

Table 7
Storage Dam Specifications

Structure ID	Catchment Area (ha)	Volume (m^3)	Depth (m)	Dimensions length x width (mxm)	Outlet Width (m)	Sill Width (m)
Northern Emplacement						
SD1 - Existing Dam 1	150	1 300	2.5	37x25	16	24
SD2 - Existing Dam 2	51	14 000	3	80x75	10	15
SD3	23	6 500	3	50x49	8	14
Southern Emplacement						
SD4 -Existing Dam 6	15	1 300	2.5	37x25	6	9
SD5	10	6 500	3	50x49	6	9
SD6 -Existing Dam 10	5	200	2	12x25	6	9
SD7 -Existing Dam 17	32	700	2	25x25	8	14
SD8	40	14 000	3	80x75	10	15
SD9 -Existing Dam 11	10	100	1.5	12x12	6	9
SD10 -Existing Dam 12	35	3 200	2.5	50x37	8	14

The requirements for each storage dam would consist of the following, namely:

- excavation and dam bank batters to be at least 1:3 (V:H);
- crest width to be a minimum 3m wide;
- freeboard to be a minimum 1m above top water level up to a wall height of 3m above that there should be an allowance made of 0.1m/m increase in wall height;
- inlet and outlet channel batters are to be 1:6 (V:H);
- outlet channel grade 1 : 400 (5cm/20m) if channel is bare;
- outlet channel grade 1 : 200 (10cm/20m) if channel is to be kept well grassed;
- level sill outlet to each channel;
- stable grass cover to be maintained below sill outlets; and
- sill width of approximately 1.5 x channel base width.

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TN
MN

Northern Emplacement
Open Cut Area
Coal Processing Area
Mine Facilities Area
Southern Emplacement
Mine Entrance
Existing Waterway
Goonbri Road
Whitehaven Coal Mine

REFERENCE
- Project Site Boundary
- Soil Stockpile Area Boundary
- Mine Access Road
- Proposed Transport Route
- Contour (Interval = 10m)(m AHD)
- Fence
- Watercourse
- Existing Dam / Water Storage
- Sediment Basin (SB)
- Storage Dam (SD)
- Diversion Bank (DB)
- Catch Bank / Drain (CB)
- Causeway
- Area of Localised Flooding
- Discharge Points
- Waterway

PROJECT SITE SCALE 1:15 000
250 0 250 500 750 m
Base Map Source: Geo-Spectrum (Australia) Pty Ltd

PROPOSED TRANSPORT ROUTE NORTHERN SECTION
SCALE 1:30 000
500 0 500 1000 1500 m
Base Map Source: Boggabri 1:25 000 Topographic Map

Figure 4
SURFACE WATER MANAGEMENT CONTROLS

6.3.2 Capture of Dirty Water

6.3.2.1 Design Specifications

The capture of dirty water aims to collect water that may have suspended solids concentrations that would be outside the range of those prescribed by DEC guidelines (see **Table 3**). Hydrocarbon products are considered in Section 6.3.2.4.

Cunningham (2005a and b) classified the dispersibility of the soils within the Project Site and along the proposed transport route as predominantly moderate to high dispersibility. This corresponds to a Type D soils based on the Landcom manuals classification (2004, p. 6.12). As the majority of soil types are Type D, sediment basins have been designed based on the soil Type D design basin which would have a designated settling zone volume and a sediment storage zone volume. This would allow water that is potentially laden with suspended solids or sediments to settle. Flocculants would have to be used in all sediment basins where water is required to be discharged to expedite the settlement process as Type D soils are dispersible.

Catch banks/drains should be constructed to divert potentially sediment-laden waters into sediment basins below sites that can potentially generate significant quantities of sediment laden water. A number of these catch banks/drains are directed directly downslope and in these circumstances these banks are to be back push banks so that no vegetation is disturbed within the bank channel. These banks effectively would act as a one-sided waterway. Another structure that is shown in **Table 8** is a waterway (WW1). This structure is to be constructed whilst overburden placement activities are to the northern emplacement and not utilised until overburden placement activities to the southern emplacement interfere with an existing waterway on the Project Site. The location of all of these structures are shown on **Figure 4** and their specifications are listed in **Tables 8** and **9**.

Table 8
Catch Bank/Drain Specifications

Structure ID	Catchment Area (ha)	Channel Bottom Width (m)	Channel Grade (%)	Bank Height (m)	Sill Width (m)	Slope Below Sill (%)
Northern Emplacement						
CB1	5	3	3.5	0.7	6	4
CB2	10	3	3	0.7	6	3.5
CB3	15	6	0.4	0.8	9	3
CB4	30	8	1.5	1.0	12	2.5
CB5	20	6	0.4	0.8	9	2.5
Southern Emplacement						
CB6	8	3	0.4	0.7	6	4
CB7	26	6	0.4	0.8	9	4
CB8	38	8	0.4	1.0	12	3.5
CB9	8	3	0.4	0.7	6	3
CB10	8	3	0.4	0.7	6	3
CB11	18	6	0.4	0.8	9	3
CB12	26	6	0.4	0.8	9	2.5
CB13	40	10	0.4	1.0	15	2.5
	Waterway Width (m)			**Bank Height (m)**		
WW1	20			1.0		

The dimensions for each catch bank are based on the upslope catchment area and topography. Generally the following should be followed for each bank, namely:

- the channel of the bank is to be trapezoidal;
- bank batters between 1:3 to 1:6 (V:H);
- channel batters are to be 1:6 (V:H);
- channel grade 1 : 400 (5cm/20m) if channel is bare;
- channel grade 1 : 200 (10cm/20m) if channel is to be kept well grassed;
- level sill outlet to each channel;
- stable grass cover to be maintained below sill outlets; and
- sill width approximately 1.5 x channel base width.

Table 9
Sediment Basin Specifications

Structure ID	Catchment Area (ha)	Volume (m^3)	Depth (m)	Dimensions length x width (mxm)	Outlet Width (m)	Sill Width (m)
Northern Emplacement						
SB1	5	1000	3	27x27	3	6
SB2	5	1000	3	27x27	3	6
SB3	5	1000	3	27x27	3	6
SB4	10	1000	3	27x27	3	6
SB5	15	1000	3	27x27	6	9
SB6	30	2000	3	34x35	8	12
SB7	10	1000	3	27x27	3	6
SB8	20	2000	3	34x35	6	9
SB9	60	5000	3	49x50	14	21
Southern Emplacement						
SB10	5	1000	3	27x27	3	6
SB11	8	1000	3	27x27	3	6
SB12	26	1000	3	27x27	6	9
SB13	38	1000	3	27x27	8	12
SB14 - Enlarge Existing Dam 19	90	7000	3	55x60	16	24
SB15	8	1000	3	27x27	3	6
SB16	15	1000	3	27x27	6	9
SB17	8	1000	3	27x27	3	6
SB18 - Enlarge Existing Dam 18	26	2000	3	34x35	6	9
SB19	40	4000	3	45x45	10	15

The requirements for each sediment basin would consist of the following, namely:

- excavation and dam bank batters to be at least 1:3 (V:H);

- crest width to be a minimum 3m wide;
- freeboard to be a minimum 1m above top water level up to a wall height of 3m above that there should be an allowance made of 0.1m/m increase in wall height;
- inlet and outlet channel batters are to be 1:6 (V:H);
- outlet channel grade 1 : 400 (5cm/20m) if channel is bare;
- outlet channel grade 1 : 200 (10cm/20m) if channel is to be kept well grassed;
- level sill outlet to each channel;
- stable grass cover to be maintained below sill outlets; and
- sill width of approximately 1.5 x channel base width.

6.3.2.2 Road Design

The mine access road into the Project Site should be constructed with an infall over its entire length so that any water that falls on the road is directed towards the mine area. This would enable this potentially dirty water to be captured by the sediment basins that capture the water that runs off the overburden emplacement. The infall should be no less then 1% or 1 in 100. In addition, the batters of this road are to be topsoiled and seeded so that vegetation can limit their erosion. Concrete causeways should also be used to traverse the waterway depressions that exist on the Project Site. The proposed transport route from the Project Site to the Whitehaven Coal Mine should be constructed with a crown. This road is to be constructed at ground level with causeways used to cross Driggle Draggle Creek, Bollol Creek and other selected depressions along the proposed route.

6.3.2.3 Hydrocarbon Products

Water that discharges from areas where mine plant, equipment and vehicles may be used or serviced may potentially contain hydrocarbons. These areas on the Project Site would include:

- coal processing area;
- mine facilities area;
- any fuel, oil and grease storage; and
- refuelling bays.

These areas should be managed by the following means.

- All water from these areas should be directed to oil separators and containment systems for subsequent removal.
- Storage tanks should have an impermeable surface and bunding so as to contain at least 110% of its storage capacity of the largest tank.
- All hydrocarbon products should be securely stored.
- There should be a designated refuelling, oiling and greasing area.

6.3.3 Maintenance of Vegetation on the Project Site

The maintenance of vegetation, in this instance ground cover, would be a critical factor in the containment of water and where possible improvement in water quality. It reduces the erosion of soil and also reduces the quantity of suspended solids being transported by filtering the water. As a general rule a ground cover should be maintined on all the land that is not being used for processing facilities, administration / maintenance facilities, roads, mining activities and the overburden emplacements. Ideally this ground cover should be 70% or better however, this value would no doubt fluctuate with seasonal conditions. 70% cover should be aimed for.

Vegetation, particularly trees, also reduces the potential for dryland salinity by reducing the depth of the water table relative to the root zone of plants. This reduction in water table depth keeps salts within the soil profile further from the surface thus reducing the potential for dryland salinity and loss of productive lands. By maintaining and/or enhancing as much vegetation on the Project Site as possible, particularly trees, the potential for dryland salinity would be reduced.

A number of critical areas are identified on **Figure 4** that should remain in a 70% or better ground cover. These areas would be subjected to large quantities of diverted water and large quantities of potentially dirty water. In order to limit soil erosion and to improve water quality, it is imperative that these areas are well maintained. Buffer areas between the overburden emplacements, catch banks and sediment basins should be a minimum of 50m.

6.3.4 Sewage

Sewage effluent is a factor which has the potential to contaminate surface water. As a result, a sewage management system should be installed and managed based on the requirements of the Narrabri Shire Council and DEC.

6.4 CONTINGENCY PLANS

A contingency plan should be implemented for surface water management if the following occur.

(i) Discharges from the various sediment basins exceed the discharge parameter limits in **Table 3**. If this occurs, one or more of the following actions should be implemented.

- Add flocculants to expedite settlement of sediments;
- Enlarge sediment basins or construct additional ones; and
- Monitor water quality both upstream and downstream of the confluence of the discharged waters.

(ii) A major hydrocarbon spill. In the event of this occurring the following should be implemented.

- Recover as much as possible at the source by collecting the contaminated ground. This should be put under cover on an impermeable surface to be later remediated and/or transported to an approved waste depot;
- Excavate one or more holes within or around the spill site to create a hydraulic gradient so that soil water and the spilled material would congregate within the holes thus enabling pumping out; and
- Monitor groundwater for any continued contamination. Treat this water or utilise this water on-site provided that process is under a DEC licence.

6.5 LONG TERM SURFACE WATER MANAGEMENT AND FINAL LANDFORM

The installation of all storage dams, diversion banks, catch banks and sediment basins should occur before any other soil disturbance works are undertaken in the respective catchments. The disturbance of vegetation associated with any works should be limited and should be staged so that the maximum vegetation cover is retained for as long as possible. The overburden emplacement should be rehabilitated as the mine progresses thus reducing the amount of denuded earth exposed to rainfall and thus potential erosion. The rehabilitation of the overburden emplacement should be commenced as soon as practicable and completed in stages as the final landform develops.

By designing the water diversion and water storage structures for the worst case scenario, all the structures would need to be in place before the mine becomes operational. These structures should be maintained for the duration of the mine and until the landform is fully revegetated. The sediment basins should be cleaned when their capacity is reduced by 20% and any erosion repaired throughout the life of the mine and subsequent maintenance period.

It is recommended that the final landform of the overburden emplacements be designed to drain as much water as possible into the void area. The remaining waters should be directed upon the overburden emplacement via graded banks into large rock flumes. The graded banks should be equally spaced down the overburden emplacements. Some basic specification for these graded banks are:

- maximum grade of 0.25% or 1 in 400;
- a channel width of not less than 1m;
- bank height of not less than 500mm;
- channel is to be parabolic in shape; and
- excavation batters are to be at least 1 : 4 (V:H).

Each rock flume would direct water from the top of the emplacement batter down to the original ground level. This water can then be directed into the existing sediment basin system. The flumes should be constructed to have the following minimum specifications.

- Parabolic shape with minimum 1m turn up either side.
- 80% of rock used must be >200mm in diameter.
- Minimum 10m width.

7 ASSESSMENT OF IMPACTS

This SWMP and assessment has been undertaken for the proposed East Boggabri Coal Mine and considers the environmental characteristics of the Project Site and surrounding areas. The SWMP has identified the sources that are likely to cause impacts to the Project Site and surrounds as the following.

- From any area that has been denuded of vegetation.
- Surface water flows from stockpiles of topsoil, subsoil, overburden and raw and processed material.
- Discharge of mine waters.
- Surface water flows from hardstand areas including roads, processing areas, site facilities and load-out facilities.
- Leaking or spillage of hydrocarbon products.

These potential sources would potentially impact on:

- surface water quantity;
  - flooding
  - water usage
- surface water quality;
  - pH
  - suspended solids
  - electrical conductivity
  - heavy metal concentrations
  - oils (hydrocarbons)
- soil erosion; and
- dryland salinity.

These impacts have been mitigated within this plan by:

- diverting clean water around disturbed areas and capturing this water to form part of the harvestable right which can be used for any purpose of the proposal;
- capturing dirty water and using it for dust suppression and other environmental purposes or treating it so that it can be discharged within acceptable guidelines. By limiting dust generation practices, maximising water storages, limiting evaporative losses and by supplementing water requirements from groundwater reserves, sufficient water would be available, even in dry years to meet the operational requirements of the proposal;
- constructing transport routes at current ground levels and creek bed levels; and
- by maintaining and enhancing as much vegetation on-site as possible.

8 RECOMMENDED MONITORING

The following monitoring including parameters and locations. It is recognised that only parameters likely to change as a result of the Proponent's activities in the respective catchment need to be monitored.

- Parameters to monitor:
  - electrical conductivity;
  - pH;
  - suspended solids;
  - hydrocarbons;
  - heavy metals;
  - nutrients; and
  - water usage.

- Locations to monitor:
  - Surface water discharge points and selected storage dams and sediment basins;
  - water within the mine void;
  - any groundwater sources used; and
  - upstream and downstream of the confluence of the northern catchment into Nagero Creek and the southern catchment into Bollol Creek.

The frequency of monitoring would reflect the parameters to be monitored, the locations to be monitored and the potential for environmental impact. **Table 10** presents the recommended monitoring schedule.

Table 10
Recommended Surface Water Monitoring

Location	Parameter	Frequency
Discharge points, and selected Storage Dam and Sediment Basins	EC, pH, suspended solids, hydrocarbons	Quarterly or in the event of a significant rain event
Discharge points, and selected Storage Dam and Sediment Basins	heavy metals, nutrients.	Annually
Void water	EC, pH, suspended solids, hydrocarbons	Quarterly
Void water	heavy metals, nutrients.	Annually
Catchment confluence points of Nagero Creek and Bollol Creek	EC, pH, suspended solids, hydrocarbons, heavy metals, nutrients.	Annually or in the event of a significant rain event

The monitoring results should be reviewed on an annual basis and the frequency, locations and/or parameters re-assessed to ensure meaningful data is being collected. All monitoring results should be presented in the relevant AEMR.

Monitoring of soil erosion and vegetative cover should also be undertaken. In the event any soil erosion greater then 300mm deep for a maximum of 10m long is identified, this should be corrected via conservation earthworks and or re-vegetation. If rehabilitated areas with groundcover <70% are identified, these areas should be reseeded, fertilised and watered so that percentage groundcover can be maintained.

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APPENDICES

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Appendix 1: Design Procedures and Data Sources

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APPENDIX 1

Design Procedures and Data Sources

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Design Procedures and Data Sources

Run-off Estimation and Catchment Yields

Peak discharges were calculated using both the deterministic and statistical rational method. As described in the design manual by the SCS (1990) and the Institution of Engineers (1987). An Intensity/Frequency/Distribution (IFD) table for the Project Site was created using the rainfall information from SCS (1990) and the Rainer computer program. The design storms for all channels and structures with outlet channels, unless stated, are for a 1 in 10 Average Recurrence Interval (ARI). Catchment yields were determined by utilising Bureau of Meteorology web site (http://www.bom.gov.au/climate/averages/tables/ca_nsw_names.shtml) and design information within SCS (1990).

Diversion, Catch Bank and Storage Dam Design

The design of diversion and catch banks was undertaken by using the procedures within SCS (1990) and Soil Services' design computer. The quantities allowed for water storages were ascertained by the harvestable right allowance policy (DLWC 1999), this allowed for the Project Site to harvest MLpa.

Sediment Basin Design

The sediment basins were designed according to the procedures within Landcom (2004) and SCS (1990).