



**ENDEAVOUR COAL PTY LTD
APPIN AREA 7
LONGWALLS 701 – 704
SURFACE AND GROUNDWATER
RESPONSE STRATEGY
Douglas Park, NSW**


BHP2 - R1B

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1. INTRODUCTION

This Surface and Groundwater Response Strategy for the Endeavour Coal Pty Ltd, Appin (Douglas) Area 7 Longwalls 701 to 704 ("the workings") is prepared in compliance with Condition 16 of the Department of Primary Industries Subsidence Management Plan (SMP) Approval for the Douglas Area 7 Longwalls 701-704 (**Appendix A**).

The strategy includes:

- a surface water quality and quantity monitoring program,
- a groundwater water quality and quantity monitoring program,
- trigger levels for subsidence impacts on groundwater and surface water systems,
- procedures to be followed in the event that monitoring of groundwater or surface water indicates an exceedance of trigger levels,
- measures to mitigate, remediate and/or compensate for identified impacts,
- a protocol for the notification of trigger level exceedances,
- a contingency strategy where, in the event of interruption to water supplies (water quality and/or quantity) due to subsidence impacts on water supply systems and/or sources, Endeavour Coal Pty Ltd will provide, without delay, water supplies of equivalent quality and quantity to locations convenient to those affected until such time that the affected water supply systems and/or source are restored.

The Strategy is consistent with the recommendations of the Independent Review of Groundwater Impacts - Proposed Douglas Area 7 Coal Development EIS/SMP (Kalf, Dr F, 2006).

Operation of the strategy requires a high level of management input to ensure the mine operates within its SMP approval requirements and its water related licences.

An essential part of the strategy is monitoring of stream and river flows and quality, dam water levels and quality, as well as groundwater levels and quality at key locations within the strategy area.

The proposed mitigation measures minimise and manage the impacts of the proposed mining on the various water sources, including the Nepean River and its tributaries, relevant surface water dams, any utilised Hawkesbury Sandstone aquifers and groundwater seeps to the rivers and streams within the strategy area.

1.1 Objectives

The objective of this strategy is to establish procedures to identify and measure potential impacts that may result from subsidence on the surface water and groundwater systems within the strategy area. The document has been developed to:

1. monitor ground movement in association with the leaseholder's subsidence monitoring activities and to assess the pre and post-mining condition of surface water courses and groundwater systems;
2. provide a forum to record and discuss subsidence impacts, with a report on the monitoring, observations and actions provided to the Department of Primary Industries - Mineral Resources (DPI-MR) Director, Environmental Sustainability Branch within four months after each longwall is completed,
3. to ensure all relevant surface and groundwater quality and flow criteria are met,
4. To minimise and manage any impacts on the availability of surface water or groundwater to potentially impacted residents and landholders,
5. To minimise erosion and sedimentation from all active and any rehabilitated subsidence areas.

1.2 Definitions

For the purpose of this document, the "strategy area" is defined as the surface water and groundwater systems overlying Longwalls 701 to 704 SMP Area, which encompasses the following limits (MSEC, 2006);

- a 35° angle of draw for the 550m maximum depth of cover (i.e., a horizontal distance of 400m outside the limit of the proposed extraction area),
- the 20mm predicted limit of vertical subsidence, which is generally within the 35° angle of draw, with the exception of land above Longwalls 18 to 20, and
- areas sensitive to far-field movements, which includes horizontal, valley closure and valley upsidence movements in the Nepean River gorge for 450m upstream and 225m downstream of the 20mm subsidence envelope and for 360m of Elladale Creek upstream from its confluence with Nepean River.

1.3 Scope

This strategy is to be used to manage the surface water and groundwater systems that may potentially be impacted due to mine subsidence within the Longwall 701 to 704 mining area.

The main features in the area are shown in **Drawing 1** and include the;

- Nepean River,
- un-named plateau stream tributaries of the Nepean River,
- water storage dams,
- water bores fed by aquifers within the Hawkesbury Sandstone, and

- seeps and springs from the Hawkesbury Sandstone aquifer to the Nepean River and plateau streams.

The strategy does not include property beyond the extent of the strategy area.

It applies to any person employed by the leaseholder in any capacity requiring them to carry out activities described by the strategy.

All other water management components not directly related to the strategy, or located outside of the strategy area, are addressed in separate management plans.

1.4 Limitations

This strategy is based on predictions of the potential subsidence effects on the surface water and groundwater systems (MSEC 2006, Geoterra 2006A, Geoterra 2006B), with the predictions derived from the planned configuration of Longwalls 701 to 704 in addition to available information and data from related studies.

The surface water and groundwater features addressed in this strategy were identified using aerial photographs, regional maps, knowledge of the site, field investigations and discussions with other specialist consultants and Endeavour Coal representatives.

The potential impact of mining subsidence on surface water and groundwater features have been assessed in detail. However, it is acknowledged that they are predictions and estimates based on existing knowledge and information. The limitations of the subsidence assessments are discussed in an accompanying study (MSEC, 2006).

The predictions are based on conservative assessments and models, and there is a low probability that ground movement and the associated impacts could exceed those predictions.

Should the predictions be exceeded or unexpected impacts occur, strategies are in place to ensure that they are identified and appropriately managed.

1.5 Previous and Proposed Longwall Mining

Previous longwall mining has occurred to the south of the proposed workings, under the southern plateau of the Nepean River at Tower Longwalls 9 to 16 and 18 to 20, as well as underneath the Nepean River in Tower Longwall 17 to the south-west of the proposed workings as shown in **Drawing 1**.

Endeavour Coal Pty Ltd is currently extracting Longwall 302 within Area 3, which is located 3.8km to the south, and it is proposed to commence extraction operations at Longwall 701 in October 2007. Longwall 704 is anticipated to be completed in 2011.

It is proposed to extract the full thickness of the Bulli Seam, which varies between 2.8m and 3.3m. Mining depths below surface will range between 450m to 555m.

Longwall 701 is located under the south plateau of the Nepean River and is adjacent to, and north of, the previously mined Tower Longwall 20.

Longwalls 702 to 704 are located under the northern plateau of the Nepean River in a previously un-mined area.

Longwalls 701 and 702-704 are connected underneath the Nepean River by main headings, however the longwalls themselves will not mine under the river gorge.

2. SURFACE AND GROUNDWATER USE AND USERS

For management purposes, water within the strategy area has been divided into the following classes:

(Plateau stream water) surface runoff from stream catchments that are undisturbed, relatively undisturbed or rehabilitated following mine subsidence overlying Longwalls 701 to 704,

(River water) water flowing in the Nepean River within the strategy area,

(Dam water) water contained within catchment dams that are undisturbed, relatively undisturbed or rehabilitated following mine subsidence overlying Longwalls 701 to 704,

(Groundwater) bore water supplies that are undisturbed, relatively undisturbed or reinstated following mine subsidence overlying Longwalls 701 to 704, and

(Seeps and springs) groundwater that discharges to surface water streams or the Nepean River from aquifers within the Hawkesbury Sandstone that are undisturbed, relatively undisturbed or impacted by mine subsidence overlying Longwalls 701 to 704.

2.1 Surface Water Systems and Land Use

For a detailed description of the strategy area surface water features refer to Geoterra, 2006A.

2.2 Dams

Domestic water supplies in the strategy area are generally obtained from rainwater tanks.

Approximately 44 earth dams ranging from 100m² to 6,600m² in area, with wall heights between 2m and 5m and lengths of 15m to 130m are located in or near creek channels within the strategy area as shown in **Drawing 2**.

2.3 River Pumping

Nine known surface water extraction licences exist between Douglas Park Weir and downstream of Ousedale Creek. Three pumps which are attached to two of the surface water licences are located in or near the strategy area as shown in **Drawing 3**.

The pumps draw water from the Nepean River for domestic, agricultural or light industrial use, however, the quantity or duration of water extraction is not available from DWE records (Geoterra, 2006A).

The Nepean River pump intakes are all below the water level by at least 0.5m.

2.4 Groundwater Systems and Private Bores

For a detailed description of the strategy area groundwater system refer to Geoterra, 2006B.

Two DWE registered bores are located within the strategy area along with four BHPB piezometers.

A further 5 bores in the BHPB NGW series are being monitored outside of the strategy area by BHPB at locations shown in **Drawing 1**, whilst six private bores are also situated in proximity to, although outside of the strategy area.

Selected details of bores within the strategy area are listed in **Table 1**, with monitored water levels in the BHPB bores shown in **Figure 1**.

TABLE 1 STRATEGY AREA BORES AND PIEZOMETERS

GW	N	E	SWL (m)	Depth (m)	Drilled	Aquifer	Lithology	YIELD (L/s)	EC (mg/L)	Purpose
34425	6215425	289085	14.6	70	1972	9* – 69.4	sandstone	0.63	good	Waste disposal
101437	6216406	291651	75	128	1997	119 - 121	sandstone	0.7	2500	Farming
102584	6216255	289480	60	186	1999	54 - 179	sandstone	0.9	1300	Dom / Stock
103161	6216499	289511	25	120	2000	17* - 110	sandstone	0.2	1450	Dom / Stock
104154	6215898	291128	74	165	2000	116 - 161	sandstone	1.3	2200	Dom / Stock
104602	6216148	288909	42	231	2002	30 - 213	sandstone	0.75	2500	Stock
104661	6216470	288973	68	219	2003	113 - 212	sandstone	1.05	fresh	Dom / Stock
Lot 24/25	6215007	289995	-	250	-	-	sandstone	-	-	Farming
BHPB PIEZOS										
NGW3	1216749.5	275027.4		72.1	2004	-	sandstone	-	-	Monit.
NGW4	1216826.2	275789.9		78.75	2004	-	sandstone	-	-	Monit.
NGW5	1216327.4	276124		66.45	2004	-	sandstone	-	-	Monit.
NGW6	1216680.5	276403.3		66.75	2004	-	sandstone	-	-	Monit.

All of the private bores were drilled between 70m and 250m below surface, with water obtained from sandstone aquifers with yields ranging from 0.2L/sec and 1.8L/sec between 9m and 213m below surface.

DWE bore data within the strategy area indicates it is more likely that regionally significant aquifers are intersected below approximately 100m to 110m deep, however, according to the available DWE records, intersections as shallow as 9m may be present as shallow, perched aquifers with limited extent.

The status, activity, usage and groundwater quality of the strategy area private bores will be assessed as outlined in the relevant Property Subsidence Management Plan for potentially affected properties in consultation with property owners and tenants.

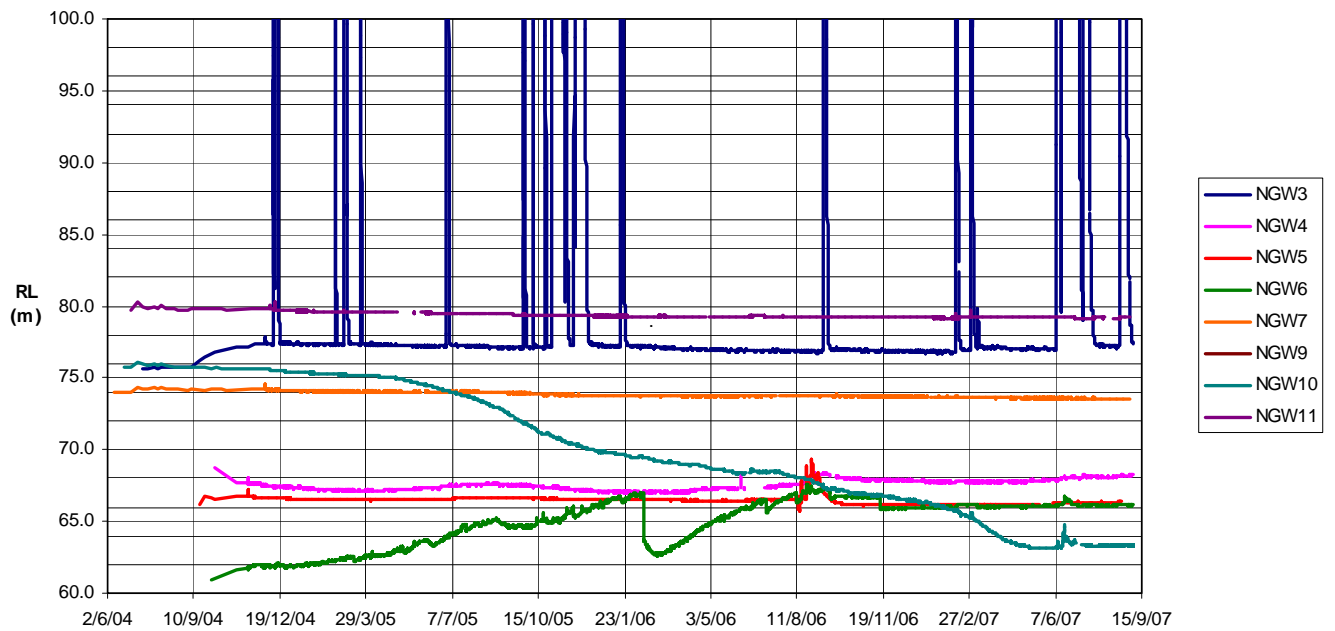


FIGURE 1 BHPB Monitored Groundwater Levels

2.5 Recreation

The river is used for various recreational activities such as fishing, primarily for bass, as well as camping on an open sandy bank or for bushwalking along river side trails.

Four wheel drive access to the river is provided by a track located to the west of Longwall 702, near the main bend in the river on the northern bank.

3. SUBSIDENCE PREDICTIONS

The predicted cumulative subsidence movements relating to extraction of Longwalls 701 to 704 are detailed in (MSEC, 2006).

In their study, (MSEC, 2006) note that the predicted ground movements are generally conservative (i.e. overestimated), particularly for uplift in the gorge. The actual subsidence movements can deviate from the predicted net movement, particularly due to the uncertainty in modelling upsidence and valley closure. This management strategy takes into account this uncertainty.

The maximum predicted subsidence after completion of Longwall 701 is above the previously extracted Longwall 18, whilst the maximum predicted subsidence after extraction of Longwall 704 is over Longwall 703 as shown in **Tables 2** and **3**.

It is assessed that that the gorge has already sustained up to 60mm of subsidence, 150mm of upsidence and 260mm of closure due to extraction of Tower Longwalls 18 to 20, with a net maximum uplift of 110mm.

Studies predict that the gorge will experience a further net uplift, although the amount will vary depending on a range of parameters (MSEC, 2006). Maximum cumulative uplift of 295mm is predicted to occur near the eastern end of Longwall 702, whilst the predicted uplift near the island and nearby river banks near the western end of Longwall 702 is approximately 105mm.

TABLE 2 Maximum Predicted Cumulative Subsidence (Plateau)

Parameter	LW701	LW702	LW703	LW704
Vertical subsidence (mm)	1070	1070	1070	1290
Transverse Tilt (mm/m)	6.3	6.3	7.2	7.6
Longitudinal Tilt (mm/m)	4.9	4.9	5.0	5.4
Transverse Tensile Strain (mm/m)	1.3	1.3	1.3	1.3
Longitudinal Tensile Strain (mm/m)	0.7	0.7	0.7	0.8
Transverse Compressive Strain (mm/m)	1.7	1.7	2.0	2.1
Longitudinal Compressive Strain (mm/m)	0.6	0.6	0.6	0.6

TABLE 3 Maximum Predicted Subsidence (Gorge)

Parameter	LW701	LW702	LW703	LW704
Cumulative Subsidence (mm)	<20	<20	22	25
Net Subsidence (mm)	<20	<20	<20	<20
Cumulative Upsidence (mm)	100	130	280	320
Net Uplift (mm)	90	125	260	295
Cumulative Valley Closure (mm)	90	205	310	440

The maximum compressive strain due to valley closure is predicted to be less than 3mm/m with the centre line of the river located a minimum distance of 175m from the proposed longwalls.

The upsidence and associated fracturing will develop sequentially, with maximum upsidence of 100mm developing from the extraction of Longwall 701, followed sequentially by 130mm, 280mm then 320mm as Longwalls 702, 703, then 704 are mined.

The upsidence will be reduced by the associated subsidence at each location, so that the predicted net maximum cumulative uplift will be 295mm.

The upsidence and compressive strain will initially develop in the gorge adjacent to Longwall 701, then will spread upstream and downstream as 702 to 704 are extracted with the maximum movement in the river to the east and west of Longwall 702.

Measurements of surface fracturing indicates that these effects extend to 5-15 m below surface where an incised stream was directly mined under and it is expected that a similar or less depth of fracturing will develop in the base of the Nepean River. As the gorge will not be directly mined under, it is unlikely that the depth of fracturing in the Nepean River gorge will be more than has been observed with subsidence in other Southern Coalfield mines which have mined directly under rivers.

4. POTENTIAL SURFACE WATER IMPACTS

4.1 River Flow

Longwalls 701 to 704 will not extract coal under the gorge and, based on observations of previous mining directly under the Nepean River it is unlikely that there would be a significant impact to river flow from the proposed mining. Previous uplift of 110mm due to mining Longwalls 18 to 20 have had no discernible impact on the Nepean River.

Subsidence modelling indicates it is likely that the river bed will fracture (MSEC, 2006), however, this is not expected to lead to loss of stream flow as the river in the gorge is at the lowest point in the regional catchment and therefore has no deeper stream or groundwater system to which it can flow, except downstream toward Menangle Weir.

As the gradient of the Nepean River is very low, and as the flow volumes are high (minimum 3ML/day, average 19ML/day), it is not anticipated that a discernible adverse effect on water flow in the Nepean River will be observed.

Fracturing and cumulative uplift of up to 295mm in the centre of the gorge will generate new void spaces in the underlying bedrock which will be filled by river and groundwater inflows. Once the fractures are filled, they do not transfer additional water unless there is an outflow path through which water can travel through the system.

4.2 River Pumps

It is not anticipated that pumps extracting water from the Nepean River will be adversely affected.

4.3 River Bed and Bank Erosion, Sedimentation and Ponding

No significant adverse impacts are anticipated on the river bed or bank sedimentation regime or pool depths except for a possible shallowing of the narrow channel on the inside of Islands 1 and 2, where the side channels can be less than 250mm deep.

Maximum uplift near the islands is predicted at around 150-200mm, however the uplift will occur in stages over three years, in which time storm flows will redistribute the sand downstream and re-establish the original flow regime and water depth.

As the shallow sandy based channels adjacent to the islands are not in the centre of the river, and as they are not located in the modelled maximum uplift areas (MSEC, 2005) it is not anticipated that they will be significantly impacted.

If the sand bar is lifted relative to the water height, the change is not anticipated to be permanent as the bed sediments are mobile and will be redistributed downstream during storm flows.

4.4 River Bank / Island Desiccation

It is anticipated that the river banks and islands could rise by up to 295mm relative to the river height, whilst the level of Menangle Weir will remain unaffected by subsidence.

The main rise will occur in the middle of the gorge, however, it is not anticipated that the uplift will result in any observable difference on island or bank vegetation or stability from the proposed mining.

4.5 River Access and Amenity

It is not anticipated that any observable adverse change will occur to the Nepean River access or amenity.

4.6 River Water Quality

The potential for diverted flow volume due to upsidence, bedrock fracturing or plateau stream bed "short circuiting" by surface water following the shortest and steepest path under the influence of gravity is assessed to be low.

There may be groundwater seepage of up to 0.2ML/day to the river resulting from subsidence movements and fracturing, however, when compared to the mean 19ML/day flow in the river, this volume is proportionally small (1.1%) and is not anticipated to have a significant impact.

The majority of groundwater seeps would discharge into the sandy substrate of the river which would provide additional opportunity for precipitation of Fe / Mn, adsorption of Ni / Zn species, retardation of outflow of seeps and enhanced mixing of river and seepage water.

It is likely that the outflow will be disseminated at various points along the river depending on the subsidence induced flow regime in the plateau, which would generate enhanced dilution, precipitation and adsorption of any seepages.

Water quality in the Nepean River is highly variable, and can often exceed ANZECC 2000 trigger values for pH, salinity and P / N nutrient species (South East Australian Upland Freshwater Streams) as well as Ni, Zn, Se, Al (Protection of 95% of Freshwater Aquatic Species) due to the significant variability of runoff in the catchment and the wide range of pollutant sources discharging to the river.

The effect of any low pH / DO, elevated salinity / dissolved metal water discharging into the Nepean River would quickly diminish within metres of the discharge point, and it is not anticipated that subsidence in the strategy area would result in the river water becoming ecotoxic.

Observation of the potentially low magnitude effects on water quality from subsidence following extraction of Longwalls 701 to 704 would be difficult to separate from the current high water quality variability in the Nepean River.

The maximum field monitored or laboratory analysed parameter, or the maxima / minima range observed by BHPB since monitoring began in the Nepean River in January 2004 within the Strategy Area at locations NR6, NR7, NR9 and NR11 is shown in **Table 4**, with plots of the relevant field data shown in **Appendix B**.

The data collected since January 2004 by BHPB indicates that in the pre-Longwall 701 to 704 situation, the Nepean River can regularly be outside the minimum / maximum, ANZECC 2000 dissolved oxygen criteria, whilst salinity and pH often exceeds the upper ANZECC 2000 criteria.

Ammonium, nitrogen oxides and total phosphorous analyses also often exceed the ANZECC 2000 criteria as do the filtered analyses of arsenic, copper, nickel, zinc and aluminium.

TABLE 4 Nepean River NR6 to NR11 Field and Laboratory Maximum (and Minimum) Analyses

Parameter	ANZECC 2000	NR6	NR7	NR7A	NR9	NR9A	NR11	NR11A
DO % sat ^	85 – 110	55 - 145	48 - 220	15 - 180	40 -175	10 - 155	35 - 145	21 - 144
SpC uS/cm ^	30 – 350	200 - 1250	200 -1000	280 - 3600	200 - 1100	226 - 3500	162 - 800	167 – 970
pH ^	6.5 – 8.0	6.6 - 8.7	6.6 - 9.1	6.5 - 9.0	6.6 - 8.9	6.5 - 8.8	6.8 - 8.7	6.6 - 8.7
NH ₄ ⁺ as N ^	0.02	0.181	0.43	0.02	0.26	<0.05	0.15	-
NO _x ^	0.04	0.67	0.91	0.36	0.6	0.01	1.52	-
Tot P ^	0.05	0.25	0.6	0.01	0.22	0.01	0.18	-
As Filt #	0.024 (As ^{III})	0.2	0.2	0.001	0.2	0.001	0.1	-
Cu Filt #	0.0014	0.014	0.011	0.001	-	-	-	-
Mn Tot #	1.9	0.26	0.223	0.038	0.083	0.125	0.225	-
Mn Filt #	1.9	0.085	0.068	0.008	0.067	0.093	0.20	-
Ni Filt #	0.011	0.041	0.038	0.039	0.039	0.038	0.034	-
Zn filt #	0.008	0.07	0.038	0.025	0.03	0.021	0.03	-
Al Tot # (>pH6.5)	0.055	1.24	1.04	<0.05	1.0	0.01	2.95	-
Al Filt # (>pH 6.5)	0.055	-	0.96	<0.01	0.78	<0.05	0.88	-
Fe Tot	-	1.15	1.25	0.24	1.16	0.27	1.74	-
Fe Filt	-	0.77	0.82	0.05	0.69	0.06	0.77	-

Note: All parameters represent maximum analysis obtained in mg/L except as shown, or a where a maxima / minima range is shown

Locations 7A, 9A and 11A indicate a deeper sample at the same location as sites 7, 9 and 11

^ ANZECC 2000 SE Australian Lowland River criteria

ANZECC 2000 trigger values for Protection of 95% of Freshwater Species

4.7 Plateau Stream Flow

It is anticipated that there should be no significant, adverse observable impacts to tributary flow in the ephemeral, first and second order plateau creeks.

Based on the 1.3m of subsidence, some creek bed or bank cracking may occur in zones of elevated tensional strain, particularly along the edge or end of the longwalls, however if there is a greater than 1m of soil cover, these cracks may not be observed.

Cracking may be observed in exposed sandstone / shale outcrops in the creek beds. Previous observations in the Southern Coalfields show that flow diversion to the shallow groundwater system can occur, although loss of stream flow is generally insufficient to be observed in low order streams as the cracks are usually small and not sufficiently connected.

No observable adverse stream gradient changes are predicted that could adversely impact flow in the low order streams.

4.8 Plateau Stream Water Quality

No adverse effect on first or second order plateau stream water quality is anticipated.

4.9 Dam Water Levels and Quality

Due to the low predicted strains and tilts, it is not anticipated that dam floor or wall integrity or dam water quality will be significantly impacted by subsidence cracking or tilting.

Dams within the centre of subsidence bowls may experience temporary extensional cracking as a longwall undermines a location, which is likely to be reversed once full subsidence develops under the dam.

5. POTENTIAL GROUNDWATER IMPACTS

5.1 Aquifer / Aquitard Interconnection Under the Plateau

Mining induced fracturing of overburden strata over the extraction area will occur on the plateau, and may potentially extend to 20m below surface. There is also potential for dilation of strata below the surface tensional zone.

No adverse interconnection of aquifers and aquitards is anticipated within 20m of the plateau surface as there are no recorded aquifers in this interval.

There may be an increased rate of rainfall recharge into the plateau due to the increased secondary porosity and permeability of the fractured sandstone / shales which can result in higher discharge volumes and duration of temporary rain dependent seeps in the gorge, and/or higher recharge rates to underlying aquifers.

The resultant enhanced seepage or altered vertical recharge patterns will depend on which preferential flow path, or paths, develops. Even though there is insufficient knowledge of the variables to predict which flow patterns will develop, the effect is not significant, and, in addition, the variability of the sandstone sequence is such that predictions would be difficult to develop between known bore hole data.

5.2 Groundwater Levels

Temporary lowering of the piezometric surface over the subsidence area due to horizontal dilation of strata and resultant increase in secondary porosity may occur, which may be more notable directly over the area of greatest subsidence and dilation, and will dissipate laterally out to the edge of the subsidence zone.

Groundwater levels may be reduced by up to 10m, and may stay at that reduced level until the new, secondary voids are refilled.

The impact of subsidence on private bores is related to a bore's proximity to each longwall, rainfall recharge and changes in the rate or duration of bore water extraction in the owner's, or adjacent bores.

On the basis that sufficient rainfall occurs and that the status of groundwater bore pumping in the property and local area remain the same, then it is anticipated that groundwater levels will recover over a few months as the newly developed secondary porosity is recharged by rainfall sourced water, unless a new outflow path develops if a bore is close to a cliff.

5.3 Well Yield and Bore Serviceability

Four DWE registered bores within or near the strategy area may be affected by subsidence. Two are located over Longwall 703 (GW101437 and GW104154) and two are located on the edge of the strategy area, northwest of the future Longwall 705 (GW102584 and GW103161).

Horizontal displacement of strata may occur which can make the bores inaccessible.

Strata dilation and subsequent refilling of the secondary voids may temporarily lower standing water levels, whilst increasing the potential yield of a bore through enhanced

permeability and secondary porosity.

Bores outside the strategy area are less likely to have observable subsidence effects.

5.4 Groundwater Quality

Increased iron hydroxide precipitation in a subsided bore's discharge water may occur if the aquifer is exposed to "fresh" rock surfaces along with dissolution of unweathered iron containing minerals, such as marcasite or siderite. The degree of change can range from no effect to a significant discolouration of the discharge water. The discolouration does not pose a health hazard, however it can result in clogging of pumping equipment and piping.

Acidity (pH) changes of up to 1 order of magnitude can occur, however any change will be substantially reduced if the bore has sufficient bicarbonate levels.

It is unlikely that there will be any significant impacts to water quality supplies from the proposed mining.

5.5 Seeps, Springs and Baseflow to River

Lowering of perched ephemeral seeps along the cliffs may occur after subsidence through fracturing of underlying confining, low permeability layers in the plateau strata, with the fracturing enabling perched water to seep out at lower levels down the cliff compared to pre subsidence levels.

The current seeps are generally short lived, with the volume and duration of flow directly related to the amount and intensity of rainfall. The seeps flow after wet periods and stop flowing after prolonged dry periods.

The volume of flow from the seeps may increase due to enhanced rainfall recharge through the plateau after rain whilst the duration of seepage may reduce due to the increased ability for water to drain to the higher post subsidence permeability areas.

The low order creeks on the plateau will be subjected to relatively low tensile strains (1.3mm/m) and tilts (<7.2mm/m), and as a result their flow and water quality is not predicted to be significantly impacted by subsidence related surface cracking.

It is not predicted that increased seepage into the Nepean River Gorge will occur.

6. SURFACE WATER MONITORING

The monitoring program has been prepared in compliance with the DPI SMP Approval Condition 16, and is designed to provide a database that enables comparison of the predicted to observed impacts of subsidence, and specifically deals with the predicted impacts on the Nepean River and its tributaries within the strategy area.

The location of all surface water monitoring points are presented in **Drawing 1**.

6.1 Rainfall

Daily rainfall data is collected at BHPB Appin and Appin West Mine Sites.

6.2 River, Stream and Dam Monitoring Locations and Frequency

Daily flow monitoring at Maldon and Menangle Weirs in the Nepean River and at Broughtons Pass Weir in the Cataract River will continue to be obtained annually from the SCA and be compared to rainfall in the local catchment.

The monthly nail height monitoring conducted by BHPB in the Nepean River should be augmented by the daily water level data collected at the weir sites. Monitoring within the SMP Area should be collected weekly at the nail heights sites during active subsidence.

As no long term impacts are expected, the need for impact management should be formally reviewed at the end of each longwall as part of the End of Panel Review process and reporting.

Table 5 identifies monitoring locations, the type and frequency of monitoring along with a brief description of monitoring sites within the Nepean River, ranging from downstream of the Cataract River confluence to the downstream edge of the strategy area.

Other monitoring sites are monitored by BHPB in the Nepean River and its tributaries, however they are either upstream or downstream of the strategy area, or are tributary streams that are not located within the strategy area.

TABLE 5 RIVER MONITORING AND FREQUENCY

Site	Type of Monitoring	Sampling Method	Frequency	Site Description
NR6, 7, 9, 11	Water Height	Field Measurement	Weekly	Nepean River Stations
NR6, 7, 9, 11	Water Quality	Grab Sample	Monthly	Nepean River Stations
River Pumps	Pump Submergence	Visual	Monthly	Douglas Pump and two unnamed Pumps

Table 6 identifies the type, method and frequency of proposed monitoring in upland streams within the strategy area.

TABLE 6 UPLAND STREAM FLOW MONITORING AND FREQUENCY

Streams	Type of Monitoring	Sampling Method	Frequency	Site Description
LW701	Visual Water Quality	Photo Grab Sample	Start / Finish of Panel	All streams overlying LW701
LW702	Visual Water Quality	Photo Grab Sample	Start / Finish of Panel	All streams overlying LW702
LW703	Visual Water Quality	Photo Grab Sample	Start / Finish of Panel	All streams overlying LW703
LW704	Visual Water Quality	Photo Grab Sample	Start / Finish of Panel	All streams overlying LW704

Opportunistic monitoring / sampling of stream flows and water quality will be undertaken depending on the ephemeral nature of each stream during the extraction period for each longwall.

Table 7 identifies the type, method and frequency of proposed monitoring in dams within the strategy area.

TABLE 7 DAM WATER LEVEL MONITORING AND FREQUENCY

Dams	Type of Monitoring	Sampling Method	Frequency	Site Description
LW701	Visual	Photograph	Start / Finish of Panel	3 dams overlying LW701
LW702	Visual	Photograph	Start / Finish of Panel	10 dams overlying LW702
LW703	Visual	Photograph	Start / Finish of Panel	13 dams overlying LW702/3 (includes 4 dams overlying chain pillar)
LW704	Visual	Photograph	Start / Finish of Panel	10 dams overlying LW703/4 (includes 1 dams overlying chain pillar)

Dams overlying chain pillars will be monitored over the extraction period of both adjoining panels.

The dam wall integrity should also be assessed at the beginning and end of each longwall for dams overlying the 20mm subsidence envelope for that longwall.

6.3 River and Stream Water Quality

Table 8 presents the parameter suites to be monitored and the sampling method for each parameter associated with the Nepean River and upland streams.

TABLE 8 RIVER AND UPLAND STREAM WATER QUALITY MONITORING PARAMETERS

SUITE	ANALYTES
Nepean River	Field EC, Eh, DO, pH, temp TDS, TSS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P, DOC Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered)
Upland Stream	Field EC, Eh, DO, pH, temp

6.4 River Depth, Stream Bed and Banks

Any observable changes in river bed depth and river accessibility will be noted during monthly field inspections, with particular emphasis on the inside channels of Islands No. 1 and 2.

If the river bed shallows to a degree where river access or amenity is adversely affected, monitoring of water depths will be conducted during each field monitoring session at those particular locations.

Photographic monitoring of the river banks in the predicted uplift areas will be conducted at the commencement and conclusion of each longwall extraction period, with a focus on the area around Islands 1 and 2 as shown in **Drawing 2**.

The results will be incorporated into the BHPB ground subsidence survey program.

7. GROUNDWATER MONITORING

The groundwater monitoring program is designed to provide a database that enables comparison of the predicted to observed impacts of subsidence. It specifically deals with:

- Establishing a rainfall / groundwater level recharge relationship,
- Impacts on groundwater levels in private bores, and;
- Impacts of the development on groundwater quality.

The location of all groundwater monitoring locations are presented on **Drawing 1**.

7.1 BHPB Piezometers Water Levels

Results from vibrating wire piezometric pressures monitored within the strategy area since July 2004, prior to mining are provided in **Table 9**.

TABLE 9 STRATEGY AREA PIEZOMETER MONITORING RESPONSES

GW	Depth (m)	SWL RL (2004)	SWL RL (Sep 2007)	2004 to 2007 Response (m)	June 2007 Rainfall Response (m)	Comments
NGW3	72.1	75.67	77.32	+ 1.65	0.40	-
NGW4	78.75	68.71	68.28	- 0.43	0.27	-
NGW5	66.45	66.15	66.36	+ 0.21	0.12	-
NGW6	66.75	60.88	66.20	+ 5.32	0.61	Anom. 4.23m decline in Feb. 2006

Daily monitoring of water levels will continue through the operational and post mining periods within NGW3 to 6 within the strategy area.

In addition, all BHPB piezometers in the Longwall 701 to 704 strategy area region will be monitored to further assess relationships between groundwater levels, rainfall recharge and any depressurisation due to subsidence.

7.2 DWE Registered Bore Water Levels and Quality

Standing water levels will be measured at least once before and after each private bore is mined under to assess if any adverse effects due to subsidence have occurred in the bores outlined in **Table 10**. This monitoring will be restricted to bores where access has been granted for monitoring purposes.

TABLE 10 STRATEGY AREA PRIVATE BORES

GW	N	E	SWL (m)	Depth (m)	Drilled	Aquifer	Lithology	YIELD (L/s)	EC (mg/L)	Purpose
34425	6215425	289085	14.6	70	1972	9* – 69.4	sandstone	0.63	good	Waste disposal
101437	6216406	291651	75	128	1997	119 - 121	sandstone	0.7	2500	Farming
102584	6216255	289480	60	186	1999	54 - 179	sandstone	0.9	1300	Dom / Stock
103161	6216499	289511	25	120	2000	17* - 110	sandstone	0.2	1450	Dom / Stock
104154	6215898	291128	74	165	2000	116 - 161	sandstone	1.3	2200	Dom / Stock
104602	6216148	288909	42	231	2002	30 - 213	sandstone	0.75	2500	Stock
104661	6216470	288973	68	219	2003	113 - 212	sandstone	1.05	fresh	Dom / Stock
Lot 24/25	6215007	289995	-	250	-	-	sandstone	-	-	Farming

The property owner will be interviewed before and after each bore is mined under to assess the bore's status, pumping rate, the general duration of pumping as well as the type and set up of the pump. The bore yield should also be measured if required, and on the basis that suitable access into the bore for monitoring instrumentation can be obtained.

The intended use of the water and observations on the quantum of iron hydroxide precipitating from the pumped water before and after mining is outlined in the PSMPs.

Consultation with bore owners and the monitoring of bores will be incorporated into the Property Subsidence Management Plan for relevant properties.

The pre-mining water sampling and analysis should be repeated after each bore is mined under to enable post mining assessment of any subsidence related changes in groundwater quality.

Where private bores are being occasionally or frequently pumped, and could thereby temporarily distort the static regional groundwater levels, the depth to groundwater should be monitored during pump resting periods, in addition to the BHPB piezometer data, to assess the regional piezometric surface across the area.

7.2.1 Private Bore Monitoring Procedure

Where the owner permits access, the depth of drawdown in each pumped bore during pumping, as well as the standing water level during rest periods should be ascertained before and after undermining.

Bores should be purged prior to sampling until pH and salinity measurements have become stable. This usually involves removal of at least three bore volumes of groundwater or purging until dry.

Samples will be collected and placed in appropriately preserved containers and kept on ice. Samples will be transported on ice under chain of custody documentation and arrive at the laboratory within appropriate holding times.

7.3 Groundwater Level and Quality Parameters

Table 11 presents the physical parameters to be measured, frequency of monitoring and sampling method, with monitoring to continue for a 12 month period after mining has ceased.

The frequency of post mining monitoring will be reassessed after mining is complete as it may be possible, depending on results, to lengthen the intervals. The End of Panel Reporting process will be used to determine this.

The frequency of monitoring and the parameters to be monitored may be varied in consultation with the DPI once the variability of the groundwater quality is established.

TABLE 11 GROUNDWATER LEVEL MONITORING FREQUENCY

Monitoring Suite	Sampling Method	Frequency	Units
BHPB Piezo	Vibrating Wire Piezo	Daily	pressure
Private Bore	Dip meter	Monthly	mbgl

At least one appropriately purged groundwater sample should be collected from each private bore, where access is available, in the pre and post-mining phase and analysed as shown in **Table 12**.

TABLE 12 PRIVATE BORE GROUNDWATER QUALITY PARAMETERS

SUITE	ANALYTES
Private Bore	Field EC, Eh, pH, temp TDS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered)

7.4 Cliff Seeps

The presence and duration of observable cliff seeps within the strategy area will be photographically and semi-quantitatively recorded during monthly field monitoring when seeps are observed to flow.

Where available and accessible, seep water samples should be collected and assessed for the parameters outlined in **Table 13**.

TABLE 13 GROUNDWATER QUALITY MONITORING PARAMETERS

SUITE	ANALYTES
Cliff Seeps	Field EC, Eh, pH, temp TDS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered)

7.5 Mine Groundwater Inflow

The active underground mining area should be observed to enable an assessment of whether any groundwater inflow is occurring to the workings above Longwalls 701 to 704.

There has been no observed surface water inflow, or significant groundwater inflow in the Appin, Tower or West Cliff Collieries since longwall mining commenced in the 1960s.

8. ASSESSMENT CRITERIA AND TRIGGER LEVELS

Trigger values for further assessment of potential subsidence effects on the surface water and groundwater systems within the strategy area are shown in the following sections.

The triggers have been developed to reflect the current variability in relevant parameters and to enable the identification of any changes that may be due to either subsidence effects and/or natural variability.

If trigger values are exceeded, the cause and effect will be investigated and specific management actions implemented if the effect is directly related to mining induced subsidence.

The Manager Environment shall be responsible for the implementation of agreed actions and shall communicate such actions to the relevant landowners or authorities.

8.1 Nepean River Water Depth, Bed and Bank Stability, Access, Amenity and Pumps

Triggers and actions for the following issues in the Nepean River are presented in **Table 14**.

TABLE 14 Nepean River Water Depth, Bed and Bank Stability and Access / Amenity Triggers and Response Action Plan

Trigger Event	Action	Responsibility
Loss of Surface Water Connectivity in River	Increase Monitoring Frequency to Fortnightly and assess whether change is due to subsidence/upsidence. If due to subsidence prepare a site monitoring and rehabilitation plan.	Manager Environment
New Section of River Bed Becomes Dry or Exposed	Increase Monitoring Frequency to Fortnightly and assess whether change is due to subsidence/upsidence. If due to subsidence prepare a site monitoring and rehabilitation plan.	Manager Environment
Adverse River Bed or Bank Erosion Occurs	Increase Monitoring Frequency to Fortnightly and assess whether change due to subsidence/upsidence. If due to subsidence prepare a site monitoring and rehabilitation plan.	Manager Environment
Adverse River Bed or Bank Desiccation Occurs	Increase Monitoring Frequency to Fortnightly and assess whether change due to subsidence/upsidence. If due to subsidence prepare a site monitoring and rehabilitation plan.	Manager Environment
Loss of River Access or Amenity	Increase Monitoring Frequency to Fortnightly and assess whether change due to subsidence/upsidence. If due to subsidence prepare a site monitoring and rehabilitation plan.	Manager Environment
Pump Inlet Rises Out of River Level	Assess whether change due to upsidence and re-instate pump below water level if change is due to mining.	Manager Environment

8.2 Nepean River Water Quality

Table 15 indicates the proposed trigger levels for water quality in the Nepean River within the Strategy Area.

TABLE 15 Nepean River Water Quality Triggers and Response Action Plan

Trigger Event	Action	Responsibility
Iron hydroxide seep observed in river	Increase monitoring frequency to fortnightly and ascertain if seep occurrence is due to subsidence. If due to mining, prepare and implement a site rehabilitation plan as required in association with DPI / DWE.	Manager Environment
A parameter outlined in Table 4 exceeds site specific baseline maximum, or is outside of site specific baseline range	Increase monitoring frequency to fortnightly and assess if due to mining. If due to mining, prepare and implement a site rehabilitation plan as required in association with DPI / DWE.	Manager Environment

8.3 Upland Stream and Dams

Table 16 outlines the triggers, actions and responsibilities in regard to upland streams and dams.

TABLE 16 Upland Stream and Dam Triggers and Response Action Plan

Trigger Event	Action	Responsibility
Loss of Stream Flow through Stream Bed Cracking	Inspect site and assess whether flow loss is due to subsidence. If due to subsidence, prepare and implement a site rehabilitation plan.	Manager Environment
Stream Water exceeds pre-mining water quality range	Increase monitoring frequency to quarterly and assess if change is due to subsidence. If due to subsidence, prepare and implement a site rehabilitation plan when the site is fully subsided.	Manager Environment
Rapid, Observable Loss of Dam Water Level	Inspect dam for subsidence cracks. If water loss is due to subsidence cracking of the dam wall or floor, provide an alternate source of water. Develop and implement a site rehabilitation plan.	Manager Environment

Flow in the upland streams is highly variable and depends on the prevailing seasonal and climatic regime. If subsidence cracking occurs in a creek bed that could adversely affect stream flow and catchment yield, the creek bed will be rehabilitated to enable the pre-subsidence stream flow and water quality characteristics to continue.

The results of water quality monitoring will be reported in the End of Panel Reports to identify any trends over time. DWE and DPI will be notified in the event of increasing

levels of any parameter or exceedances of ANZECC guideline levels.

If a rapid change in dam water storage level is noted, the cause of the change will be investigated. If it is found that subsidence cracking of the dam floor or wall led to the change in water level the dam will be rehabilitated by resealing the dam floor and wall once the ground is fully subsided. In the interim, an alternate source of water will be provided to the landowner.

8.4 Groundwater

Table 17 outlines the triggers, actions and responsibilities in regard to groundwater.

It has been recognised by the author through monitoring groundwater bores associated with the Tahmoor Colliery that landowners pumping their own bores, as well as the effect of other landholders pumping bores in an adjacent property, can significantly affect temporary standing water levels in a bore, without any influence from subsidence.

On this basis, if the combined monitoring of both BHPB and private bores indicates a persistent drawdown of equal to or greater than 5m over a 2 month period, then the cause of the exceedance will be investigated to assess whether the drawdown is due to;

- lack of rainfall recharge (using the cumulative sum of monthly rainfall deviation from the monthly mean),
- operation of landowner bores either within or outside an affected bores property,
- subsidence, or
- any or all of the above

The 5m drawdown trigger level has been derived through monitoring of groundwater level variability in the existing BHPB piezometers within the strategy area, prior to the area being mined.

TABLE 17 Groundwater Triggers and Response Action Plan

Trigger Event	Action	Responsibility
Reduction of Groundwater Level in a Private Bore by over 5m over a 2 Month Period, Reduction of Bore Yield or Adverse Bore Serviceability	<p>If a landowner indicates that a reduction in their bore water level that exceeds a drop of 5m, or an adverse effect occurs to their bore, BHPB will review the groundwater level monitoring data from BHPB piezometers and other private bores to assess if the loss is due to mining.</p> <p>In addition The bore water level, pumping rate, rate of drawdown or bore serviceability will be inspected as required.</p> <p>If the adverse effect is due to subsidence, BHPB will initially provide an interim alternate source of water, then prepare and implement a site rehabilitation plan when the site is fully subsided. (see description below)</p>	Manager Environment
Notable Increase in Iron Precipitation or Groundwater Salinity in a Private Bore	<p>If a landowner indicates that an observable increase in iron hydroxide precipitate or salinity has occurred, BHPB will collect a water sample and compare it to the baseline pre-mining water quality where the data has been collected to assess if the loss is due to mining. (see Tables 20 and 21 for criteria)</p> <p>If the change is due to subsidence, BHPB will initially provide an interim alternate source of water, then prepare and implement a site rehabilitation plan when the site is fully subsided. (see description below)</p>	Manager Environment
Gas release from a Private Bore	<p>If a landowner indicates that gas is being produced from a groundwater bore, BHPB will collect a gas and water sample</p> <p>If the change is due to subsidence, BHPB will initially provide an interim alternate source of water, then prepare and implement a site rehabilitation plan when the site is fully subsided. Site measures consistent with the SMP Safety Management Plan will be implemented to ensure the safety of the area. This will include appropriate signage and exclusion zones if necessary.</p>	Manager Environment
Notable Seepage from the Cliff in the Nepean River Gorge	<p>If a seep is observed that has not been monitored in previous gorge inspections, BHPB will collect a water sample and inspect the overlying cliff face and plateau for evidence of mining related cracking to assess if the seep is due to mining.</p> <p>If the seep is new, or enhanced due to mining, BHPB will prepare and implement a site rehabilitation plan in association with DPI / DWE if required.</p>	Manager Environment

If a landowner reports an increase in iron hydroxide precipitation or water salinity, as an initial default, the ANZECC 2000 irrigation and livestock guidelines shown in **Tables 18** and **19** will be used to assess the bore water quality.

TABLE 18 GROUNDWATER CRITERIA – MAJOR IONS AND NUTRIENTS

	pH	TDS	Na	Ca	Cl	F	SO ₄	NO ₃	Hardness as CaCO ₃
Irrigation	6 - 8.5	-	-	-	-	2	-	25-125 (N)	>60-350
Livestock	-	<4000/5000	-	-	-	2	-	-	-

TABLE 19 GROUNDWATER CRITERIA – METALS (MG/L)

	Cu	Pb	Zn	Ni	Fe	Mn	As	Se	Cd	Cr
Irrigation	5	5	5	2	10	10	2.0	0.05	0.05	1
Livestock	1/0.4	0.1	20	1	-	-	0.5	0.02	0.01	1

NOTE: irrigation criteria for short term trigger values (< 20 years)

Livestock criteria for beef / sheep

9. SURFACE WATER AMELIORATIVE ACTIONS

On completion of mining induced subsidence, rehabilitation of any significant impacts to surface water features will be undertaken to restore, to the greatest practical extent, the impacted feature to its pre-mining characteristics.

The following sections outline ameliorative actions that would be used.

9.1 Stream Bed Cracking or Bank Instability

If stream bed cracking or bank instability is identified, the effects on plateau stream flow and stability will be assessed.

A site specific management and mitigation plan will be developed in consultation with relevant stakeholders and implemented when active subsidence is complete.

9.2 River Access and Amenity

If the river shallows as a result of subsidence movements to a degree where access or amenity is adversely affected, a site specific management and mitigation plan will be developed in consultation with relevant stakeholders.

The plan would address the actual circumstances of the change, and if the sand bed does not sufficiently re-distribute downstream after a major storm event, additional measures such as excavation of sediments would be implemented in consultation with key stakeholders.

All appropriate approvals would be gained prior to any works being undertaken.

9.3 Surface Cracking

It is predicted that there will not be significant crack development as a result of mining. In addition, the deep soil cover and the soil and creek bank stabilising cover of trees and grasses will mitigate the effects of cracking within the strategy area.

The mining area will be regularly inspected with the trigger for remediation occurring when a significant crack or cracks develop that could pose an adverse threat to stream bed or bank stability or water quality.

Any impacts identified that may require remediation on privately owned land will be conducted only after consultation and agreement with the land owner.

9.4 Adverse Effects on Overland Surface Drainage and Pooling

It is predicted that there will not be significant subsidence effects on overland surface drainage and pooling. In addition, the vegetated ephemeral nature of the catchments over the proposed longwalls will mitigate the effects on surface drainage. It is also unlikely that there would be observable increased pondage due to differential subsidence.

9.5 Impact on Stream Bed and Bank Stability / Erosion

No destabilisation of the creek lines over the proposed longwalls is predicted.

If adverse subsidence effects do occur, the following actions will be used to remediate the impacts where appropriate.

9.5.1 Alluvial Bank Stabilisation

Where subsidence monitoring indicates instability in unconsolidated banks, the bank may be graded back to its angle of repose and revegetated.

The stream bank will be initially monitored during the active subsidence phase and then rehabilitated if required.

9.5.2 Rilling and Piping of Subsidence Cracks

Subsidence cracks in the soil can be protected from erosion by ripping the exposed surface and placing topsoil in any less vegetated areas. Loose soil will be protected by establishing grass and installing contour banks above the area to divert surface runoff away from subsidence impacted areas, along with silt fences placed downstream of the works area in the stream channel.

Contour banks may be installed on the up-gradient side of and areas of cracking to slow water runoff from the slopes and to minimise erosion.

9.5.3 Vegetation Stabilisation of Denuded Areas

If required, disturbed areas will be protected from erosion by grass seeding followed by tree planting as establishing sustainable vegetation growth is critical in attaining successful riparian zone rehabilitation.

Revegetation of the creek banks and the (limited) alluvial terraces would mimic the current vegetated sections of the creek by using grasses, indigenous trees and shrubs.

10. POTENTIAL GROUNDWATER AMELIORATIVE ACTIONS

Any mining induced damage to bore infrastructure or function will be managed such that there is minimal impact on the utilisation of that water. Should the accessibility, available drawdown or yield of a bore be impacted due to subsidence, the Colliery is required to provide an alternative water supply until a suitable permanent water supply can be developed.

If the level does not sufficiently recover and the effect is due to subsidence rather than regional climatic or anthropogenic factors, repairs or maintenance to a bore can be undertaken after maximum subsidence has developed. At this time the pump intake can be lowered, the bore extended to a greater depth or if these measures were not successful a new bore can be established.

With these mitigation measures in place it is unlikely that water supply to properties will be significantly impacted by the proposed mining.

10.1 Groundwater Yield

In the event of a monitored or reported adverse impact on the yield or saturated thickness of a private registered bore, the cause will be investigated.

If a groundwater level drop of over 5m for a period of over 2 months is recorded, and the reduction in bore yield is a consequence of subsidence, BHPB will enter into negotiations with the affected landowners and the Mine Subsidence Board with the intent of formulating an agreement which provides for one, or a combination of;

- re-establishment of saturated thickness in the affected bore(s) through bore deepening;
- establishment of additional bores to provide a yield at least equivalent to the affected bore prior to mining;
- provision of access to alternative sources of water; and
- compensation to reflect increased water extraction costs, e.g. due to lowering pumps or installation of additional or alternative pumping equipment.

10.2 Groundwater Quality

In the event of an adverse change in water quality, particularly in regard to salinity and / or iron levels, the Mine will implement an investigation to determine if the cause is due to subsidence.

If subsidence cracking has caused a notable increase in iron hydroxide precipitates or the landowner reports a change in salinity, and that change that exceeds the trigger levels outlined in Tables 20 and 21, the mine will enter into negotiations with the affected landowner with the intent of formulating an agreement which provides for one, or a combination of;

- re-establishment of the water supply from a new bore to provide water equivalent to the pre mining status of the bore (on the basis that the landholder has allowed for the pre-mining status of the bore to be established);

- provide access to an alternative source of water, or;
- compensate the bore owner to reflect the economic costs incurred due to the subsidence effects on the water quality.

10.3 Groundwater Dependent Ecosystems

Subsidence will lower groundwater levels above the extracted longwalls, and may affect seepage location, duration and rates into the gorge, however, there are no known groundwater dependent ecosystems in the strategy area.

11. CONTINGENCIES

11.1 Surface Water

The Mine recognises that a significant change in the beneficial use of the river, streams or dams should not occur as a consequence of subsidence.

In the event that a trigger has been reached or is being approached, the Mine will commission a hydrologist to review the data, with the outcomes of that review, including any recommendations, being subject to discussion and agreement with the DPI and DWE.

A trigger of adverse effects on stream flow, water quality or dam capacity would initially lead to an increase in the analytes monitored and/or frequency of sampling to confirm the magnitude and extent of the change, and to verify that the change is a consequence of mining.

Mine staff shall notify the affected landowner(s) if any trigger level is reached. If it is the contracted hydrologist's opinion that the effect is a consequence of subsidence, mitigation measures will be initiated with the agreement of the landowner and on-going observation of the trigger that has been exceeded, along with the preparation and implementation of a site specific monitoring and rehabilitation plan, will be conducted.

An independent expert may also be used where a dispute arises as to the cause of the change, given that water supply and quality can be affected by non-mining related factors such as climatic and seasonal variability, water use by a landowner, agricultural use, bacterial infection or fertilizer contamination to name a few possible causes.

11.2 Groundwater

In the event that routine monitoring indicates that a trigger has been reached or is being approached, the Mine will commission a hydrogeologist to review the data, with the outcomes of that review, including any recommendations, being subject to discussion and agreement with the DPI.

A trigger of pH or EC would initially lead to an increase in the analytes monitored and/or frequency of sampling to confirm the magnitude and extent of the change in water chemistry and determine if the change is a consequence of mining.

Should the standing water level trigger be achieved in any bore, the Mine staff shall notify the affected landowner(s) and, if it is the hydrogeologist's opinion that the reduction is a consequence of mining, mitigation measures identified in Section 10 will be initiated.

An independent authority may also be used where a dispute arises as to the cause of the

change, given that groundwater supply and quality can be affected by non-mining related factors such as bore siltation, aquifer depletion, adjoining users, bacterial infection, fertilizer contamination etc.

12. REPORTING

Surface and groundwater monitoring results and interpretations will be reported within four months of the completion of each panel to outline trends in surface water quantity or quality as well as standing groundwater levels and quality.

The report will be completed by a suitably qualified hydrologist / hydrogeologist. The assessment of trends will consider the ANZECC trigger levels and any natural variations that occur, and will include;

- a statistical analysis (mean, range, variance, standard deviation) of the results for the parameters measured in the Nepean River, upland creeks, dams, bores or wells, and;
- an interpretation of the water quality results and trends in water quality and water levels at surface and ground water monitoring points supported by graphs and contour plots.

It will provide an interpretation and review of the results in relation to trigger criteria and predictions made in the EIS.

13. RESPONSIBILITIES AND ACCOUNTABILITIES

13.1 Manager Environment

- Authorise the Plan and any amendments thereto;
- Notify the Director Environmental Sustainability of any triggers being exceeded;
- Ensure that the requisite personnel and equipment are provided to enable this strategy to be implemented effectively;
- Ensure this strategy is reviewed should any changes to the mine plan or if levels of subsidence are greater than predicted; and
- Reporting in the End of Panel Report and Annual Environmental Management Report.

13.2 Environmental Coordinator

- Ensure that inspections are undertaken in accordance with the schedule;
- Ensure that persons conducting the inspection are appropriately trained, understand their obligations and the specific requirements of this plan;
- Review and assess monitoring results and inspection checklists; and
- Promptly notify the Manager Environment of any identified environmental issue.

13.3 Contract Hydrogeologist

- Review the monitoring to the standard and frequency as outlined in this plan;
- Promptly notify the Manager Environment of any identified environmental issue; and
- Compile the reports ready for submission as required by the DPI / DWE.

14. AUDIT, REVIEW AND MODIFICATION OF THE STRATEGY

This strategy has been agreed between the relevant parties and will be reviewed following the completion of mining of each panel.

Other factors that may require a review of the strategy are:-

- Observation of greater impacts on water related features due to mine subsidence than was predicted;
- Observation of fewer impacts on water related features due to mine subsidence than was predicted; and
- Observation of significant variation between observed and predicted subsidence.

The monitoring data will be reviewed annually as well as at strategic milestones in the mine life including:

- The end of each longwall to assess the need for specific site amelioration of adverse mining related impacts, such as creek bed cracking or bank erosion related to subsidence;
- Required reporting periods, and
- The end of Longwall 704.

The strategy will be reviewed if there are changes to the mine plan, if monitoring results are outside of predictions or if government requests such a review.

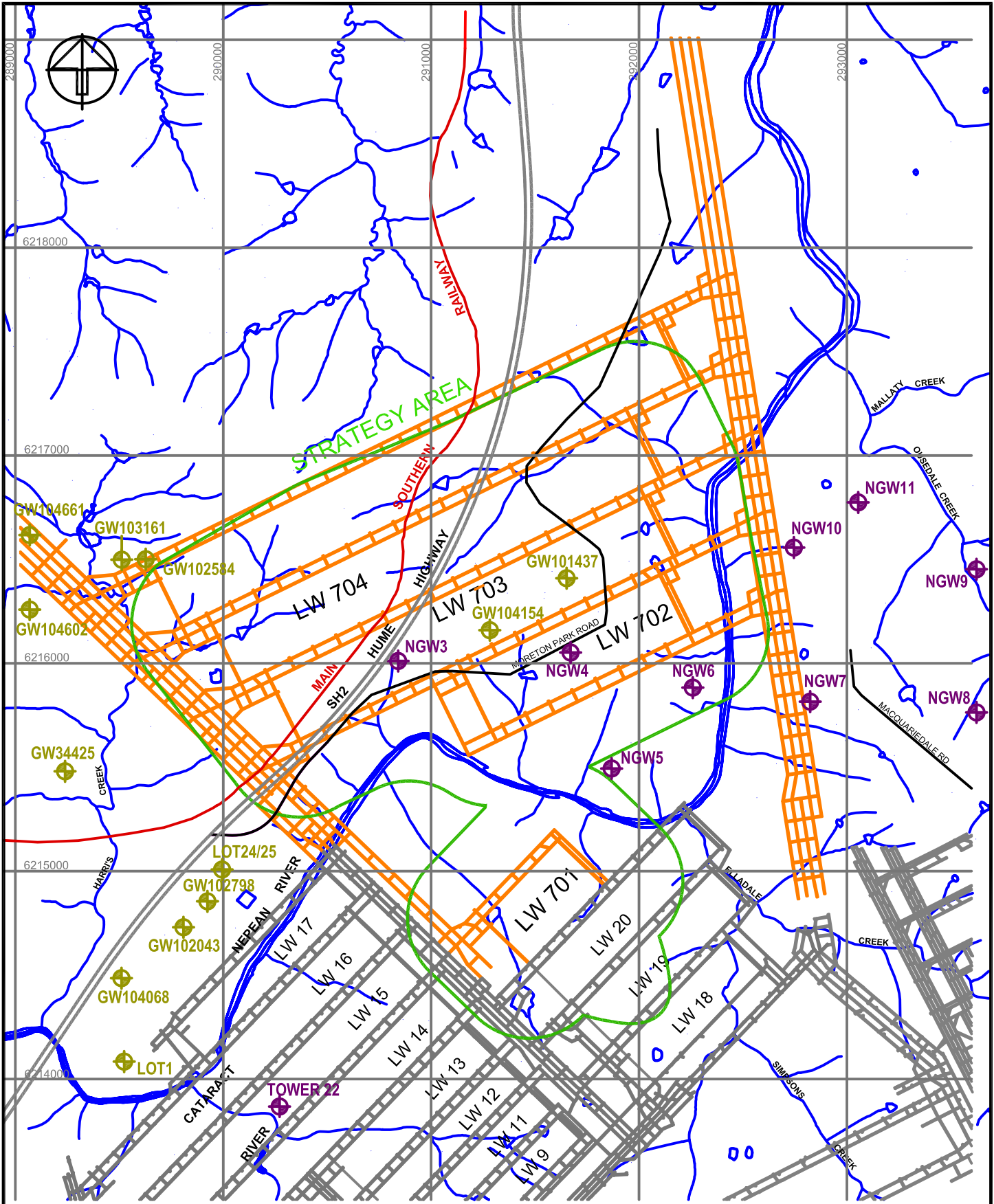
All modifications will be made in consultation with and only with the agreement of DPI.

15. TRAINING

All personnel who conduct inspections will be trained in the requirements of the strategy. Training will be conducted on the field testing equipment and sampling procedure for laboratory analysis. This training is supported by an ISO 14001 certified Environmental Management System.

16. REFERENCES

- ANZECC & ARMCANZ, 2000 An Introduction to the Australian and New Zealand Guidelines For Fresh and Marine Water
- Department of Housing and Department of Land and Water Conservation 1998 Managing Urban Stormwater: Soils and Construction Manual, DoH and DLWC, Sydney.
- Department of Infrastructure Planning and Natural Resources, 2005 Management of Stream / Aquifer Systems in Coal Mining Developments
- Geoterra Pty Ltd, 2006A Douglas Area 7 Longwalls 701 to 704 Surface Water Assessment
- Geoterra Pty Ltd, 2006B Douglas Area 7 Longwalls 701 to 704 Groundwater Assessment
- Kalf, Dr F. 2006 Independent Review of Groundwater Impacts - Proposed Douglas Area 7 Coal Development EIS / SMP
- MSEC, 2006 The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Surface and Sub-surface Features Due to Mining Longwall Panels 701 to 704 at Douglas Colliery in Support of an SMP Application
- National Environment Protection Council (NEPC), 1999, Guideline on the Investigation Levels for Soil and Groundwater, Schedule B(l) of the National Environment Protection (Assessment of Site Contamination) Measure.



LEGEND

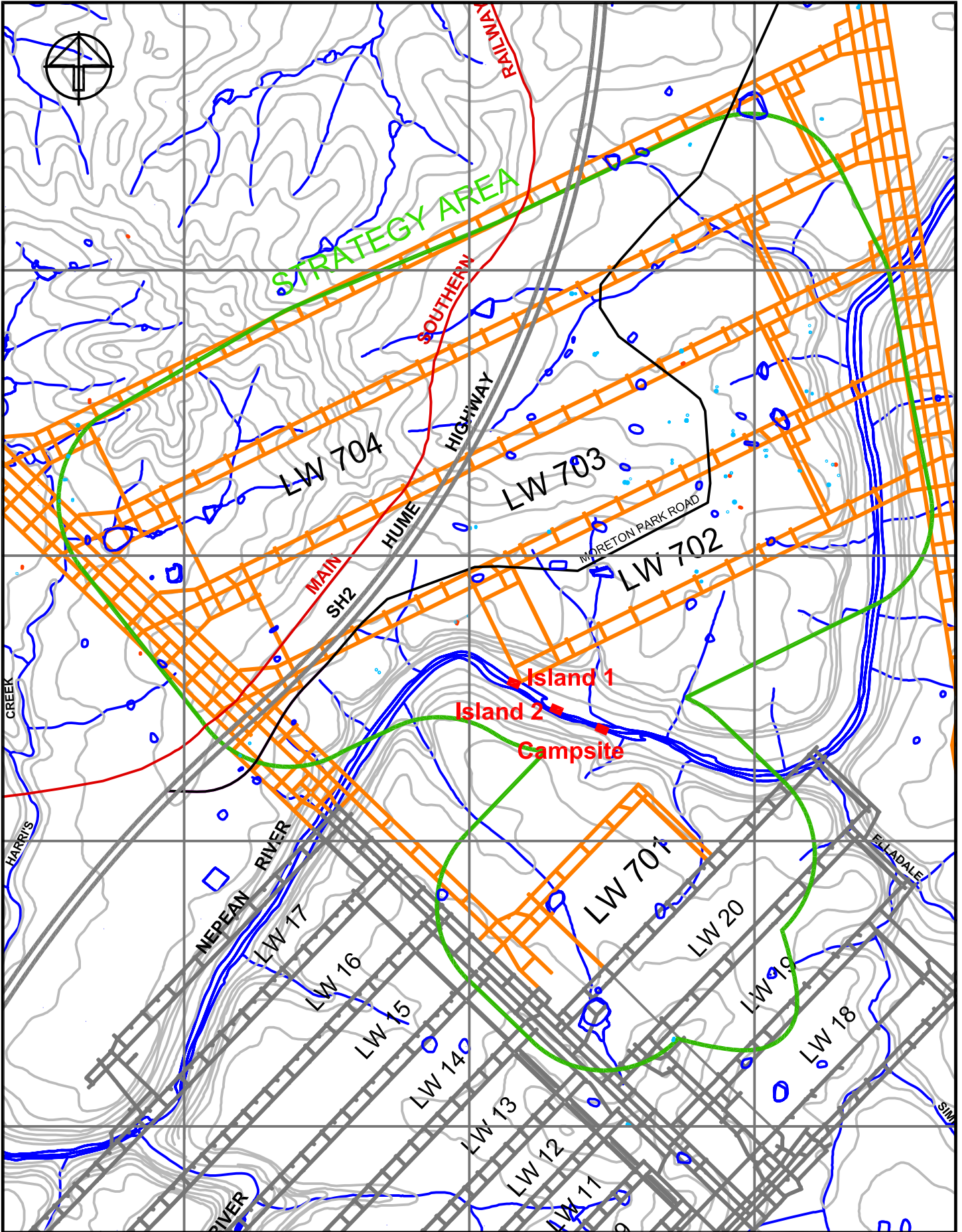
- ⊕ DNR REGISTERED BORES
- ⊕ BHPB PIEZOMETERS

PROJECT:	BHP 1
DRAWN:	A. DAWKINS
DATE:	31 AUG 2007
SCALE:	1:2500

**BHP
DOUGLAS AREA 7
LONGWALLS 701-704
STRATEGY AREA LOCATION**

GeoTerra

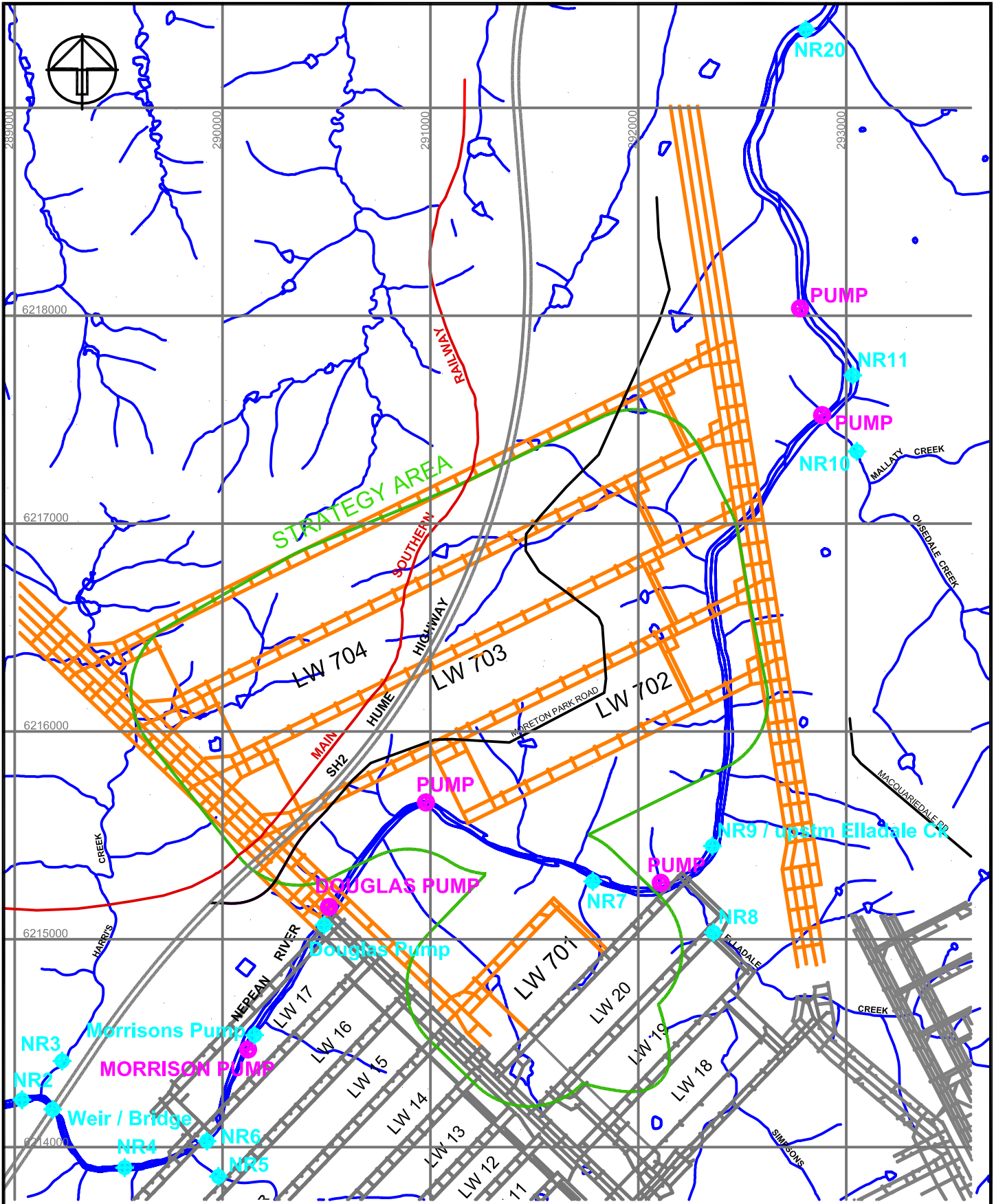
Drawing 1



PROJECT:	BHP 1
DRAWN:	A. DAWKINS
DATE:	31 AUG 2007
SCALE:	1:3500

BHPB
DOUGLAS AREA 7
LONGWALLS 701-704
DAMS AND STREAMS

GeoTerra
Drawing 2



LEGEND

- NEPEAN RIVER PUMP
- ◆ SURFACE WATER SITE

PROJECT:	BHP 1
DRAWN:	A. DAWKINS
DATE:	31 AUG 2007
SCALE:	1:2500

**BHPB
DOUGLAS AREA 7
LONGWALLS 701-704
RIVER PUMPS & MONITORING SITES**

GeoTerra

Drawing 3

APPENDIX A

DPI APPROVAL CONDITIONS



New South Wales

DEPARTMENT OF PRIMARY INDUSTRIES

File N°: 04/1677-02
INT06/28890

1 NOV 2006

The Company Secretary
Endeavour Coal Pty Ltd
C/- PO Box 514
UNANDERRA NSW 2526

Dear Sir/Madam

Re: Douglas Area 7 Subsidence Management Plan

I approve the Subsidence Management Plan as set out in your Subsidence Management Plan application for Longwalls 701-704 in your application dated September 2006 (including the "SMP Approved Plan" Drawing No. D07_0659), and supporting supplementary information provided to the Department, in accordance with s112 of the *Environmental Planning and Assessment Act 1979* subject to the exclusions and conditions set out in Appendix A, attached.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

The conditions have been attached to mitigate the proposed activity in order to minimise environmental impacts.

Please note that this approval does not remove the requirement to obtain any necessary approvals, consents, licences or permits from any other Government Authorities.

If you require any further information, please contact Michael Lloyd, Subsidence Executive Officer, on (02) 4931 6603.

Yours faithfully

B D BUFFIER
DIRECTOR-GENERAL

Subsidence Management Plan Approval

I, the Director-General, Department of Primary Industries, having considered the likely environmental impacts of the mining operations identified in the Project Description specified in Schedule 1 and having had regard to the principles of ecologically sustainable development as defined in the *Protection of the Environment Administration Act 1991*, hereby approve the Subsidence Management Plan identified in Schedule 1 for the purposes of SMP Condition that became effective on 18/3/2004 in Consolidated Coal Lease No. 767, subject to the conditions set out in Schedule 2.

This Approval only authorises the underground mining operations identified in the Project Description for the Period identified in Schedule 1. Obligations under this Approval regarding rehabilitation, monitoring and impact management continue to apply after the expiry of this period unless otherwise notified in writing by the Director-General.

These conditions are required to:

- ensure optimal mineral resource recovery;
- prevent, minimise, manage and/or offset adverse impacts;
- provide for the ongoing environmental management of the project;
- ensure the area disturbed by mining is appropriately rehabilitated.

The rights and duties of a Leaseholder are those prescribed by the *Mining Act 1992*, subject to the terms and conditions of the Lease which include a requirement to carry out operations in accordance with the Subsidence Management Plan conditionally approved by this Approval. This Subsidence Management Plan Approval does not override any obligation on the Leaseholder to comply with the requirements of other legislation and regulatory instruments unless specifically provided in the Mining Act or other legislation or regulatory instruments.

Note: This Approval does not constitute an approval under Section 138 Coal Mines Regulation Act 1982 or clause 88 of the Coal Mines Health and Safety Regulation 2006.

SIGNED



Alan Coutts
Deputy Director-General
NSW Department of Primary Industries

Date of Approval:

1 November 2006

File No: 04/1677-02

SCHEDULE 1 Description of Approved Activity

Project Description: Douglas Area 7 Longwalls 701-704

Subsidence Management Plan: Subsidence Management Plan Douglas Area 7 Projects dated April 2006

Seam: Bulli

Approved Period of Mining: Date of Approval until 1 November 2013 or the expiry/cancellation of CCL767 (whichever occurs earlier)

SCHEDULE 2

Definitions

Activity	The proposed longwall mining described in the EIS and SMP
AEMR	Annual Environmental Management Report
Application Area	The area identified within the SMP
Bore	Any bore or well connected or proposed to be connected with sources of sub-surface water, and used or proposed to be used or capable of being used to obtain supplies of such water
Council	Wollondilly Shire Council
DEC	Department of Environment and Conservation
Department	Department of Primary Industries
Director General	Director General of the Department of Primary Industries, or delegate
District Inspector of Coal Mines	District Inspector of Coal Mines with DPI
DNR	Department of Natural Resources
DoP	Department of Planning
EIS	Environmental Impact Statement, titled <i>Environmental Impact Statement Douglas Area 7 Project</i> , volumes 1, 2A and 2B, dated April 2006
Environment	includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings
IRGI	<i>Independent Review of Groundwater Impacts</i> prepared by Dr F Kalf dated 6 October 2006
IRMP	Infrastructure Risk Management Plan
Leaseholder	The leaseholder of Consolidated Coal Lease 767
Longwall mining	The extraction of the longwall panels covered by the SMP
MSB	Mine Subsidence Board
Principal Subsidence Engineer	Principal Subsidence Engineer with DPI
PSMP	Property Subsidence Management Plan
SCA	Sydney Catchment Authority
SMP	Subsidence Management Plan, titled <i>Subsidence Management Plan Douglas Area 7 Project</i> , volumes 1 and 2, dated April 2006 and supplementary supporting information provided to the Department
SMP Approved Plan	Plan No. D07_0659 titled 'Approved Plan Extraction of Longwalls 701-704, signed by the Mine Manager on 10/4/2006 and approved by the Director General, NSW Department of Primary Industries
Subsidence Impacts	Direct or indirect impacts resulting from subsidence from longwall mining
Subsidence	Movement and/or deformation of the ground surface or subsurface strata as a direct and/or indirect result of longwall mining

Conditions

Limits on Approval

- 1 The Leaseholder must carry out the activity strictly in accordance with SMP Approved Plan.
- 2 The Leaseholder must carry out the activity generally in accordance with the:
 - a) SMP; and
 - b) EIS,subject to the conditions of this Approval.

In the event of any inconsistency between the conditions of this Approval and the SMP or EIS, the conditions of this Approval prevail to the extent of any inconsistency.

- 3 Where this Approval requires actions to be undertaken by the Leaseholder, including remediation of subsidence impacts, the obligation continues until the Director General notifies the Leaseholder that the action has been completed to his or her satisfaction.
- 4 The Director General may vary the conditions of this Approval by notice in writing.

- 5 The Director General may, at his or her discretion, suspend or revoke this Approval if:
- the Leaseholder fails to adhere to any condition of the Approval; or
 - the head of any other government authority requests suspension or revocation on the basis of the Leaseholder's non-compliance, or potential non-compliance, with legislation administered by that agency related to this Approval.

General Obligation to Minimise Harm to the Environment

- 6 The Leaseholder must implement the SMP (as amended by the conditions of this Approval) and carry out any additional practicable measures (including those identified in the EIS) necessary to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the activity.

Implementation of Approval

- 7 Any plans, programmes, reports or strategies required as a condition of this Approval must be developed having regard to:
- any guidelines adopted by the Director General for the purpose of subsidence management and mine rehabilitation; and
 - the requirements set out in Appendix A to this Approval.

- 8 The Leaseholder must implement any plan, programme or strategy required and approved pursuant to this Approval.

Note: The Leaseholder may, at any time, submit an amended plan, programme or strategy for approval. Once approved, the amended plan, programme or strategy must be implemented, however, up until the date of approval, the Leaseholder must continue to implement the previously approved plan, programme or strategy.

- 9 Any modifications to plans, programs or strategies already approved for the purposes of the conditions of this Approval must have regard to the matters set out in condition 7. Amended plans, programmes or strategies submitted for approval must be accompanied by all relevant supporting documentation to assist in the assessment of the amendment or modification.

Note: This condition relates to plans, programmes and strategies required by the conditions of this Approval – it does not apply to variations to the SMP or the SMP Approved Plan which must be done in accordance with the requirements of the Mining Act, the conditions of title and the variation procedures identified in the SMP guidelines.

Directions

- 10 The Leaseholder must comply with any written direction given by the Director-General, Director Environmental Sustainability, Director Mine Safety Operations or Principal Subsidence Engineer relating to:
- the implementation of any aspect of the SMP or an approved plan, programme or strategy;
 - assessing or reviewing the adequacy, effectiveness, or coverage of any approved plan, programme or strategy or any aspect of the SMP;
 - the type, timing and/or location of monitoring of baseline conditions, subsidence or subsidence impacts;
 - any reporting requirement under this Approval;
 - the carrying out of works to address subsidence impacts; and
 - the carrying out of any studies or investigations related to subsidence or subsidence impacts and the reporting of any findings or conclusions.

The obligations under this condition prevail over any other obligation under this Approval.

Note: Compliance with a written direction will not operate as a defence to a breach of any obligation under this Approval that occurred prior to the Direction being given.

Subsidence Monitoring

- 11 The Leaseholder must submit to the Principal Subsidence Engineer for approval a subsidence monitoring programme for the longwall panels which are the subject of this Approval. This programme must include:
- a) inspection regimes;
 - b) layout of monitoring points;
 - c) parameters to be measured;
 - d) monitoring methods and accuracy;
 - e) timing and frequencies of surveys and inspections;
 - f) recording and reporting of monitoring results.

The Leaseholder must not commence longwall mining prior to the subsidence monitoring programme being approved.

Note: The programme should be submitted to the Principal Subsidence Engineer at least 90 days prior to the expected commencement of operations to enable sufficient time for the assessment of the programme. The Principal Subsidence Engineer may require the provision of further information to assist in the assessment of the programme or a resubmission of the programme if it is considered inadequate. Complex issues or the need for additional information or a resubmission of the programme may require a longer assessment period.

Environmental Monitoring

- 12 The Leaseholder must submit to the Director Environmental Sustainability for approval an environmental monitoring programme for the longwall panels which are the subject of this Approval. This programme must address subsidence impacts on:
- a) surface and groundwater (quality and quantity);
 - b) flora and fauna;
 - c) Aboriginal sites;
 - d) the Nepean River gorge and associated landforms; and
 - e) water quality (including ecotoxicology) of the Nepean River.

The Leaseholder must not commence longwall mining prior to the environmental monitoring programme being approved.

Note: The programme should be submitted to the Director Environmental Sustainability at least 90 days prior to the expected commencement of operations to enable sufficient time for the assessment of the programme. The Director Environmental Sustainability may require the provision of further information to assist in the assessment of the programme or a resubmission of the programme if it is considered inadequate. Complex issues or the need for additional information or a resubmission of the programme may require a longer assessment period.

Infrastructure and Property Management

- 13 The Leaseholder must submit to the Director Mine Safety Operations for approval management plans for any infrastructure that may be affected by subsidence. These plans must be developed in consultation with:
- a) the owners/operators of the infrastructure and
 - b) any Government Agency with a regulatory role for the infrastructure.

The Leaseholder must not commence longwall mining prior to the management plans for the following infrastructure being approved:

- a) Douglas Park Twin Road Bridges;
- b) Moreton Park Road Bridge (South); and
- c) Sydney Catchment Authority's Upper Canal System and associated structures that may be affected by subsidence.

The Leaseholder must not commence extraction of longwalls 702 to 704 prior to the management plans for the following infrastructure items being approved:

- a) Main Southern Railway and associated structures/infrastructure that may be affected by subsidence;
- b) Hume Highway and associated structures that may be affected by subsidence;
- c) telecommunication optical fibre cables and other telecommunication infrastructure and related structures that may be affected by subsidence;
- d) Morton Park Road and associated structures that may be affected by subsidence; and
- e) electricity transmission lines that may be affected by subsidence.

- 14 The Leaseholder must submit to the Director Mine Safety Operations for approval management plans to address the safety and serviceability of buildings and man-made structures potentially affected by subsidence. These plans must be developed in consultation with the:

- a) owner of the property; and
- b) Mine Subsidence Board.

The management plans must be based on data from:

- a) structural inspections of buildings and structures (where access is allowed) undertaken by a suitably qualified person; and
- b) a geotechnical investigation of the cliff formations and steep slopes along the Nepean River Gorge that may be affected by subsidence undertaken by a suitably qualified person.

The Leaseholder must not undertake any longwall mining that is likely to cause subsidence that may impact upon buildings or structures not owned by the Leaseholder prior to a management plan for the relevant building or structure being approved.

Note: The Property Subsidence Management Plans submitted with the SMP must be resubmitted for approval before carrying out any longwall mining that is likely to cause subsidence that may impact on the particular building or structure. The requirements set out in this condition as well as the matters required by condition 7 must be addressed in the management plans submitted for approval – this can be done either through a complete revision of the management plans or by attaching Addendums to the previously submitted plans which address the additional matters required by this Approval.

Public Safety

- 15 The Leaseholder must submit to the Director Mine Safety Operations for approval a plan to manage public safety in any surface areas that may be affected by subsidence. The Leaseholder must not commence longwall mining prior to this plan being approved.

Water Management

- 16 The Leaseholder must submit to the Director Environmental Sustainability for approval a Surface and Ground Water Response Strategy. The Surface and Ground Water Response Strategy must include:
- a) trigger levels for subsidence impacts on ground and surface water quantity and quality that require actions and responses;
 - b) the procedures that would be followed in the event that the monitoring of ground or surface water indicates an exceedance of trigger levels;
 - c) measures to mitigate, remediate and/or compensate any identified impacts;
 - d) a protocol for the notification of identified exceedances of the trigger levels; and
 - e) a contingency plan where, in the event of interruptions to water supplies (water quality and/or quantity) due to subsidence impacts on water supply systems and/or sources, the Leaseholder must provide, without delays, water supplies of equivalent quality and quantity to locations convenient to those affected until such time that the affected water supply systems and/or sources are restored.

This response strategy must be consistent with the recommendations of the IRGI and be prepared:

- a) by a qualified hydrogeologist/hydrologist; and
- b) in consultation with relevant landholders and government agencies.

The Leaseholder must not commence longwall mining prior to the Surface and Ground Water Response Strategy being approved.

Environmental Management

- 17 The Leaseholder must submit to the Director Environmental Sustainability for approval a plan for rehabilitation of the endangered River Flat Eucalypt Forest Community (Riparian Forest) likely to be affected by subsidence impacts (including Riparian Forest downstream from the application area that is indirectly affected by subsidence impacts). The plan must:
- be prepared by a suitably qualified person;
 - include baseline information on the condition of the Riparian Forest;
 - detail the procedures for rehabilitation and enhancement of the Riparian Forest; and
 - include completion criteria and a programme to monitor the effectiveness of the rehabilitation.

The Leaseholder must not commence longwall mining prior to the plan being approved.

Note: This condition does not affect the requirement to implement the environmental management strategies identified in the SMP and EIS.

Incident and Ongoing Management Reporting

- 18 The Leaseholder must, within 24 hours of becoming aware of the occurrence, notify:
- the Principal Subsidence Engineer;
 - the operators of all infrastructure covered by condition 13; and
 - any Government Agency with a regulatory role if they request such notifications,
- of the following:
- Any significant unpredicted and/or higher-than-predicted subsidence and/or abnormalities in the development of subsidence;
 - Any exceedance of predicted impacts on groundwater resources and/or the natural environment that may have been caused (whether partly or wholly) by subsidence;
 - Any observed subsidence impacts adverse to the serviceability and/or safety of infrastructure and other built structures that may be affected by longwall mining;
 - Any significant subsidence-induced cracking and/or ground deformations observed in any surface areas within the SMP application area;
 - Any observed rock falls or instability of cliff formations/steep slopes along the Nepean River Gorge that may have been caused (whether partly or wholly) by subsidence.

Note: Under Condition 10, the Leaseholder can be directed to, among other things, prepare a report on an incident reported under this condition. A report on the details of the incident, including likely or known causes, response action and proposed response measures will generally be required for incidents that involve material property or environmental damage or have the potential to cause such damage.

- 19 The Leaseholder must prepare and maintain a Subsidence Management Status Report which must include but not be limited to:
- the current face position of the longwall panel being extracted;
 - a summary of any subsidence management actions undertaken by the Leaseholder in the period subsequent to the last regular submission of the Status Report;
 - a summary of any comments, advice and feedback from consultation with stakeholders in relation to the implementation of this Approval (including the preparation, implementation and review of plans, programmes, reports or strategies required by this approval) undertaken or received in the period subsequent to the last regular submission of the Status Report and a summary of the Leaseholder's response to the comments, advice and feedback given by the stakeholders;
 - a summary of the observed and/or reported subsidence impacts, incidents, service difficulties, community complaints, and any other relevant information reported to the Leaseholder in the period subsequent to the last regular submission of the Status Report and a summary of the Leaseholder's response to these impacts, incidents, service difficulties and complaints;
 - a summary of subsidence development based on monitoring information compared with any defined triggers and/or the predicted subsidence to facilitate early detection of potential subsidence impacts;

- f) a summary of the adequacy, quality and effectiveness of the implemented management processes based on the monitoring and consultation information summarised above, and
- g) a statement regarding any additional and/or outstanding management actions to be undertaken or the need for early responses or emergency procedures to ensure adequate management of any potential subsidence impacts due to longwall mining.

The Subsidence Management Status Report must be updated at least every 14 days to reflect any changes in the information required to be included in the Report. The Status Report must be regularly submitted to the Principal Subsidence Engineer and each operator of infrastructure referred to in condition 13 every four (4) months from the commencement of extraction. The Status Report (as updated from time to time) must be provided, upon request, to the Mine Subsidence Board, the Director of Environmental Sustainability, the Principal Subsidence Engineer of the Department of Primary Industries, owners/operators of any infrastructure within the application area and any other Government Agency with a regulatory role if they request such notifications.

End of Panel Report

- 20 Within 4 months of the completion of each longwall panel, an end of panel report must be prepared to the satisfaction of the Director Environmental Sustainability. The end of panel report must:
- a) include a summary of the subsidence and environmental monitoring results for the applicable longwall panel;
 - b) include an analysis of these monitoring results against the relevant;
 - impact assessment criteria;
 - monitoring results from previous panels; and
 - predictions in the SMP and EIS;
 - c) identify any trends in the monitoring results over the life of the activity; and
 - d) describe what actions were taken to ensure adequate management of any potential subsidence impacts due to longwall mining.

Independent Environmental Audit

- 21 If directed by the Director Environmental Sustainability, the Leaseholder must commission and pay the full cost of an Independent Environmental Audit of the activity. This audit must:
- a) be conducted by a suitably qualified, experienced, and independent person/s whose appointment has been endorsed by the Director Environmental Sustainability;
 - b) have the scope developed in consultation with the relevant agencies and agreed to by the Director Environmental Sustainability;
 - c) assess the environmental performance of the activity, and its effects on the surrounding environment, particularly with respect to the Nepean River;
 - d) assess whether the activity is complying with the relevant standards, performance measures and statutory requirements including compliance with this approval;
 - e) review the SMP and any strategy/plan/programme required under this Approval; and, if necessary,
 - f) recommend measures or actions to improve the environmental performance of the activity, and/or the SMP and other strategy/plan/programme required under this Approval.

Note: It is the role of the reporting and auditing required under this Approval to inform the Leaseholder, the Department and other stakeholders of the effectiveness of the implementation of the terms of this Approval. The Leaseholder is expected to be proactive in identifying areas where impacts from the longwall mining can be better managed and implement necessary measures and, where necessary, amend any approved plans, programmes or strategies to ensure that this is achieved. Condition 4 of the Approval permits the Director General to amend the terms of this approval at any time. This power will generally only be exercised where the terms of this Approval and/or the carrying out of this project is causing impacts that the Department considers to be unreasonable. The Department or other Government agencies may consider other enforcement action if environmental impacts caused by the longwall mining which is the subject of this Approval is in breach of legislative requirements – proactive action by the Leaseholder will be taken into consideration when considering any enforcement action.

Access to Information

- 22 Within 3 months of the submission of an End of Panel Report (as required by Condition 20) or Independent Environmental Audit (as required by condition 21) or the approval of a plan, programme or strategy required under this Approval or the SMP (or any subsequent revision of these documents), the Leaseholder must, to the satisfaction of the Director General:
- a) provide a copy of these document/s to all relevant agencies;
 - b) ensure that a copy of the relevant documents is made publicly available at the Leaseholder's regional office; and
 - c) put a copy of the relevant document/s on the Leaseholder's website.

Survey Marks

- 23 At the completion of subsidence, or otherwise as required by the Department of Lands, the functionality of any survey marks affected by subsidence must be fully restored to the satisfaction of the Department of Lands.
-

APPENDIX A

Additional Requirements for plans, programmes and strategies

Note: These requirements are additional to those identified in the guidelines and specific conditions of Approval which require the preparation of the plans

Condition 13 Infrastructure Management Plans

Ongoing Consultation with owners/operators and government agencies
Review Schedule
Contingency Plans to address deviations from predicted subsidence impacts.

Condition 14 Property Management Plans

Ongoing Consultation with owners/operators and government agencies
Review Schedule
Contingency Plans to address deviations from predicted subsidence impacts.

Condition 15 Public Safety Management Plans

Ongoing Consultation with authorities and stakeholders responsible for management of surface areas accessible by public
Review Schedule
Contingency Plans to address deviations from predicted subsidence impacts.

Condition 16 Water Management Plan

Ongoing Consultation with landholders and government agencies
Review Schedule
Contingency Plans to address deviations from predicted subsidence impacts.

Condition 17 Riparian Forests Management Plan

Ongoing Consultation with landholders and government agencies
Review Schedule
Contingency Plans to address deviations from predicted subsidence impacts.

APPENDIX B

NEPEAN RIVER NR6, NR7, NR9, NR11 WATER QUALITY PLOTS

