NSW GOVERNMENT
Department of Planning

MAJOR PROJECT ASSESSMENT
Metropolitan Coal Project

Director-General's
Environmental Assessment Report
Section 75I of the
Environmental Planning and Assessment Act 1979
June 2009

Cover Photo: Metropolitan Colliery Product Coal Stockpile

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EXECUTIVE SUMMARY

Helensburgh Coal Pty Ltd (HCPL), a subsidiary of Peabody Pacific Pty Ltd, owns and operates the Metropolitan Colliery, located 30 kilometres north of Wollongong in the Southern Coalfield. Metropolitan Colliery has been operating since the 1880s, with longwall mining commencing in the 1990s. Underground mining operations are supported by the colliery's surface facilities, located in on the fringe of Helensburgh township.

Metropolitan Colliery currently operates without development consent because it has been in operation since before the commencement of the *Environmental Planning & Assessment Act 1979* (EP&A Act). In 2005, the *State Environmental Planning Policy (Major Projects) 2005* established that all such coal mines were required to obtain project approval under Part 3A of the EP&A Act within 5 years. Metropolitan Colliery is applying for project approval for its existing and proposed operations because of this requirement.

HCPL is seeking approval to extract up to 3.2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from the Bulli Coal Seam over a period of 23 years, principally using longwall mining methods. The proposal has a capital investment value of $50 million. It is classified as a major project under Part 3A of the EP&A Act, and consequently the Minister is the approval authority for the project.

The project was exhibited during October and November last year. During this period, the Department received a total of 96 submissions on the project, including 10 from public authorities, 65 from the general public and 21 from special interest groups. A number of public authorities and other submitters had strong concerns about the predicted impacts of the project on Waratah Rivulet. Other issues of concern were potential impacts on upland swamps, Woronora Reservoir, Aboriginal heritage sites, endangered fauna and the F6 Freeway and Princes Highway.

Following the exhibition period, the Minister directed the Planning Assessment Commission (PAC) to assess key aspects of the project in more detail. The PAC held public hearings in March this year and heard presentations from community stakeholders, Government agencies and HCPL. The PAC's terms of reference included a review of potential subsidence-related impacts on the values of Sydney's drinking water catchment, in particular the Waratah Rivulet and Woronora Reservoir, taking into consideration the recommendations of the Southern Coalfield Inquiry. The PAC was also directed to advise on the significance and acceptability of these potential impacts, and to recommend appropriate measures to avoid, minimise or offset these impacts.

In recognition of concerns raised in public and agency submissions and by the PAC during the assessment process, the Department required HCPL to prepare a Preferred Project Report (PPR) for the project. A draft of the PPR was submitted to the Department and was provided to the PAC during its review. The PAC prepared its report in the light of this draft of the PPR. An expanded and final version of the PPR was provided to the Department on 21 May 2009, which was too late to be considered by the PAC in its review. However, the final version did not change any significant mine parameter. Rather, it contained additional clarifying, explanatory and supporting material.

The PPR represents a very substantial revision of the originally-exhibited mine plan. It splits the original single longwall mining domain into two, leaving a significant area of land un-subsided between the two. This reduces the overall extent of the longwall mining area and substantially reduces potential subsidence impacts on Waratah Rivulet and the lower stretch of the Eastern Tributary. It also leads to a reduction in the proposed mine life by about 2.8 years and sterilises approximately 6.86 million tonnes of coal.

The Department has assessed the project application, EA, submissions on the project, HCPL's response to submissions and PPR in accordance with the relevant requirements of the EP&A Act, including the objects of the Act and the principles of ecologically sustainable development. The Department has also closely considered the PAC's findings and recommendations as part of its assessment of the merits of the project.

The PAC's recommendations focussed around limiting impacts of subsidence on major sections of the Waratah Rivulet and Eastern Tributary such that the environmental consequences were "negligible". It also made recommendations to provide further assessment of the potential impacts of subsidence on

particular upland swamps and significant Aboriginal heritage sites. The Department supports these recommendations and has proposed conditions of approval to give them effect.

The project would result in some adverse residual environmental impacts, primarily by way of subsidence impacts on natural features, particularly on limited sections of Waratah Rivulet and the Eastern Tributary and other watercourses. The Department has recommended conditions to monitor and manage these impacts, and to remediate them where reasonable and feasible. Non-subsidence-related impacts are not predicted to be significant, and the Department is satisfied that they can be minimised, mitigated or managed through the imposition of a comprehensive range of conditions of approval.

The assessment has also found that the project offers a number of social and economic benefits for the region, as it would:

- extend the life of the Metropolitan Colliery by up to 23 years;
- provide increased security for 320 employees over the course of the mine life;
- attract $50 million in capital investment;
- directly produce $56 million in wages and salaries;
- lead to $372 million in annual business turnover in the Illawarra Region; and
- generate significant royalty and tax income for the Government.

On balance, the Department believes that the project represents a logical progression of HCPL's existing mining operations, is satisfied that its benefits sufficiently outweigh its costs and is able to be conducted in a manner that is consistent with the objects of the EP&A Act. Consequently, it believes the project is in the public interest and should be approved subject to conditions.

1 BACKGROUND

1.1 Project Location

Helensburgh Coal Pty Ltd (HCPL), a wholly owned subsidiary of Peabody Pacific Pty Ltd, owns and operates the Metropolitan Colliery, which is located approximately 30 kilometres (km) north of Wollongong on the Woronora Plateau (see Figure 1).

Figure 1: *Project Location*

1.2 Project Setting

The full project area is identified with various hatchings on Figure 2. The proposed new mining area is bounded by the Garawarra State Conservation Area and the F6 Southern Freeway, to the west by the Woronora Special Area and to the north by the Heathcote National Park. The new mining area is outlined in dark blue on Figure 2.

Key land uses within the proposed mining area include:

- the Woronora Special Area and the Woronora Reservoir;
- the Garrawarra Centre – aged care facility, associated housing and cemetery;
- public road corridors including the F6 Southern Freeway and Princes Highway;
- utilities infrastructure (eg electricity transmission lines, optical cables and water pipelines);
- mine-related services and infrastructure (eg environmental monitoring equipment and boreholes and a ventilation shaft area); and
- rural residences and sheds.

Key land uses adjacent or close to the proposed mining area include:

- Heathcote and Royal National Parks, Garawarra and Dharawal State Conservation Areas;
- Holsworthy Military Reserve;
- Helensburgh township, including residential, business, light industrial and recreational areas;
- environmental protection areas associated with the Hacking River east of Helensburgh;
- Metropolitan Colliery's surface facilities area; and
- Illawarra Railway.

Metropolitan Colliery's surface facilities area is located in the Helensburgh Gully, surrounded by steep slopes to the north, west and south. The valley opens up to the east, and overlooks Camp Gully. Figure 3 is an aerial photograph of this area and shows all existing and proposed surface infrastructure.

1.3 Historical Background

Metropolitan Colliery began extracting coal by underground methods in the 1880s. Longwall mining began in the mid 1990s and HCPL is currently mining Longwall 18.

Until recently, Metropolitan Colliery and most other coal mines in the Southern Coalfield operated without development consent. This was because the passage of the *Environmental Protection and Assessment Act 1979* (EP&A Act) was accompanied by model transitional provisions, which meant that existing coal mines did not need to obtain development consent, provided that those provisions were adopted in the relevant LEP. Provisions adopted in the Wollongong LEP meant that Metropolitan was then able to continue to operate without development consent.

However, in May 2005, the *State Environmental Planning Policy (Major Projects) 2005* was gazetted. This SEPP established that all development which, in the opinion of the Minister for Planning is "development for the purpose of .... coal mining" is declared to be a "major project", to which the new Part 3A of the EP&A Act applied. The SEPP established a 5 year transitional period during which all mines in NSW which did not have an existing development consent were required to obtain a project approval under Part 3A.

When Part 3A of the EP&A Act was passed in August 2005 it included amendments to the *Mining Act 1992*. These amendments removed an exemption under section 74(1) of that Act, whereby existing mines operating under a mining lease did not require a new or amended development consent for new or expanded mining operations within the area of the lease. Transitional provisions associated with the amendments provided a 5 year timeframe for the implementation of this change which expires on 16 December 2010.

Therefore, due to the implementation of the Major Projects SEPP and these amendments to the Mining Act, all existing underground coal mines operating in NSW, including Metropolitan Colliery, are required to obtain a project approval from the Minister for Planning under Part 3A of the EP&A Act by 16 December 2010.

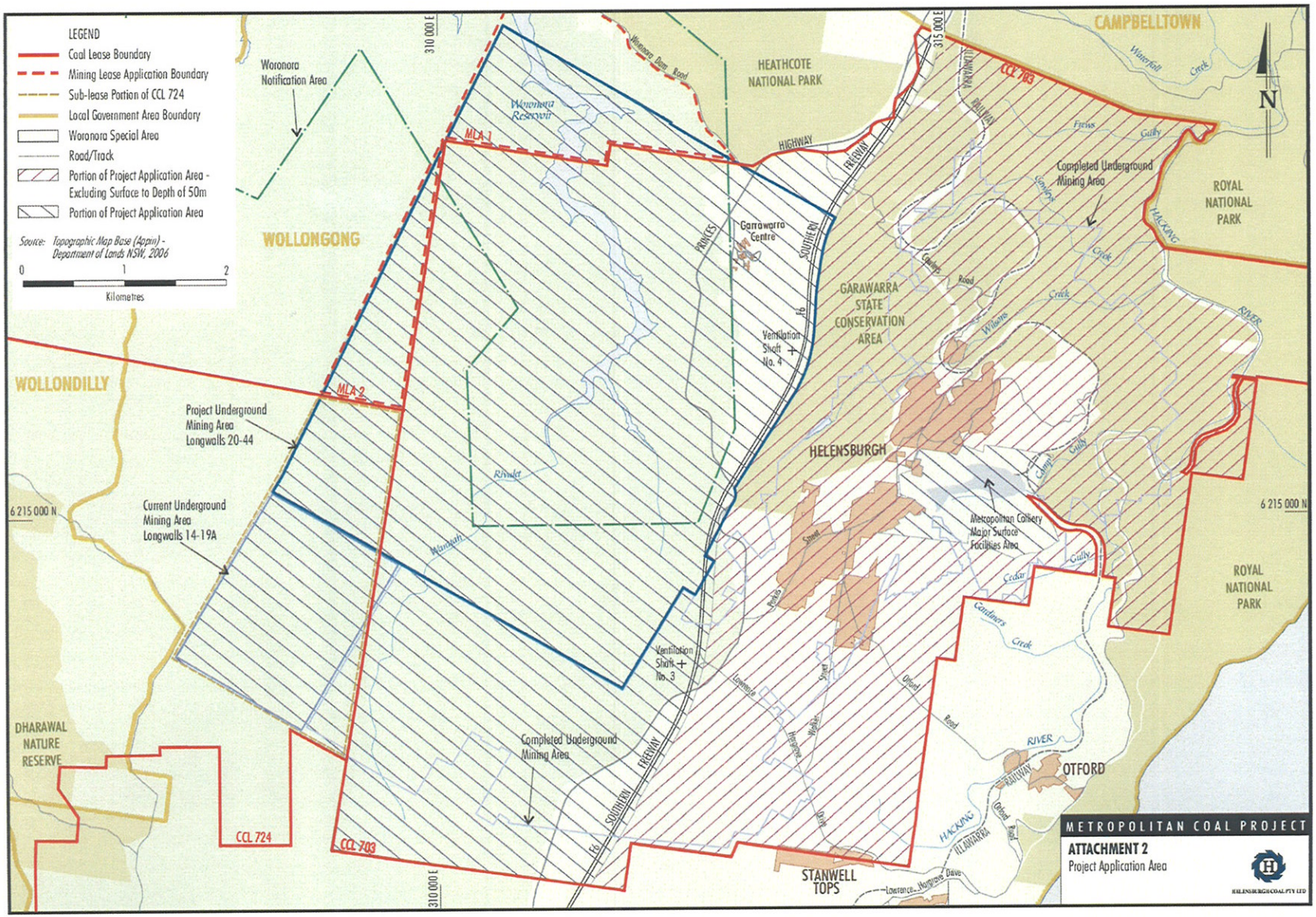

Figure 2: *Project Area*

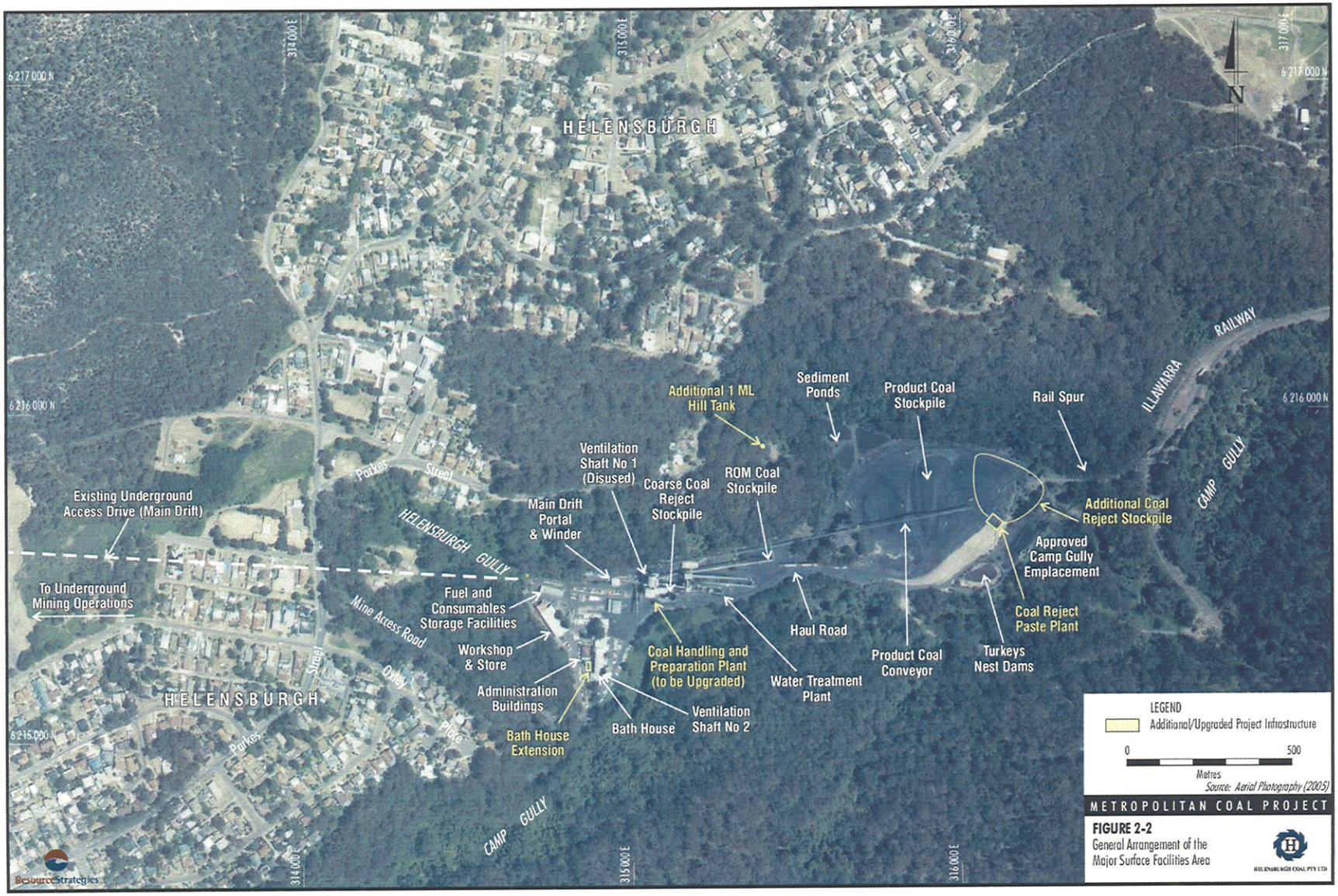

Figure 3: *Existing and Proposed Surface Infrastructure*

1.4 Southern Coalfield Inquiry

In December 2006, the NSW Government established an independent Inquiry into underground coal mining in the Southern Coalfield. The Inquiry was established because of concerns held by the Government over both previous and potential impacts of mining-induced subsidence on significant natural features. The terms of reference required the panel conducting the Inquiry to focus its review on subsidence-related impacts on rivers, significant streams, swamps and cliff lines. The panel's review included the impacts of mining Metropolitan Colliery's Longwalls 8 - 14 on the Waratah Rivulet. The panel's report was released in July 2008 and included a total of 22 recommendations.

Key recommendations included:

- a precautionary approach be taken to any new mining proposal that may have unacceptable impacts on significant natural features;
- this approach is to include the adoption of 'risk management zones' to focus the assessment and management of potential impacts on significant natural features such as rivers;
- an onus of proof on industry to provide a greater upfront understanding of environmental impacts;
- environmental assessments for project applications should address subsidence effects, impacts and environmental consequences by providing:
  - a minimum of two years baseline data, collected at appropriate frequency and scale, for significant natural features,
  - identification and assessment of the significance of all natural features within 600m of the edge of longwalls,
  - key aspects of the subsidence assessment should be subject to independent scientific peer review and/or use of expert opinion in the assessment process; and
- further research be conducted into certain areas such as the prediction of non-conventional subsidence, impacts of mining on swamps, and remediation of streams.

The Metropolitan Coal Project's EA was completed in the months immediately following completion of the Southern Coalfield Inquiry. Consequently, it could not fully reflect the Inquiry's recommendations.

2 PROPOSED PROJECT

2.1 Original Project

The project as originally submitted and exhibited contained a mine plan based on 25 longwall panels oriented roughly northwest-southeast (proposed Longwalls 20 – 44, see Figure 4). This mine plan involved full extraction of all longwalls beyond a certain lateral distance from the Woronora Reservoir. There was no deliberate protection or reduction in potential subsidence impacts for the Waratah Rivulet or other watercourses within the mining area. HCPL's original strategy was not to avoid impacts on the Waratah Rivulet, but rather to remediate them. Further, remediation was proposed only to a certain standard (ie to restore pool-holding capacity) and only for limited locations (ie four major rockbars on the Waratah Rivulet known as WRS5, WRS6, WRS7 and WRS8). No remediation was proposed for other watercourses, including the Eastern Tributary, or for other rockbars on the Waratah Rivulet.

2.2 Revised Project

HCPL prepared a Preferred Project Report (PPR) for the project, following a request to do so by the Department (see section 3.5). The PPR contained a new mine plan, which substantially revises that originally prepared and exhibited (see Figure 5). The key parameters of the original project and the revised project are compared in Table 1.

The revised mine plan splits the original single longwall mining domain into two, leaving a significant area of land un-subsided between the two. This reduces the overall extent of the project's longwall mining area and substantially reduces potential subsidence impacts on the Waratah Rivulet and the lower stretch of the Eastern Tributary.

As set out in the PPR, extraction is now proposed to take place from only the first eight of the original longwalls (Longwalls 20 – 27, termed in this report the "southern domain", see Figure 5). The remainder of the mining area is proposed to have its longwalls re-oriented by roughly 90°, such that they run roughly northeast-southwest. The PPR names these afresh as Longwalls 301 – 317. They are also termed in this report the "northern domain".

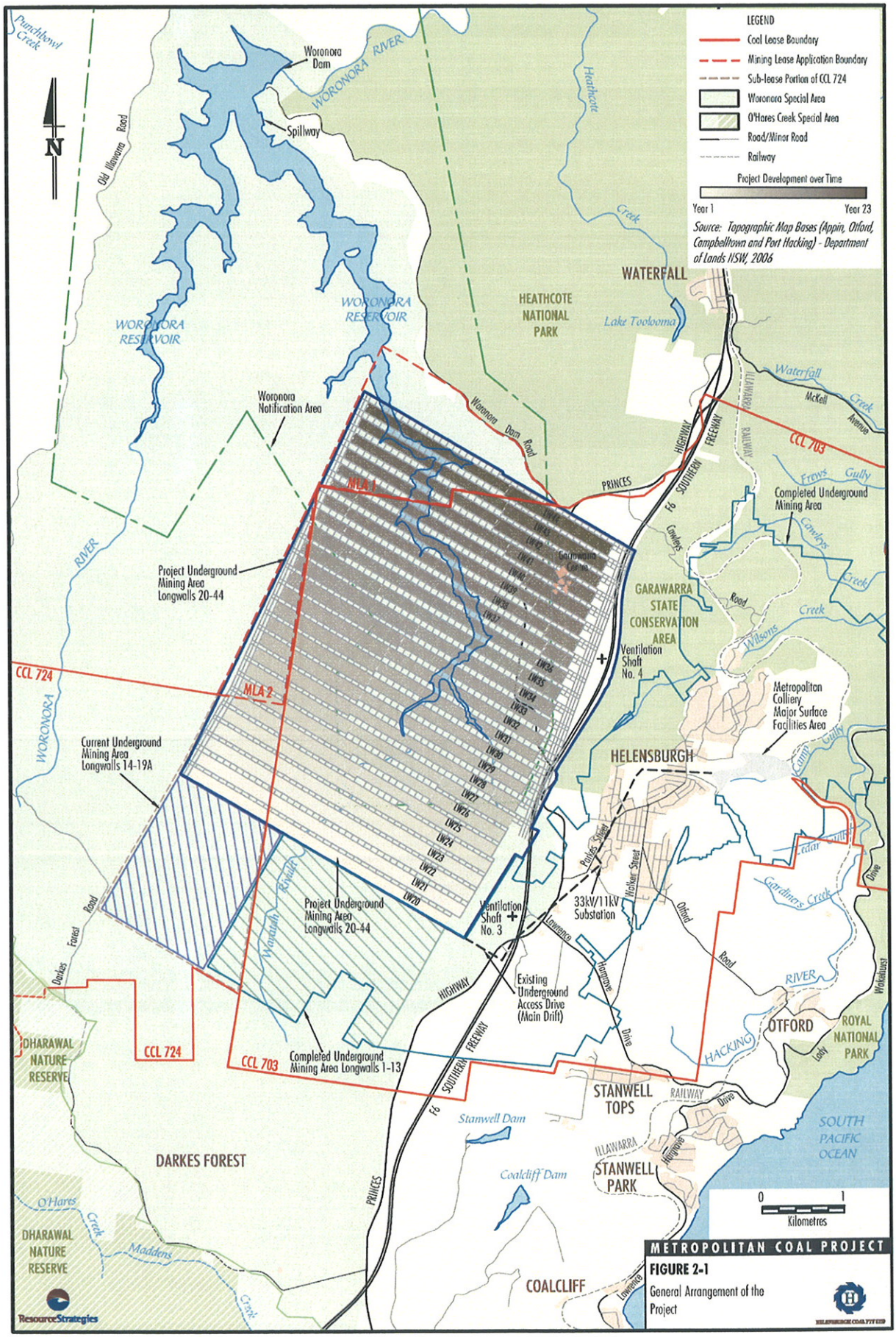

Figure 4: *Original (Exhibited) Mine Plan*

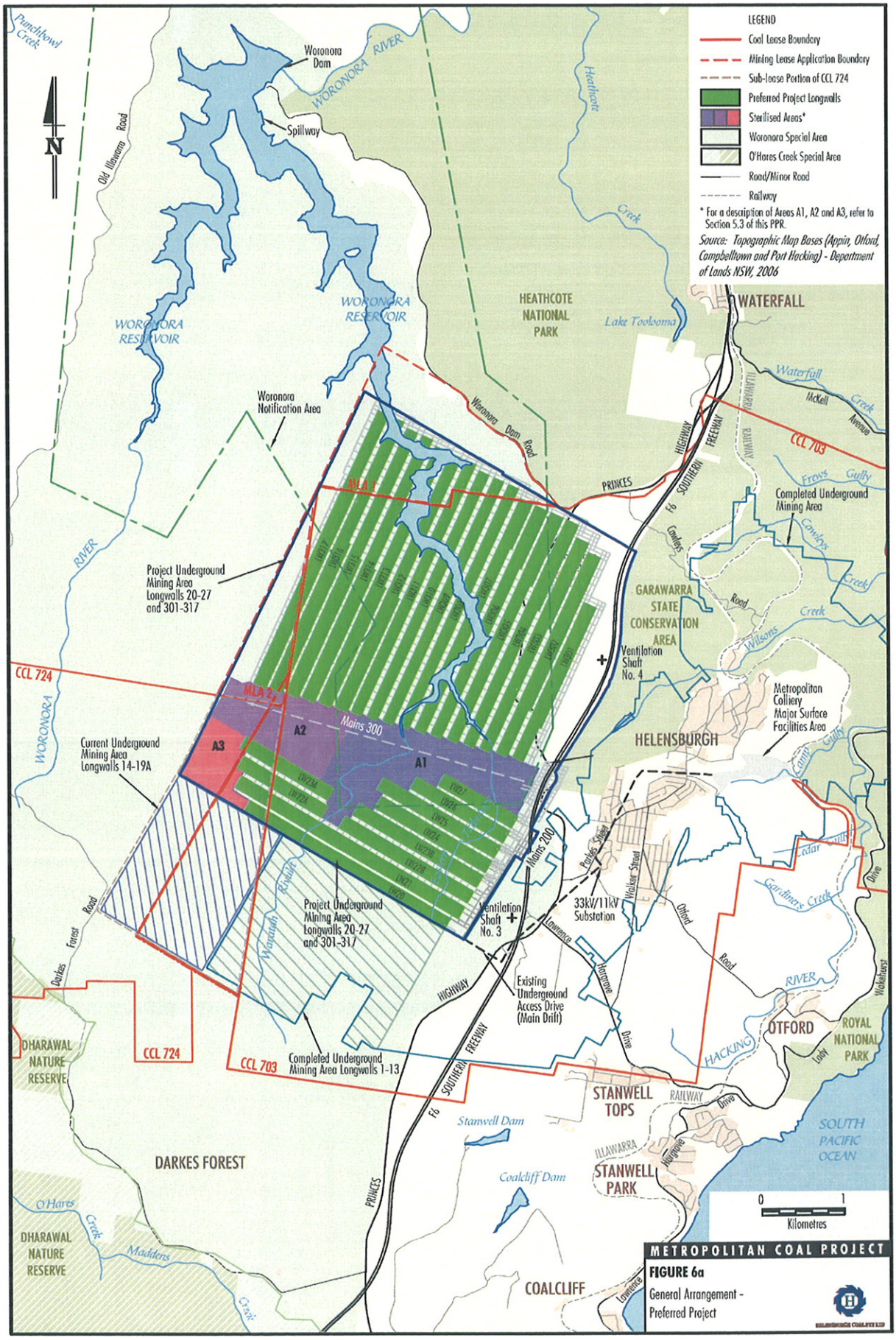

Figure 5: *Preferred Project Report (ie Revised) Mine Plan*

Table 1: *Original Project and Revised Project Summary*

Aspect	Original Project	Revised Project
Project Summary	• **extracting up to 3.2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from the Bulli Coal Seam for a period of 23 years using longwall mining methods;** • **augmenting, upgrading and using the existing infrastructure at the mine;** • **processing run-of-mine coal at the mine;** • **transporting product coal from the mine by rail;** • **disposing of coal rejects at the mine or transporting them by road for disposal; and** • **rehabilitating the site.**	• No change, except reduction in additional longwall mine life to approximately 20.2 years.
Mining and Reserves	The project is based on a coal reserve of approximately 63 Mt of ROM coal from the Bulli Coal Seam from proposed Longwalls 20 to 44. The underground mining operations would use longwall mining methods.	• Mining Longwalls 20 to 27 in the southern domain of the new mining area and Longwalls 301 to 317 in the northern domain of the mining area. • Decision not to mine (by longwall methods) approximately 6.9 Mt of product coal and 8.6 Mt of ROM coal in Areas A1 and A2, reducing the coal reserve to approximately 54.4 Mt.
Coal Processing	Coal from the underground mining operations would be processed at the Coal Handling and Preparation Plant (CHPP) on site. Upgrades to the CHPP would increase its capacity to approximately 600 tonnes per hour of ROM coal, as well as include installation of a beneficiation circuit to permit the production of thermal coal. Upgrades are expected to be completed in Year 3 of the project.	• No change.
Water Demand and Supply	Water demand would vary. However median demand is predicted to be approximately 868 megalitres per year (Mtpa), mainly to supply underground mining operations (for cooling and dust suppression) and for the CHPP. This water would be sourced primarily from the Camp Gully Weir, surface run-off and town water.	• No change.
Coarse Reject Management	Approximately 8.5 Mt of coal reject would be produced over the life of the project. Approximately 3.5 Mt would be transported via trucks to the Glenlee Washery (south of Narellan) for emplacement. Emplacement at Glenlee is proposed to cease in Year 12 of the project. The remaining 5 Mt would be backfilled into longwall mine voids via goaf injection. Construction of a coal reject paste plant and associated infrastructure is required to permit goaf injection. This plant is expected to be fully operational by Year 5 of the project. In addition a short-term, 50,000 t coal reject stockpile would be located within a portion of the approved Camp Gully Emplacement, adjacent to the coal reject paste plant, during Years 2-4 of the project.	• No change.
Project Life	23 years (from the date of grant of a mining lease).	• Approximately 20.2 years of longwall mining.
Employment	Peak construction workforce of up to 50 employees and maintenance of an operational workforce of approximately 320 employees.	• No change.
Construction and Use of Surface Infrastructure	Major elements are: • upgrades of the existing mining and materials handling systems (eg longwall machinery and conveyors); • continued use of the existing surface facilities area and the existing supporting infrastructure; • upgrades of the CHPP, including addition of a beneficiation circuit; • construction of a coal reject paste plant and associated coal reject stockpile, pumping, pipeline and underground delivery systems; • surface access and associated works within the Woronora Special	• No change.

	Area and surrounds, required for environmental monitoring, management and remediation of mine subsidence; • upgrades and/or extension of the existing supporting infrastructure systems (eg underground access, water management system, yard area, conveyor transfers and drives, ventilation, gas management and electrical systems) as required; and • other associated minor infrastructure, plant, equipment and activities.	
Hours of Operation	24 hours a day, 7 days a week, aside from truck loading and hauling of product coal and coal reject, which would take place between 7am and 6pm, five days per week.	• No change.
Product Coal	Production of up to 2.8 Mtpa of hard coking and semi-hard coking (including minor quantities of thermal coal) for export and domestic markets. ROM coal production of up to 3.2 Mtpa	• No change.
Product Coal Transport	Approximately 90% of semi-hard coking and thermal product coal would be railed to the Port Kembla Coal Terminal for transport to domestic and overseas customers, and up to 120,000 tpa of hard coking coal would be transported via trucks to the Corrimal and Coalcliff Coke Works.	• No change.
Mine Access	Access to the Metropolitan Colliery Major Surface Facilities Area would continue to be via the existing Mine Access Road which intersects Parkes Street in Helensburgh.	• No change.
Rehabilitation and offsets	The rehabilitation strategy for the project would involve: • adaptive management and stream rehabilitation for Waratah Rivulet, including the restoration of 4 rockbars WRS 5, 6, 7 and 8 (located downstream of Flat Rock Crossing above longwalls 20 – 27, see Figure 5). Key points are: – within the adaptive management approach a Trigger and Response Plan (TARP) would be developed; – evaluation zones and Risk Management Zones (RMZs) would be established for all 4 rock bars; – multiple triggers would be incorporated into the TARP to initiate response or contingency measures; – a reduction in pool water levels and flow over the rock bars, due to a measurable increase in rock bar leakage rates, would be the trigger for stream restoration; – restoration works would be undertaken at the rock bars following each successive longwall panel within 600 m of the evaluation zone, to retain pools upstream of these rock bars; – consequently, it is expected that there would be primary, secondary and final restoration works following each phase of subsidence effects; – up to $12 m has been budgeted for restoration of these 4 key rockbars; • rehabilitation of project surface disturbance areas; and • rehabilitation of mine subsidence impacts. All disturbed areas would be progressively rehabilitated with rehabilitation of remaining surface disturbance areas at the completion of the project.	• Greater emphasis on avoidance of impacts on the Waratah Rivulet and the lower section of the Eastern Tributary, rather than remediation of watercourse impacts. This is expected to avoid the need to remediate rockbars WRS6, WRS7 and WRS8, although WRS5 is still expected to be substantially impacted and to require remediation. • Otherwise, unchanged.
Community Contributions	The project would contribute $372M in annual direct and indirect business turnover and $56M in annual household income for the Illawarra. $250,000 for research programs into subsidence effects on streams and stored waters, techniques for remediation of stream bed cracking, comparing outcomes of rehabilitation and natural remediation, and the refinement of predictions of non-conventional subsidence effects (particularly valley closure and upsidence) $50,000 per year to Sydney Catchment Authority for the life of the project totalling $1,150,000.	• No change, except that contributions to SCA would be limited to a once-only $100,000 for weed control in the Woronora Catchment.
Capital Value	$50,000,000	• No change.

Key features of the mine plan for the southern domain set out in the PPR (see Figure 5) are:

- Longwalls 20 and 21 are proposed to be extracted over their entire length, including beneath the Waratah Rivulet;
- Longwalls 22 and 23 are then proposed to incorporate a barrier pillar beneath the Waratah Rivulet;
- Longwalls 24 – 27 are substantially shortened in length – extraction is proposed only on the eastern side of the Waratah Rivulet; and
- a substantial pillar of coal is then proposed to be left un-mined by longwall methods under the lower reaches of both the Waratah Rivulet and the Eastern Tributary.

The pillar of coal between the two longwall domains (labelled A1 and A2 on Figure 5) would still be subject to mine development and potentially also to additional mining. It is proposed, for example, that the main headings for the northern domain ("Mains 300") would be constructed within this area, although no subsidence would result from these "first workings". HCPL has indicated that it considers that Area A1 would be sterilised from any other mining "in the absence of further technological advances". However, HCPL considers that Area A2 could be mined in the future, probably by non-longwall methods. Area A3 (from which Longwalls 20 - 24 are truncated by a north-south trending igneous dyke system) could also be subject to future mining. HCPL considers that such mining is at least 15 years in the future, and it is not seeking approval for any extraction in Areas A1 – A3 at this time, other than the development of the Mains 300.

Longwall void length varies between 1182 m (for the shortest of the half-longwalls separated by a barrier pillar in the southern domain, ie Longwall 22A) and 3228 m (Longwall 317). Chain pillar width is proposed to be generally 40 m of solid coal. Within 495 m of the Woronora Reservoir's full water storage level (horizontal distance), it is proposed that chain pillars would be 65 min width. For the maingates for Longwalls 21, 22 and 25, it is proposed that intermediate chain pillar widths would be used (55 m, 57 m and 50 m, respectively).

The revised mine plan leads to a reduction in the proposed mine life by 2.8 years to approximately 20.2 years, due to the decision to not mine an area containing approximately 6.86 Mt of coal.

2.3 Socio-Economic Benefits

Metropolitan Colliery primarily produces semi-hard and hard coking coal. The Southern Coalfield is renowned for its premium quality hard and semi-hard coking coals. It is the only source of hard coking coal in NSW. This premium hard and semi-hard coking coal predominantly occurs in the Bulli Coal Seam, and is characteristically low in ash and sulphur and has a low volatility. Bulli Coal Seam coal is highly sought after in the production of coke for steel making. It is used in the Port Kembla and Whyalla Steelworks and is a valuable export commodity.

In the Southern Coalfield, Metropolitan Colliery holds large untouched reserves of coking coal within the Bulli Seam, totalling approximately 63 Mt of ROM coal. If approved, the Metropolitan Coal Project would produce significant quantities of coking coal The Metropolitan Coal Project would also supply a total of 940,000 tonnes of thermal coal to export markets over its project life (see Table 2).

Table 2: *Metropolitan Coal Project Quantity and End Use of Coking Coal Produced*

Coal Type	*Quantity Product Coal Produced Over the Life of the Project (Mt)*	*Percentage of total (%)*	*End Use*
Semi-hard Coking Coal	50.7	93	Transported by train to Port Kembla Coal Terminal for export to steelmaking customers around the world.
Hard Coking Coal	2.76 (up to 0.12 per year)	5	Transported via road to the Corrimal and Coalcliff Coke Works for coke production. The Corrimal and Coal Cliff Coke Works supplies premium grade coke to Australian and overseas producers of base metals (lead and zinc smelting) and pig iron for use in steelmaking.
Total	53.46	98*	

* *Remaining 2% is Thermal Coal*

From HCPL's perspective, the project is justified by a combination of coal resource availability and market opportunity over the proposed mine life. The coal produced from the Metropolitan Coal Project would help supply the rising global coal demand, particularly for coking coal. This demand saw international spot prices soar to over US$300 per tonne in 2008. Prices are now sitting at around $110 per tonne. The ultimate need for the project is driven by growth in both domestic and international markets to supply coking coal, primarily for the production of iron and steel.

Over the life of the project, the mine is forecast to provide 700 direct and indirect jobs; including continued direct employment for 320 people. It would pay directly $56 million in annual household incomes and generate $372 million worth of annual business turnover in the Illawarra Region. The contributions to the NSW-wide economy are greater, with 1,951 jobs, $154 million annual household incomes and $687 million annual business turnover predicted to be generated.

3 STATUTORY CONTEXT

3.1. Major Project

The proposal is classified as a major project under Part 3A of the EP&A Act because it constitutes development for the purpose of coal mining, and therefore meets the criteria in Clause 5 of Schedule 1 of *State Environmental Planning Policy (Major Projects) 2005*. As such, the Minister for Planning is the approval authority.

3.2. Permissibility

The majority of surface infrastructure associated with the project is situated on land zoned 7d (Environment Protection – Hacking River) under the *Wollongong Local Environmental Plan 1990*. The majority of the proposed underground mining area associated with the project includes land zoned 7a (Environment Protection – Special Use [Water Catchment]) and other land zoned 5a (Special Use), 5b (Special – Railways), 5c (Special – Main Roads) and 7d (Environment Protection – Hacking River). Mining is permissible with consent in all these zones. Consequently, the Minister may approve the carrying out of the project.

3.3. Exhibition and Notification

Under Section 75H(3) of the EP&A Act, the Director-General is required to make the Environmental Assessment (EA) for a project publicly available for at least 30 days.

After accepting the EA for the project, the Department:

- made the EA publicly available from 22 October 2008 until 24 November 2008 at the:
  - Department's Information Centre;
  - Wollongong City Council's offices ;
  - Nature Conservation Council's offices; and
  - Metropolitan Colliery; and on the
  - Department's website;
- notified relevant State government authorities and Wollongong City Council by letter; and
- advertised the exhibition in the Sydney Morning Herald, Daily Telegraph, Illawarra Mercury and Corrimal Northern Leader.

This satisfies the requirements in Section 75H(3) of the EP&A Act.

During the assessment process the Department also made a number of documents available for viewing or download on the Department's website. These documents included the:

- project application;
- Director-Generals environmental assessment requirements;
- EA;
- HCPL's responses to issues raised in submissions;
- Planning Assessment Commission's Terms of Reference and Report; and
- PPR.

3.4. Planning Assessment Commission

On 14 November 2008, under Section 23D(1)(b)(ii) of the EP&A Act, the Minister for Planning directed the Planning Assessment Commission (PAC) to assess key aspects of the project in more detail. The Minister directed that the PAC:

(a) carry out a review of the potential subsidence related impacts of the Metropolitan Coal Project on the values of Sydney's drinking water catchment, and in particular its potential impact on the Waratah Rivulet and Woronora Reservoir, taking into consideration the recommendations of the Southern Coalfield Inquiry;
(b) advise on the significance and acceptability of these potential impacts, and to recommend appropriate measures to avoid, minimise, or offset these impacts; and
(c) identify and comment on any other significant issues raised in submissions regarding the Metropolitan Coal Project or during the public hearings.

For the purposes of this review, the PAC was constituted as:

- Dr Neil Shepherd (Chair);
- Professor Jim Galvin (Subsidence);
- Mr Colin Mackie (Groundwater);
- Dr John Tilleard (Surface water); and
- Professor Jeffrey Bennett (Resource Valuation).

Dr Shepherd is a permanent member of the PAC. The remaining four members were appointed as "casual members" of the PAC for the currency of the Metropolitan review.

The PAC held public hearings on 11 and 12 March 2009 and heard presentations from a total of 18 parties including community stakeholders, Government agencies and HCPL. Following the public hearings, the PAC received further submissions from some of those who made presentations at the public hearings.

The PAC's inquiry initially focused on the content of the EA as exhibited, and this was the basis on which public submissions and presentations were sought and considered. After the Department required submission of the PPR on 20 April 2009, a draft PPR was provided to the Department on April 23, and thence provided by the Department to the PAC.

The PAC prepared its report in light of submissions made to the Department following exhibition, the public hearing presentations and subsequent submissions, and the first draft of the PPR. The PAC reported to the Minister on 22 May 2009. A copy of the PAC's report is attached as Appendix B, together with all submissions made to the PAC.

Under Section 75J(2)(c) of the EP&A Act, the Minister is required to consider any findings or recommendations of the PAC in deciding whether or not to approve the project.

3.5. Preferred Project Report

In recognition of concerns raised in public and agency submissions and by the PAC during its assessment process, on 20 April 2009 the Department issued a requirement, under Section 75H(6)(b) of the EP&A Act, for HCPL to prepare a Preferred Project Report (PPR) for the project. A draft of the PPR was submitted to the Department on 23 April 2009.

An expanded and final version of the PPR was provided to the Department on 21 May 2009, which unfortunately was too late to be considered by the PAC in completing its review. However, the final version did not change any significant mine parameter. Instead, it contained additional clarifying, explanatory and supporting material.

These refinements clarified, explained and supported the existing PPR, rather than added to or changed it. Thus, the PAC's assessment of the PPR remains accurate and relevant. However, the Department's assessment must take into account the additional material included in the final version of the PPR. The final PPR is attached as Appendix C.

3.6. Objects of the EP&A Act

The Minister is required to consider the objects of the EP&A Act when making decisions under the Act. These objects are detailed in Section 5 of the Act, as follows:

"The objects of this Act are:

(a) to encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,

(ii) the promotion and co-ordination of the orderly and economic use and development of land,

(iii) the protection, provision and co-ordination of communication and utility services,

(iv) the provision of land for public purposes,

(v) the provision and co-ordination of community services and facilities,

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats,

(vii) ecologically sustainable development; and

(viii) the provision and maintenance of affordable housing; and

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State; and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment."

The objects of most relevance to the Minister's decision on whether or not to approve this project are those under Section 5(a)(i), (ii), (iii), (vi) and (vii).

The EP&A Act adopts the definition of Ecologically Sustainable Development (ESD) found in the *Protection of the Environment Administration Act 1991*. Section 6(2) of that Act states that ESD "requires the effective integration of economic and environmental considerations in decision-making processes" and that ESD "can be achieved through" the implementation of the principles and programs including the precautionary principle, the principle of inter-generational equity, the principle of conservation of biological diversity and ecological integrity, and the principle of improved valuation, pricing and incentive mechanisms. In applying the precautionary principle, public decisions should be guided by careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment and an assessment of the risk-weighted consequences of various options.

The Department has fully considered the objects of the EP&A Act, including the encouragement of ESD, in its assessment of the application. The assessment seeks to integrate all significant economic, social and environmental considerations and avoid any serious or irreversible damage to the environment, based on an assessment of risk-weighted consequences.

HCPL has also considered a number of alternatives to the project, including the alternative of not proceeding, and considered the proposal in the light of the ESD principles.

3.7. Environmental Planning Instruments

Under Sections 75I(2)(d) and 75I(2)(e) of the EP&A Act, the Director-General's report for a project is required to include a copy of, or reference to, the provisions of any State Environmental Planning Policy (SEPP) that substantially governs the carrying out of the project and any environmental planning instrument (EPI) that would (except for the application of Part 3A) substantially govern the carrying out of the project and that have been taken into consideration in the assessment of the project.

The EA contains a thorough review of the relevance of all SEPPs and EPIs applicable to the project (see Section 3.2 of the EA) and a summary of these has been provided in Appendix F. All relevant SEPP's and EPIs have been taken into consideration in the environmental assessment of the project.

3.8. Statement of Compliance

Under Section 75I of the EP&A Act, the Director-General's report is required to include a statement relating to compliance with the environmental assessment requirements issued for the project.

The Department is satisfied that the Director-General's environmental assessment requirements have been complied with.

3.9. *Environmental Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* addresses Commonwealth Government interests concerning protection of matters of national environmental significance. If a proposal is likely to have a significant impact on matters of National Environmental Significance, it must be referred to the Commonwealth Minister for Environment, Water, Heritage and the Arts. That Minister is then required to determine whether the EPBC Act applies, ie whether the proposal is a "controlled action" under that Act.

HCPL referred the Metropolitan Coal Project to the Commonwealth Department of Environment, Water, Heritage and the Arts, which deemed the project to not be a "controlled action".

4 ISSUES RAISED IN SUBMISSIONS

The Department received a total of 96 submissions following exhibition of the original project:

- 10 from public authorities;
- 21 from special interest groups; and
- 65 submissions from the general public, including 1 form letter from Helensburgh Coal Community Reference Group.

A summary of the issues raised in submissions is provided below. A full copy of these submissions is attached in Appendix E.

4.1 Public Authorities

The **Sydney Catchment Authority** (SCA) has adopted principles for the management of coal mining projects within its Special Areas. From these principles SCA has developed "desired outcomes", including:

- no damage to SCA's infrastructure;
- no permanent reduction in water quantity or quality; and
- no adverse environmental consequences of subsidence impacts.

SCA is concerned that the project would not be consistent with these desired outcomes. SCA was not satisfied that HCPL had demonstrated that there would be no net reduction of flows into the Woronora Reservoir or a neutral or beneficial effect on water quality. SCA considers there is currently insufficient evidence to demonstrate that mining would not have a measurable effect on water resources and that streambed remediation methodology and effectiveness is yet to be proven.

The **Department of Environment and Climate Change** (DECC) stated that it is not in a position to support the proposal as exhibited until key issues are addressed, consistent with the Southern Coalfield Inquiry's recommendations, as follows:

- protection of all "highly significant natural features" such that subsidence impacts are "negligible". DECC considers that these features include Waratah Rivulet, key upland swamps and Aboriginal sites "of significance";
- improved level of environmental assessment. DECC considers that the EA had significant deficiencies in providing a quantitative analysis of subsidence impacts and resulting environmental consequences, and inadequate scientific data and methods to test assumptions and claims; and
- improved adaptive management approach. DECC considers that there are uncertainties between subsidence effects and environmental consequences. Adaptive management should be implemented to provide a systematic process for continually detecting impacts, validating predictions and improving mining operations to prevent further impacts.

DECC also provided advice on air quality, noise impacts, greenhouse gas emissions and waste management.

The **Department of Primary Industries** (DPI) supports the proposed mine development as an appropriate use of the State's coal resources but has some residual concerns. Potential impacts on Waratah Rivulet are a key issue. DPI agrees with HCPL's predictions of the likely extent of subsidence impacts on Waratah Rivulet. Project assessment needs to consider these environmental impacts against the value of coal foregone. The approval needs to clearly specify the acceptable level of impacts. DPI believes that further remediation in addition to the 4 rock bars proposed by HCPL should

be considered. In addition, further detail from HCPL is required on criteria for stream rehabilitation as well as the rehabilitation of the surface facilities area based on an agreed end land use.

The **Department of Water and Energy** (DWE) advised that it is not in a position to support the current proposal until issues which it considered to be required outcomes are addressed. DWE was of the view that if HCPL is unable to meet these conditions then the proposal should not proceed.

The **Roads and Traffic Authority** (RTA) indicated that its major area of concern is the ongoing management of the F6 Freeway and Lawrence Hargrave Drive.

The **Dams Safety Committee** (DSC) considered the risk associated with the proposal to be the loss of stored waters rather than the impact of subsidence on the Woronora Reservoir dam wall, which is approximately 5 km from the proposal. The DSC has considered the proposed mine layout, involving narrowing of longwalls under and adjacent to stored waters, and indicated that the proposed mine layout is technically viable in principle.

Wollongong City Council (WCC) highlighted concerns regarding potential impacts on groundwater systems, surface water quantity and quality, aquatic ecology and terrestrial flora and fauna, particularly impacts to riparian corridor habitats. WCC also mentioned traffic matters, economic and social matters and heritage matters as areas of concern.

Wollondilly Shire Council (WSC) had concerns regarding the project and indicated that the EA is not sufficient for accurate evaluation and decision making processes. WSC has particular concerns with the EA's assessment of goaf injection of coal reject, coal reject transport, ventilation shaft air, the reliance on monitoring, mitigation and remediation and the risk assessment.

Sutherland Shire Council (SSC) had significant concerns regarding the project, particularly the potential impacts on Woronora Reservoir, which provides the water supply for Helensburgh and the Sutherland Shire. SSC does not consider the proposed project reflects the precautionary principle, and does not support approval until greater certainty is provided.

4.2 Community and Interest Groups

There were 86 submissions from the community and special interest groups. Special interest groups that made submissions are listed in Table 3. Of these 86 submissions, 63 (73%) objected to the project, 18 (21%) supported the project and 5 (6%) did not object but raised concerns. The key issues from both the community and special interest groups are shown in Figure 6.

Table 3: *Special Interest Groups that made Submissions*

Alliance for Sustainable Wellbeing	Northern Illawarra Residents Action Group
Blue Mountains Conservation Society	Rivers SOS
CFMEU Mineworkers Helensburgh Lodge	Sada Pty Limited
CFMEU Mining and Energy	Sutherland Climate Action Network
Coast and Wetlands Society Incorporated	Sutherland Shire Environment Centre
Environmental Defenders Office (NSW)	The Colong Foundation for Wilderness Ltd
Healthy Cities Illawarra	The Nature Conservation Council
Helensburgh Coal Community Reference Group	The United Mineworkers South Western District
Illawarra Escarpment Coalition	Walter Mining Pty Ltd
National Parks Association of NSW	Wollongong Transport Coalition

Submissions from the community and special interest groups also raised a number of other concerns, including cumulative impacts of coal mining, lack of baseline data, mining being a listed key threatening process, coal reject emplacement and habitat connectivity. Submissions in support of the project generally cited employment and socio-economic benefits as key reasons why the project should be approved.

4.3 Response to Submissions

HCPL has provided responses to the issues raised in submissions (see Appendix D). The response to submissions contained three parts:

- Part A – Responses to State government agencies;
- Part B – Responses to other submitters (local government, special interest groups and individuals); and
- Part C – Responses to PAC Queries.

The full response to submissions was made publicly available on the Department's website.

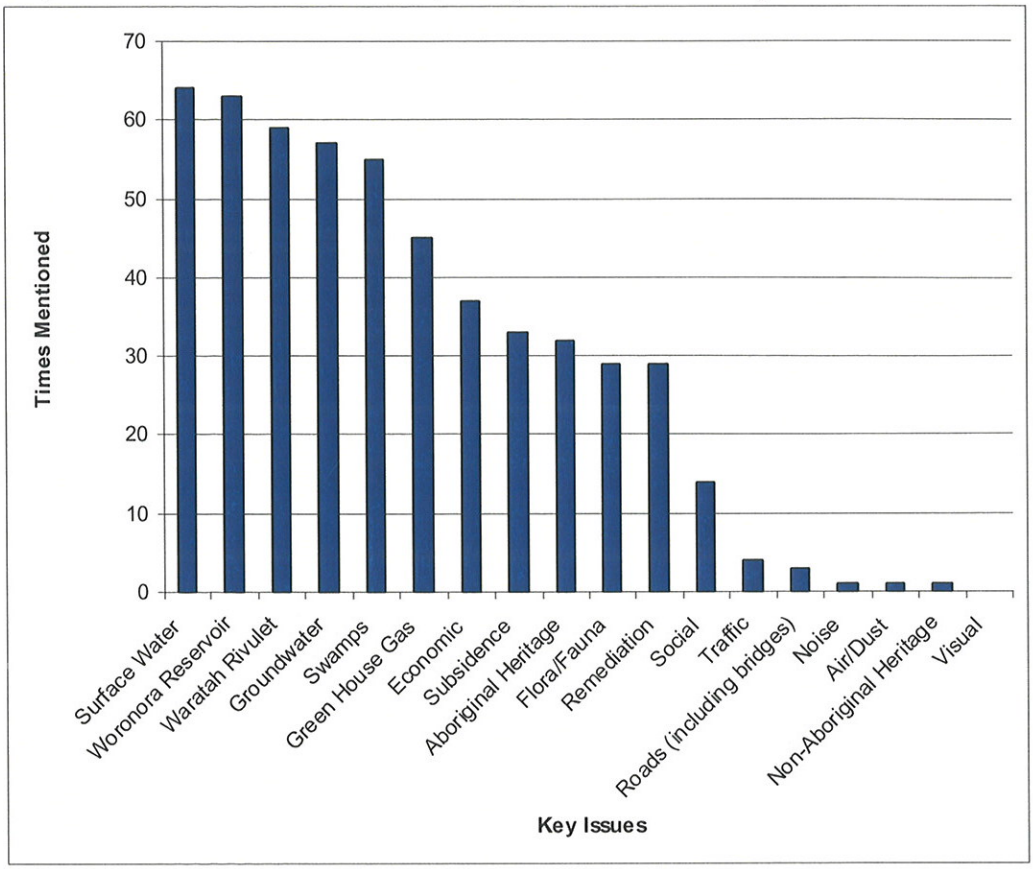

Figure 6: *Key Issues for Community and Special Interest Groups.*

5 ASSESSMENT

Key documents considered during the Department's assessment include HCPL's:

- environmental assessment (including the appendices);
- response to submissions (including its responses to PAC queries);
- PPR.

The Department's assessment has also had close regard to the PAC's report, which is quoted or paraphrased extensively, and the recommendations of the Southern Coalfield Inquiry. It has also taken into account the submissions made both following exhibition of the EA and separately to the PAC inquiry. However, as indicated in section 3.4, the PAC gave consideration to issues raised in these submissions which were within its Terms of Reference. Many of these issues were further addressed in presentations and submissions then made directly to the PAC.

It is also noted that many submissions (including agency submissions) became less applicable following presentation of the PPR, with its revised mine plan. The revised mine plan is so fundamentally different to that originally exhibited that the conclusions drawn in previous submissions are in many respects no longer accurate or relevant. The PAC's report also addresses relevant agency positions in detail, in the context of the PPR. Thus, the key references in the following assessment are to the PAC's report and the PPR.

5.1 Mine Subsidence

5.1.1 Introduction

The approach taken in this assessment report also follows that taken in the Southern Coalfield Inquiry and the PAC report in considering subsidence effects separately to their impacts and consequences. The SCI defined the terms *subsidence effect*, *subsidence impact* and *environmental consequence* in

respect of subsidence and natural features. The PAC extended the use of these terms to also include man-made structures and surface modifications. The term *subsidence effect* describes subsidence itself. Any physical change to the fabric or structure of the ground, its surface, or man-made features is described as a *subsidence impact*. The term *consequence* is used to describe any change in the amenity or function of a feature that arises from an impact. In turn, some consequences may give rise to *secondary consequences*. Consequences related to natural features are *environmental consequences*. By way of example, tensile strain due to the ground surface being 'stretched' as a result of undermining is a subsidence effect, a crack resulting from this tensile strain is a subsidence impact, loss of water down the crack is an environmental consequence, and the drying of a water dependent ecosystem as a result of this loss of water is a secondary environmental consequence.

As noted in section 3.5, the PPR represents a very substantial revision of the originally-exhibited mine plan. However, due to the short time available for its preparation, it is not a complete revision of the EA, including its appendices. Most significantly, the subsidence impact assessment associated with the PPR is limited in scope. Consequently, the Department has had to rely substantially on the subsidence impact assessment included in the original EA in reporting the overall subsidence impacts of the project. The PPR indicates that subsidence impacts (and therefore consequences) of the preferred project are either less than or very similar to the impacts and consequences predicted for the original mine layout. The Department generally accepts this conclusion and considers that the subsidence impact assessment in the original EA is a reasonable basis for describing the impacts of the preferred project.

The Metropolitan Coal Project proposes to continue to extract the Bulli Coal Seam using longwall mining methods. The depth of cover to the seam varies between 400 and 560 metres (m), which means that Metropolitan Colliery is a "deep" coal mine by Australian standards. The seam dips at a low rate from the southeast to the northwest, dropping some 120 m over a distance of 6 km. Seam thickness varies from 2.5 to 3.8 m. The maximum seam thickness able to be extracted using the current longwall is 3.4 m. The proposed maximum longwall void width is 163 m, reducing to 130 m within much of the DSC's Notification Area for Woronora Reservoir. These widths are small by industry standards, with most longwall panel widths in NSW falling in the range of 250 to 400 m. Narrower longwall widths generally reduce surface subsidence effects, impacts and consequences relative to wider longwalls.

5.1.2 Subsidence Effects

Subsidence effects are defined as deformation of the ground mass due to mining, being all mining-induced ground movements including both vertical and horizontal displacement, tilt, strain and curvature. So-called 'systematic' or conventional components of subsidence (vertical displacement, tilt, and tensile and compressive strain) are those effects that are normally associated with a flat-dipping seam in level topography, unaffected by major geological structures such as faults and dykes.

Additional 'non-conventional' subsidence components can arise in steep or incised topography, especially in the presence of high horizontal stresses, such as occur in the Southern Coalfield. These components include valley closure, upsidence and far-field horizontal movements. Valley closure is a phenomenon whereby one or both walls of a valley move horizontally towards the valley centreline, due to changed horizontal stress conditions. Upsidence is a relative upward movement or uplift, created by the horizontal compression and buckling behaviour of rock strata in the vicinity of a valley floor. Upsidence is measured as the difference between the amount of downwards vertical displacement expected in conventional circumstances and the amount that actually occurs in non-conventional circumstances. Upsidence is generally reflected by shearing and buckling of near-surface strata, generally at or close to the centreline of valleys, which may lead to the development of a local fracture network. It is caused largely by valley closure and, to a lesser extent, by valley uplift.

Of all subsidence effects, it is upsidence which causes the greatest impacts on streams and watercourses in the Southern Coalfield. Buckling and shear in the near-surface strata, which leads to upsidence, can generate an extensive network of fractures and voids in the valley floor. Ground movements due to conventional subsidence (ie tensile and compressive strain) may also contribute to this network of cracks. Upsidence is difficult to predict at any particular location because it is commonly displayed as very local deformations. Valley closure is more easily predicted.

The PAC reviewed subsidence behaviour in the Southern Coalfield, and identified a number of key factors to take into account when assessing subsidence effects and their impacts and consequences at Metropolitan Colliery. These were to the effect that:

- predicted conventional subsidence effects are decreased because of the relatively low width-to-depth ratio within longwall mining voids and increased width-to-height ratio for chain pillars;
- sections of the project area are prone to unconventional subsidence effects, especially closure and upsidence, which would "overprint" the conventional subsidence effects of the proposed mine plan;
- because of the relatively high cover depth and relatively low void width, subsidence effects would develop incrementally, and not plateau above a longwall panel until a number of additional panels have been extracted;
- some surface features are likely to experience concentrated strains rather than uniformly-distributed strains, whilst predicted strains may not eventuate at other surface features; and
- some surface areas are likely to experience a localised reversal in predicted strain type (ie compressive strains may actually occur where tensile strains are predicted, or vice versa).

Conventional Subsidence Effects

The EA's subsidence impact assessment (SIA) was undertaken by Mine Subsidence Engineering Consultants (MSEC). MSEC predicted conventional subsidence parameters using its Incremental Profile Method (IPM). As reported by the PAC, IPM is an empirical technique and its accuracy is dependent on calibration to a database of existing results representative of the site in question. It has significant advantages over most other empirically-based techniques because it provides for evaluating how changes in any of a number of parameters affect each increment of vertical displacement and, hence, the shape of the final vertical displacement profile (from which all other subsidence parameters are derived). IPM takes into account:

- mining height;
- mining depth, which can vary due to changes in seam gradient or topography;
- void width and length; and
- chain pillar width.

IPM produces final vertical displacement profiles that are quite sensitive to local changes in the mining environment. Furthermore, it allows predictions to be made at any point on the surface. These attributes are useful because the depth of mining at Metropolitan Colliery varies due to changes in topography, void width and interpanel pillar width are also variable, and surface features of interest are scattered throughout the mining area.

Nonetheless, IPM did not produce accurate predictions of vertical subsidence for Longwalls 1 - 14. The key reason for this is that subsidence for these longwalls behaved differently than expected when compared to other mines in the Southern Coalfield. MSEC customarily applies adjustment factors (based on previous measurements in similar or nearby collieries) to take into account regional similarities or differences in geology and other site-specific factors. Use of the regional factors that MSEC had established for the Southern Coalfield led to significant under-prediction of total vertical subsidence for Longwalls 1 - 14. Measured subsidence generally varied between 120% and 140% of predictions, which is high given that IPM is usually considered to be a conservative methodology which over-estimates vertical subsidence.

MSEC suggests that the reason for the variant subsidence behaviour at Metropolitan is thicker sequences of mudstones within the 150 m of rock strata immediately above the coal seam. Mudstones are likely to crush more completely and subside more evenly than sandstones, which break more easily into blocks, leading to a higher "bulking factor". Consequently, subsidence is more complete in mines where there are more mudstones in the caved and fractured zones.

MSEC has taken this problem into account, and essentially derived a local "adjustment factor", taking into account both regional experience and previous experience at Metropolitan. This factor reduces theoretical chain pillar strength by one third, allowing more complete vertical subsidence to be modelled. Application of this factor provided a suitably conservative buffer over observed vertical subsidence for Longwalls 1 - 14, and it has therefore been applied by MSEC when predicting subsidence effects in the new mining domains. As pointed out by the PAC, providing that the reason for the increased vertical subsidence above Longwalls 1 – 14 has been correctly identified and geological conditions in the new mining domain remain similar, then this approach is valid. Indeed, MSEC reports that there is some evidence that the mudstone strata thin towards the north, and that its predictions may therefore prove overly-conservative. However, the PAC has considered the possibility that MSEC's adjusted methodology would still under-predict vertical subsidence in the new domains and has recommended that numerical re-modelling of subsidence effects to better identify causative

factors should be undertaken, providing that observed vertical subsidence exceeds predictions by more than 15% or does not fit predicted distribution profiles. The Department supports this recommendation.

While retrospective use of the adjustment factor led to appropriately-conservative predictions of vertical subsidence and reasonable correlations between measured and predicted tilts, the PAC has observed that compressive and tensile strain predictions above Longwalls 1 – 14 were still not particularly accurate. This is partly because predictions of strain due to valley closure ("closure strain") were not made, but the same poor correlation exists around a number of ridge tops. Measured tensile strains were up to 3 – 5 mm/m, and measured compressive strains commonly up to 3 mm/m, but in one place as high as 10 mm/m. In a number of cases, the sign of measured strain was the reverse of that predicted (ie observed tensile strain resulted where compressive strain was predicted).

The Department accepts the PAC's conclusions regarding the EA's prediction of conventional subsidence effects that:

> *"In summary, the methodology utilised by MSEC to predict the conventional component of subsidence is considered appropriate. Subject to site conditions in the Project Area being similar to those over Longwalls 4 to 14, the methodology can be anticipated to produce reasonably accurate predictions of vertical displacement and tilt. An assessment of the accuracy of strain predictions is not possible since conventional subsidence behaviour is only one contributor to strain development. However, once fracturing is initiated, strains (tensile or compressive) are unlikely to be uniformly distributed in accordance with theoretical calculations. Rather, they will concentrate at the fracture planes. The sensitivity of features to the form (tensile or compressive) and possible location, spacing, width and depth of these fractures need to be considered on a feature specific basis when predicting subsidence impacts and consequences."*

Non-Conventional Subsidence Effects

The formation of an upsidence fracture network in the Waratah Rivulet has been monitored in detail at Metropolitan Colliery for a number of years. The PAC reports that monitoring has revealed that the fracture network becomes deeper with the passage of each longwall in its vicinity. Ultimately, the main fracture network extends to a depth of about 12 m and bed separation extends to a depth of some 20 m. Upsidence also extends some tens of metres laterally, ie beneath the valley sides, and does not necessarily directly follow the line of a watercourse. Rather, it can cut across headlands and bends.

MSEC has undertaken much of the work funded by the coal industry over recent years in an endeavour to improve the understanding and prediction of valley closure and upsidence in the Southern Coalfield. MSEC's prediction methodology for valley closure and upsidence is based on two elements – valley depth and valley shape, both of which are generally understood to contribute to the scale of valley closure and resultant upsidence. Together, these elements are used to produce a modelled valley topography termed *equivalent valley height*. MSEC's predictions of valley closure and upsidence for Waratah Rivulet used the most conservative factor to represent valley shape (ie Waratah Rivulet was modelled as being more prone to valley closure, based on valley shape, than the available database would suggest). Thus, MSEC's predictions are likely to be conservatively high.

MSEC's predictions of valley closure and upsidence are also "upper bound" predictions, rather than probabilistic predictions. As pointed out by the PAC, this approach of putting an upper restriction on valley closure and upsidence (essentially a worst case scenario) is, again, inherently conservative. Consequently, observed valley closure and upsidence is generally found to be less than MSEC's predictions. As can be seen from Figure 7 below, at Metropolitan Colliery's Longwalls 1 - 14, observed valley closure generally has been between 30-70% of predictions. Observed upsidence has been generally less than 70% of predictions, and commonly less than 30%.

However, as pointed out by the PAC, this conservative approach to predicting upsidence and closure *effects* does not translate to a conservative approach when predicting upsidence and closure *impacts*. In the absence of a sufficiently-large database relating observed non-conventional subsidence effects with observed impacts, and sufficient discrimination to identify site-specific characteristics, MSEC instead relates observed subsidence impacts to a "back calculation" of predicted valley closure and upsidence. This same basis for prediction of impacts was used by MSEC in assessing predicted subsidence impacts for the recent modification to Dendrobium Coal Mine's development consent for its Mining Area 3. Despite its limitations (discussed in the Department's assessment report for the

Dendrobium modification), this approach is considered by the Department to be current best practice for the Southern Coalfield.

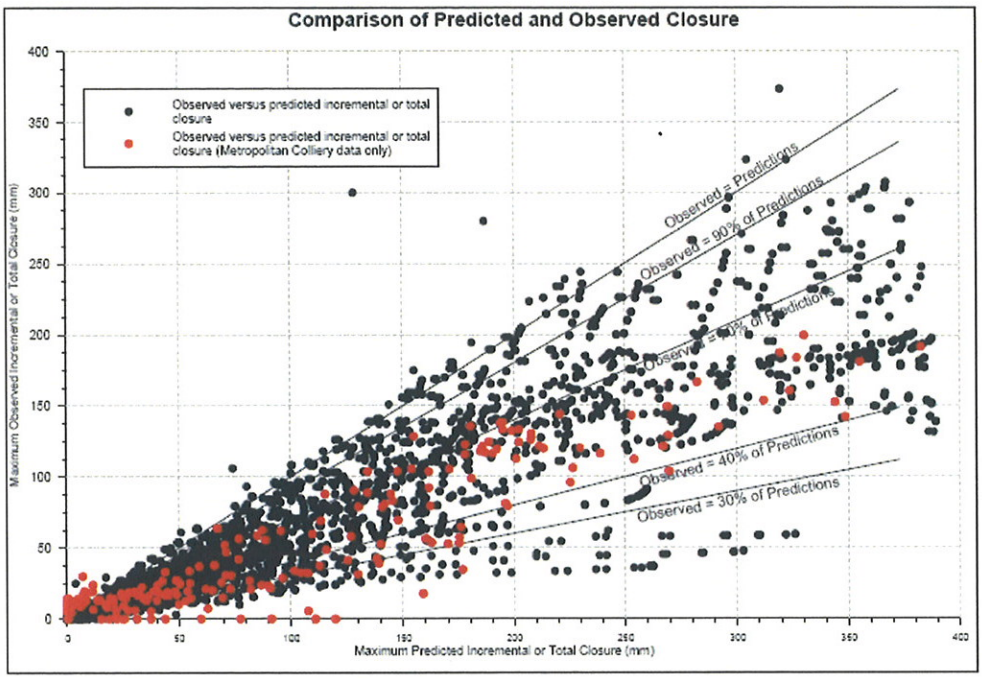

Fig. 3.15 Plot of Predicted versus Observed Closure

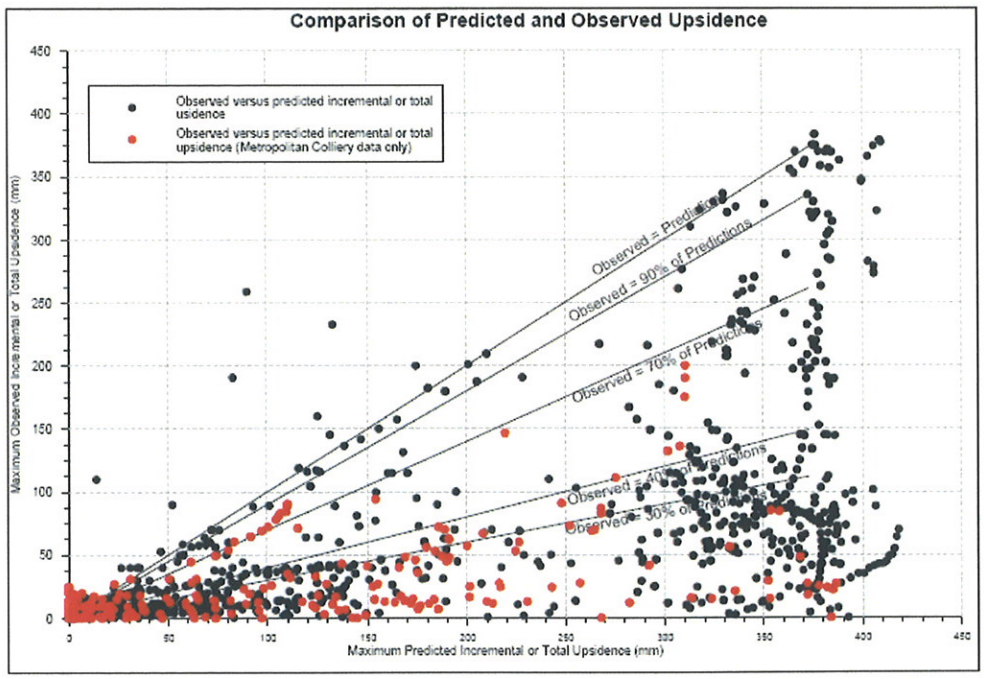

Fig. 3.16 Plot of Predicted versus Observed Upsidence

Figure 7*: Predicted vs Observed Valley Closure and Upsidence (from MSEC285)*

This approach is then used by MSEC to identify a threshold value for predicted valley closure considered likely to result in significant subsidence impacts for the related watercourse (ie increased rockbar leakage). As pointed out by the PAC, basing predictions of impacts on predicted values of closure (rather than measured values) means that the conservatism inherent in MSEC's predictions of subsidence effects has been lost. That is, the predicted level of impact is directly associated with a predicted level of subsidence effect, no matter that this was predicted conservatively.

The threshold value considered by MSEC to be likely to cause increased rockbar leakage is 200 mm. This value is the same as that suggested by MSEC in the Dendrobium subsidence impact assessment

as the threshold associated with "major fracturing or flow diversions". Despite its limitations, there is currently no better predictor for the onset of major watercourse fracturing, leading to rockbar leakage and pool drainage. Consequently, a number of the queries put to HCPL by the PAC seeking further information revolved around the issue of avoiding 200 mm of valley closure. The 200 mm threshold was also a key factor in a number of scenarios modelled in the SIA and in the eventual design of the setbacks from the Waratah Rivulet for Longwalls 22 – 27 included in the PPR. It has also been accepted by the PAC as the target for HCPL to aim for in limiting impacts on watercourses – the PAC's proposed standard of "negligible consequences" for key watercourses is "assumed to be achieved" where predicted valley closure is less than 200 mm.

Nonetheless, the Department notes that MSEC has proposed the 200 mm valley closure threshold based solely on its own qualitative review of watercourse-related subsidence impacts at its client mines. It is generally accepted that the figure is far from established. It must be seen as indicative, rather than determinative. There remains a possibility, particularly for fragile rock types, that significant buckling and shearing of sections of stream beds will eventually be observed where predicted valley closure is less than 200 mm. Notwithstanding, such impacts are considered to be less likely for rockbars, which by their nature are formed by the more massive and resistant rock strata.

5.2 Subsidence Impacts on Surface Water Features

As can be seen from Figure 4, the mine plan included within the EA provided no deliberate protection or reduction in potential subsidence impacts for the Waratah Rivulet or other watercourses within the mining area. Perhaps the sole exception to this principle was any accidental reduction in stream impacts which may have resulted from the proposal for wider chain pillars within most of the DSC's notification area for the Woronora Reservoir. HCPL's original strategy was not to avoid impacts, but rather to remediate them. Remediation was proposed only to a certain standard (ie to restore pool-holding capacity) and only for limited locations (ie four major rockbars on the Waratah Rivulet known as WRS5, WRS6, WRS7 and WRS8). No remediation was proposed for other watercourses, including the Eastern Tributary, or for other rockbars on the Waratah Rivulet.

This situation was changed markedly by the PPR's revised mine plan and its other commitments. The PPR is straightforward when it states that its objective is to:

> *"minimise the original Project's potential environmental impact to the Waratah Rivulet and the Eastern Tributary... Specifically, the Preferred Project mine plan avoids the drainage of pools along the majority of the lower reach of the Waratah Rivulet (from Longwall 24 to the full storage level of Woronora Reservoir). ... The Preferred Project mine plan also significantly reduces the potential subsidence effects on the lower reaches of the Eastern Tributary."*

The assessment of potential impacts on the Waratah Rivulet and other watercourses is based on the mine plan contained within the PPR.

5.2.1 Waratah Rivulet

As indicated in section 2.2 above, the varied mine plan for the southern domain includes 2 complete longwalls beneath the Waratah Rivulet (Longwalls 20 – 21), two longwalls with barrier pillars (Longwalls 22 – 23) and four shortened longwalls which are set back from the Waratah Rivulet to the southeast. This varied mine plan is anticipated to produce substantially less impact on much of the Waratah Rivulet. The PPR sets out the anticipated impacts on the Rivulet as follows:

- "avoidance of drainage of ponds along the majority of the lower reach of the Waratah Rivulet;
- reduction in the potential for redirection of some surface flow into a shallow fracture network that may have developed as a consequence of cracking of the Waratah Rivulet stream bed;
- reduction in the potential for localised and transient impacts to water quality that may have occurred as a consequence of shallow cracking of the Waratah Rivulet ... stream bed; and
- reduction in the potential extent of localised iron staining that would occur as a consequence of shallow cracking of the Waratah Rivulet ... stream bed."

While the Department (and the PAC) accept the essential accuracy of these statements, they do not guarantee that there would be no additional impacts on the Rivulet. On the contrary, of the 2300 m of the stream proposed to be undermined by the project as set out in the EA, only about 800 m is anticipated in the PPR to be subject to closure strain of 200 mm or less (see Figure 8). Figure 8 shows that MSEC expects that closure strain would be >300 mm over Longwalls 20 and 21 and the majority of 22, and would not reduce to 200 mm until a point on the Rivulet longitudinally adjacent to half the width of Longwall 24. This is equivalent to about 1150 m of stream length from the tailgate of Longwall 20. Further, an additional 350 m of stream length between the point on the Rivulet longitudinally

adjacent to half the width of Longwall 27 and full storage level is anticipated to be subject to closure strains of 200 – 250 mm. Nevertheless, it is important to note that the need to remediate an extensive section of the Rivulet is expected to decrease or be eliminated. In particular, HCPL anticipates that the major rockbars WRS6, WRS7 and WRS8 (which are above Longwalls 25 – 27) would not be subject to "increased rockbar leakage".

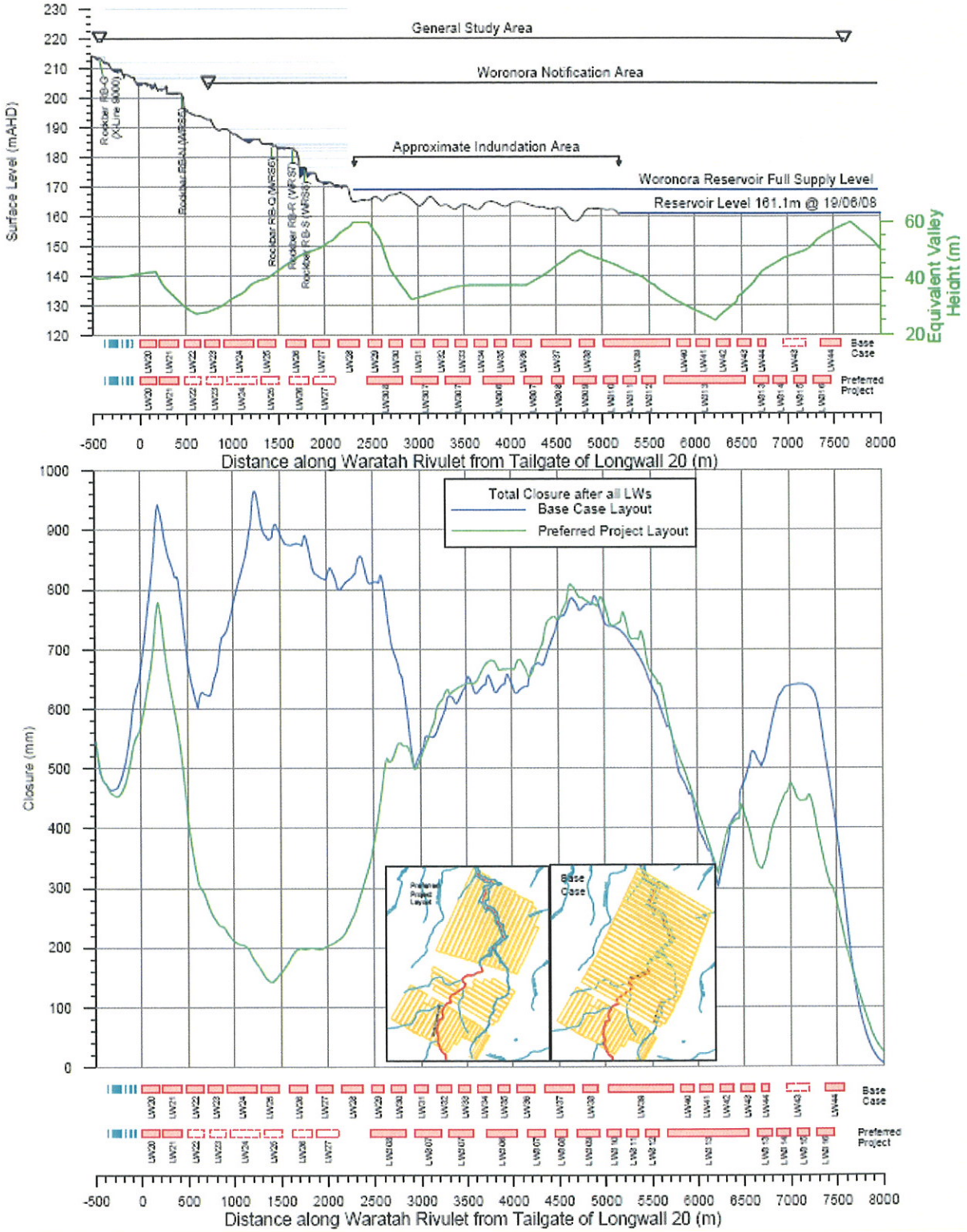

Figure 8: *Predicted Valley Closure Profile for Waratah Rivulet (from MSEC403)*

HCPL has argued in the PPR that *"The full extraction of Longwalls 20 and 21 is required to allow transition from the originally proposed mine plan to the Preferred Project mine plan involving substantial stand-offs that may otherwise not have been required."* Further, that *"Adaptive management involving modification to the mine plan in response to observed effects for Longwalls 20 to 23 is no longer a viable component of the Preferred Project."* However, that *"Adaptive management would be considered an appropriate management tool in relation to the environmental impact of Longwalls 24 to 27."*

In these statements, HCPL has adopted the position that, for reasons to do with mine planning and mine economics, the preferred mine plan, as proposed, must be accepted for Longwalls 20 - 23 regardless of resultant subsidence impacts and environmental consequences, but that mining of Longwalls 24 - 27 can be "outcomes driven", that is, managed to a set of desired standards.

However, neither the PAC nor the Department accept this position. It is simply not acceptable that nearly two thirds of the Waratah Rivulet between the tailgate of Longwall 20 and the full storage level of the Woronora Reservoir would still be subject to closure strains that are predicted as likely to cause major fracturing, increased rockbar leakage or flow diversions.

The PAC has recommended that the full extraction of Longwalls 20 and 21 should be approved. It is true that parts of the Waratah Rivulet above Longwall 20 have already been subject to high closure strains and consequent streambed cracking resulting from the mining of Longwalls 11 - 13. Visual inspection also indicates that there is substantial iron staining present in the streambed at least as far downstream as the proposed maingate for Longwall 22.

It is recognised that full extraction would be likely to lead to further streambed cracking (Figure 8 shows that total closure strain of 400 - 780 mm is predicted upstream from Longwall 22). This is likely to lead to further downstream iron staining, and probably require the remediation of rockbar WRS5, which is located above the tailgate of Longwall 22. The PAC "reluctantly accepts" that full extraction of Longwall 20 and 21 may produce significant negative environmental consequences for the Rivulet above Longwall 22. The basis for this is that an abrupt change from full extraction at Longwalls 20 and 21, which would induce significant consequences, to negligible consequences for the Rivulet at Longwall 22, is simply not feasible if mining is to continue without interruption (ie the necessary setbacks for Longwall 22 to reduce closure strains below 200 mm are simply too large).

However, the PAC considers that the mine plan (either for Longwall 22 or subsequently) should be adjusted such as to guarantee what it terms "negligible consequences" above Longwall 23. The PAC has defined "negligible consequences" for watercourses as "no diversion of flows, no change in the natural drainage behaviour of pools and minimal iron staining". It is accepted by both the PAC and the Department that iron staining is commonly a downstream impact (ie it may not be spatially associated with riverbed cracking that leads to subsurface flow, rather it is generally associated with the downstream re-emergence of that flow).[1] The PAC is therefore talking about *consequential* iron staining, resulting from diversion of flows above the longwall in question.

HCPL included detailed stream mapping for the Waratah Rivulet in its response to the PAC's Query No 30. This mapping clearly shows that the middle third of the section of the Waratah Rivulet between Longwall 20 and full storage level is dominated by "boulder fields". In this section, the stream bed is choked with boulders and other sediment, which in turn is heavily vegetated. There are only a few small pools within this section of the Rivulet. The heavy iron staining on the rocky substrate of the Rivulet also appears to die out within these boulder fields. It is not clear whether this is the result of a physical effect (eg filtering) or a chemical effect (eg reduction of the ferric iron), or some combination of effects. Nonetheless, it is the point at which the impact of the upstream mobilisation of iron-rich groundwaters appears to die out. Therefore, it is a natural point at which to isolate the river from further impacts and consequences of the same type (ie streambed cracking and resultant pool drainage and iron staining). The boulder field begins close to the tailgate for Longwall 23.

There is a very significant pool above Longwall 24, shown as Pool P on MSEC's stream map. It is the pool immediately upstream of WRS6, and is mapped as 165 m in length. This pool is also the first pool downstream of the boulder fields, and is characterised by very clear water and a healthy and abundant

[1] This general rule may not be the case within a "gaining" stream, where fresh cracking in an area of groundwater baseflow to the stream may presumably be associated with iron staining.

population of a variety of aquatic macrophytes, with no iron staining present. There seems to be every reason to aim for negligible environmental consequences for this pool.

The Department has given careful consideration to the PAC's recommendation for negligible consequences across Longwall 23. HCPL has made strong representations that such a requirement would lead to its inability to extract Longwall 23A at all. Given the need for mine continuity and transition, and that the most significant environmental values in the Rivulet are downstream of the boulder fields; the Department considers that a requirement that Pool P (and its controlling rockbar WRS6) are subject only to negligible environmental consequences is a sound and manageable outcome. The Department considers that it is important that there is no drainage of Pool P (even on a temporary basis) and no ingress of iron staining to it from stream bed cracking which takes place upstream. MSEC has confirmed that closure strains for Pool P are predicted to be between 160 mm (at the downstream end of the pool, adjacent to WRS6) and 203 mm (at the upstream end of the pool).

The Department accepts the PAC recommendation that the full extraction of Longwalls 20 - 21 should be approved. On the basis that Pool P is subject to negligible consequences, it recommends that the mine plan proposed by HCPL for Longwalls 22 and 23 be agreed to. The Department has therefore proposed that conditions require that subsidence impacts cause negligible consequences downstream of the maingate of Longwall 23.

Finally, this requirement should apply to the full length of the Waratah Rivulet downstream from the maingate of Longwall 23 to full storage level. MSEC predicts that some 350 m of the Rivulet downstream from the point longitudinally adjacent to midway within Longwall 27 would be subject to closure strains of 200 - 250 mm. Much of this results from the increase in equivalent valley height in this section of the stream's valley (see Figure 8). It is recalled that MSEC has been conservative in the factor for valley shape inherent in its calculation of equivalent valley height. Therefore, it may be that the closure strains predicted do not eventuate, and that there is no increase in rockbar leakage at Rockbars V and W (located downstream of rockbar WRS8).

The Department considers that achievement of the negligible consequence outcome is well within HCPL's capability for this small additional section of the Rivulet. It also increases the chances of achieving negligible consequence at the key rockbar WRS8, the downstream end of which is located above Longwall 27. The Department has proposed conditions in order to achieve negligible environmental consequences for the section of Waratah Rivulet between the maingate of Longwall 23 and the full storage level of Woronora Reservoir.

5.2.2 Eastern Tributary

The Eastern Tributary is the second largest watercourse affected by the proposal. It feeds the southeast trending arm of the Woronora Reservoir but is a much smaller stream than the Waratah Rivulet. While the Rivulet is a 4th order stream within the southern domain, and is estimated to contribute 29% of the inflows to Woronora Reservoir, the Eastern Tributary is a 3rd order stream, and contributes nearly 9% of inflows to the reservoir. The Eastern Tributary is referred to as Tributary C in the subsidence impact assessment and as sub-catchment 10 in the surface water assessment. The EA reports that the Eastern Tributary is situated in a moderately steep, incised valley with numerous in-stream pools. The pools in the lower reaches are larger, and similar to pools in the Waratah Rivulet. The PAC inspected two sections of the Eastern Tributary, and considered that its lower reaches are similar in nature to Waratah Rivulet, but smaller in scale.

The PAC was of the view that the EA contained little information to guide its judgement on the acceptability of potential consequences of mining on the Eastern Tributary. It noted that neither remediation nor adaptive management were proposed by HCPL for the Eastern Tributary, leaving it fully vulnerable to the consequences of subsidence impacts. The PAC considered that these consequences were likely to be similar to those already seen in the undermined sections of the Waratah Rivulet. The PAC therefore recommended that the same standard of protection that it proposed for the Waratah Rivulet (ie negligible environmental consequences) should be given to the lower reaches of the Eastern Tributary (from a major stream junction downstream to full storage level).

Figure 9 shows the predicted closure strain profile for the Eastern Tributary under the preferred mine plan, as set out in the PPR. The preferred mine plan substantially reduces the predicted closure profile for the lower reaches of the stream. The proposed pillar of unmined coal (Area A1) would lie beneath nearly 700 m of the Tributary, from about 100 m upstream of the full storage level (see Figures 5 and 9). About 1200 m of the Tributary would have reduced subsidence impacts, from midway across

Longwall 26 to the Reservoir. However, a section of the tributary, about 350 m in length, is predicted to be subject to valley closure levels in excess of 200 mm, due to a change in valley shape and consequent equivalent valley height. HCPL has made a convincing case that reducing valley closure to 200 mm over this stretch of the Tributary would cause it to be unable to extract Longwall 27. Nonetheless, the Department is mindful of the PAC's recommendation to minimise environmental consequences over the lower reaches of this stream.

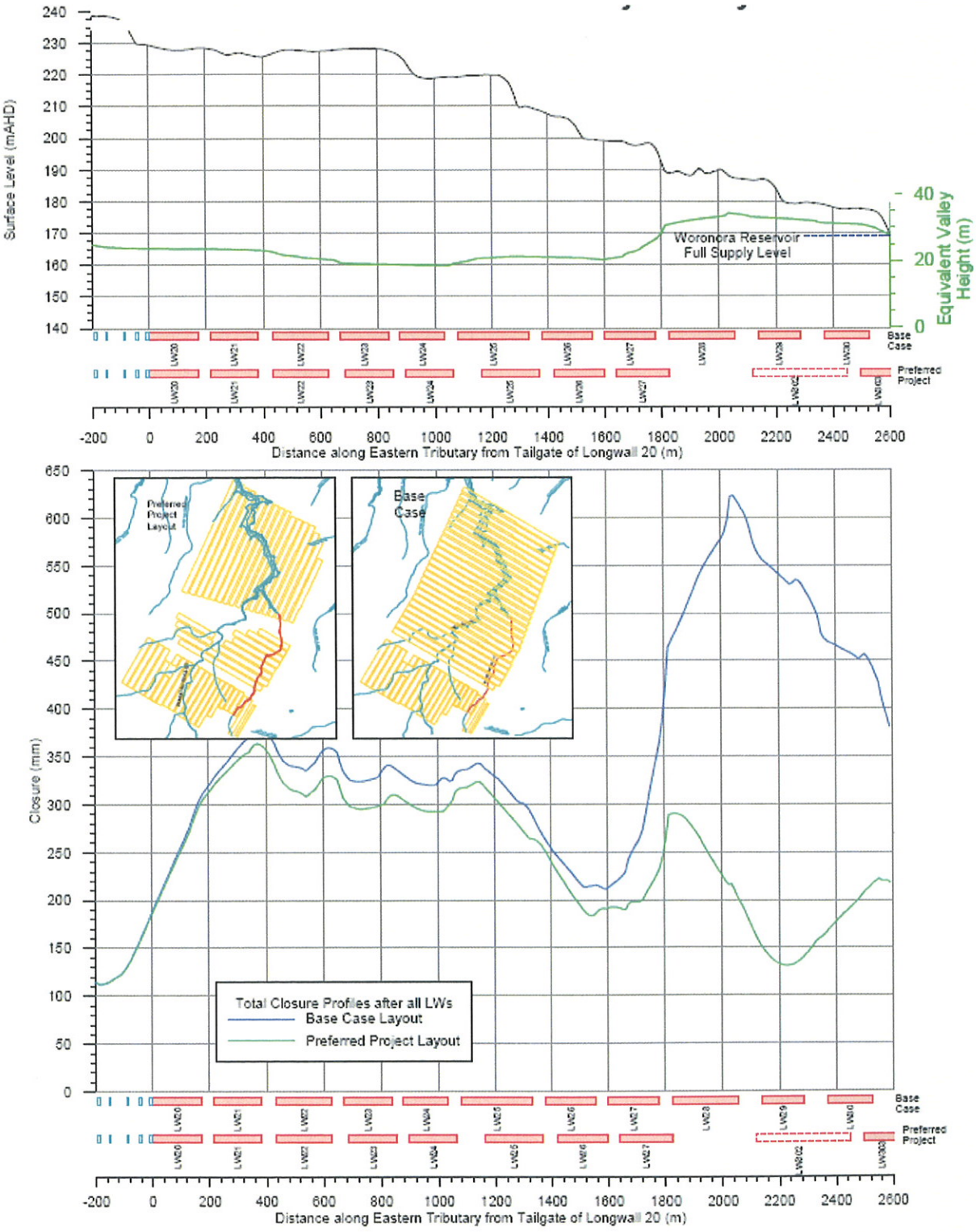

Figure 9: *Predicted Valley Closure Profile for Eastern Tributary (from MSEC403)*

The Department has therefore recommended a condition that the environmental outcome for the lower length of the Eastern Tributary be set at "negligible consequences" for at least 70% of the stream downstream of the maingate of Longwall 26 to full storage level. This distance is a little over one kilometre. Providing that the mine plan set out in the PPR is applied, the Department anticipates that only a very limited section of the Tributary, adjacent to and immediately downstream of the maingate of Longwall 27, would be at risk of any consequences above the "negligible" threshold. It considers that this satisfactorily addresses the outcomes recommended by the PAC.

5.2.3 Other Watercourses

There are numerous other watercourses in the project area that would be subject to subsidence impacts. The Surface Water Assessment (Appendix C to the EA, prepared by Gilbert and Associates), identifies 22 stream catchments affected by the project and addresses them in detail. The PAC considered that there were two key bases on which to differentiate these streams from Waratah Rivulet and the lower reaches of the Eastern Tributary. These are:

- *Severity of impact* – upsidence and valley closure are generally greatest for the deepest and narrowest valleys. Waratah Rivulet and the lower Eastern Tributary have the greatest reported equivalent valley height of the affected waterways. In general, the smaller waterways are expected to experience smaller upsidence and resultant subsidence impacts. Tributary B appears to be an exception to this, with predicted impacts similar to Waratah Rivulet; and
- *Scale and significance of consequences* – the magnitude and significance of environmental consequences are expected to be lower for the remaining waterways. This expectation is based on the following:
    - Waratah Rivulet and Eastern Tributary are very steep streams with frequent waterfalls, cascades and runs. Loss of surface water as a consequence of cracking would not be as great on streams with gentler gradients where less head is available to drive subsurface flow;
    - loss of pools is an important consequence in Waratah Rivulet and Eastern Tributary. This consequence is less dominant in streams where pools are less frequent; and
    - Waratah Rivulet and Eastern Tributary are effectively permanent streams that were predicted (based on the original mine plan) to regularly cease to flow as a consequence of sub-surface flows post-mining. The consequence of losing surface flows to sub-surface flows is less significant where a stream is already ephemeral.

Essentially, most of the smaller streams are predicted to be subject to lesser subsidence impacts. Further, it is expected that the environmental consequences of these impacts would be less, because the streams themselves are smaller. They carry less water (they are primarily 1st and 2nd order streams), contribute a lesser water catchment service, are ephemeral and have lesser ecosystem value. Tributary B (located west of the Waratah Rivulet over Longwalls 20 – 23A) is a small stream which is 3rd order in its lower reaches. The PAC has recognised that it is likely to be subject to high valley closure strains and upsidence. It has recommended that watercourse monitoring should be directed towards improving the predictability of environmental consequences for watercourses, and that Tributary B should be included in the representative sample of watercourses subject to monitoring. The Department supports this recommendation, which should be given effect to via the Water Management Plan proposed in conditions.

5.2.4 Adaptive Management and Remediation

The EA originally proposed remediation as the key management option to address subsidence impacts and environmental consequences. Remediation was proposed only for 4 key rockbars (WRS5, WRS6, WRS7 and WRS8A/B, equivalent to Rockbars N, P, R, S and T in HCPL's response to the PAC's Query No 30). The projected cost of remediation was $12.5 m.

The preferred mine plan has the predicted outcome of avoiding the need to remediate these rockbars, with the exception of WRS5, which is located longitudinally adjacent to the tailgate of Longwall 22 and is predicted to be subject to a closure strain of about 400 mm. Further, the PPR proposes "adaptive management involving modification of the mine plan" for Longwalls 24 – 27. HCPL would also develop and implement a Waratah Rivulet Management Plan and associated Trigger Action Response Plan (TARP). However, it is not entirely clear the scope of actions which are covered by the term "adaptive management". For example, the PPR makes clear that shortening of subsequent longwalls would be considered by HCPL, but the triggers for this are not listed (eg minor or serious exceedances of its proposed standard that there is no increased rockbar leakage). Further, it is not clear whether this standard would also be applied to the current longwall (ie early takeoff of a longwall approaching the Rivulet due to observed impacts or consequences). It is also not clear whether monitoring of

subsidence effects (eg incremental valley closure strain) would be a trigger for adaptive management, or only observed subsidence impacts, or possibly even only observed environmental consequences. This lack of clarity was not alleviated by HCPL's response to the PAC's Query No 33, in which, rather than listing a clear and immediate set of response triggers, it instead suggested that a key trigger for modification of the longwall geometry would be a "measurable reduction in the quality or quantity of yield to Woronora Reservoir." Given natural variabilities, including sub-catchment inflows, it is likely that any such change could not be established for a number of years.

The Department considers that all these factors should be taken into account in the mine's contingency planning and adaptive management strategy. If the project is approved, then the mine plan should be developed in such a way as to be capable of modification, such as to ensure that subsidence impacts and environmental consequences remain within the performance measures set out in the approval.

The PAC proposes that Longwall 23 should also be subject to adaptive management. The Department has recommended clear environmental outcomes for the Waratah Rivulet downstream of the maingate of Longwall 23 (ie negligible consequences). If the subsidence effects and impacts associated with mining Longwalls 20 - 22 are such that HCPL considers that it is at risk of breaching this required outcome if extraction of Longwall 23A is undertaken as currently proposed, then the Department would expect HCPL to adaptively manage the Longwall 23A layout in order to achieve that outcome.

The PPR proposes that remediation ("restoration") would be used "as a contingency measure for ... Waratah Rivulet where avoidance and/or minimisation cannot be achieved." While the PAC expressed some doubt as to whether the PPR made it clear that this commitment continued to extend to Longwalls 20 - 23, HCPL has since confirmed that it does. However, it is not clear whether it extends to parts of this section of the Rivulet other than WRS5, where the prior commitment had been made. Further, it is clear that the PPR contains no commitment to remediation of any section of the Eastern Tributary.

Both the PAC and the Department are of the view that remediation should be undertaken throughout the affected reach of the Waratah Rivulet, as well as that section of the Eastern Tributary which is similar in character to the Rivulet. The appropriate standard is that "negligible consequence" (as previously defined) is achieved, which requires the restoration of flows and pool holding capacity. The PAC and the Department have therefore recommended that HCPL must restore surface flows and pool holding capacity to pre-mining levels as soon as reasonably practicable. It should be noted that this requirement applies to all pools and rockbars, not just the key rockbars listed in the EA. Further, the defined stretch of the Waratah Rivulet proposed to be subject to this condition includes that stretch of the Rivulet previously impacted by mining Longwalls 1 - 14.

The Department agrees with the PAC that the most likely means of achieving satisfactory remediation of stream beds is pressure injection of polyurethane resin (PUR) grouting.

5.2.5 Woronora Reservoir

Woronora Reservoir is part of SCA's water supply system for southern Sydney and the Illawarra region. SCA advised the PAC that Woronora Reservoir is not inter-connected to other parts of this supply system and therefore is the sole source of supply to the area of Sydney south of the Georges River and also to the Helensburgh area. The capacity of the dam is 72,000 ML. Its catchment area is some 75 km^2, of which approximately 27 km^2 (36%) is within the area likely to be affected by the project and previous longwall mining.

Because Woronora Reservoir is an isolated and key component of the Metropolitan water supply system, the PAC gave it close consideration and sought detailed additional submissions from both SCA and HCPL in order to clarify whether or not the project may have any significant impact on catchment yield to the reservoir. On the basis of the evidence put before it, the PAC could not be conclusive as to whether or not there would be any loss of catchment yield. It considered that neither assessment based on standard flow measurement techniques on the Waratah Rivulet nor the hydrologic modelling used to date is capable of giving a definitive answer on the likelihood or otherwise of loss of catchment yield. However, it concluded that:

> *"... the local and regional groundwater conditions coupled with the mine parameters, would suggest that the likelihood of water being lost from the surface water system as a consequence of mining, and then by-passing Woronora Reservoir, is very low. This conclusion accords with the findings of the Southern Coalfield Inquiry, viz:*

> No evidence was presented to the Panel to support the view that subsidence impacts on rivers and significant streams, valley infill or headwater swamps, or shallow or deep aquifers have resulted in any measurable reduction in runoff to the water supply system operated by the Sydney Catchment Authority or to otherwise represent a threat to the water supply of Sydney or the Illawarra region.

On the basis of available evidence, the Department agrees with this position. It also notes that revised groundwater modelling presented to the PAC suggests that increased infiltration from the surface, due to additional fracture paths at the conclusion of mining, would be 0.15 Ml/day. This figure is equivalent to 0.2% of the average streamflow input to the Reservoir, based on the 70 Ml/day reported in the EA. It suggests that there would be some additional leakage, albeit minor, through the "constrained zone". However, the Department notes that this figure is an outcome of modelling, and therefore dependent on model inputs, as well as the fact that the model cannot produce zero outputs. Thus, there is as yet no evidence that there would be an actual reduction in surface streamflows to the Reservoir.

Nonetheless, the PAC considered that the issue is not beyond doubt and recommended that a specific surface and groundwater monitoring and investigation program be developed between HCPL and SCA to shed additional light on the existence or otherwise of catchment yield impacts. The Department supports this recommendation and has proposed a catchment modelling and monitoring program to this effect.

The other major issue potentially affecting the Reservoir is the possibility of leakage of stored waters to the mine workings below. The potential for hydraulic connections between stored waters and mine workings in the Southern Coalfield was the subject of a major inquiry commissioned by the State Government in the mid 1970s and conducted by Justice Reynolds. The inquiry concluded that, at depths of cover greater than 120 m, excavation width should not exceed one third of the cover depth, provided that the panels were separated by pillars that had a width of one fifth of the cover depth or fifteen times the height of extraction. Effectively, this was to prevent pillar failure and maintain a constrained zone above each mining panel.

As noted above, within the DSC's notification area for Woronora Reservoir, the proposed longwall layout has been adjusted to generally conform to the DSC's 1998 guideline *Mining in Notification Areas of Prescribed Dams*. Longwalls 301 – 317 are proposed to be narrowed to 133 m in width beneath a zone surrounding the stored waters of the Woronora Reservoir. This zone was determined by HCPL by a 35^{O} angle of draw plus 0.5 times the depth of cover from the edge of the full supply level for the Reservoir. Interpanel pillar width has been increased from 40 m to 65 m within this zone. The proposed longwall width is consistent with the recommendations of the Reynolds Inquiry but the interpanel pillar width is a little less than recommended. The PAC was advised by HCPL that the proposed longwall panel layout is consistent with those generally adopted by the DSC and that HCPL considers that it should be seen as a "starting point" for mine design below stored waters.

The PAC has indicated that, since the Reynolds Inquiry, a range of field, laboratory and computer simulation studies indicates that these recommendations are overly-conservative in many circumstances. In addition, a number of very low permeability claystone strata in the Southern Coalfield are considered to act as hydraulic barriers to surface water flowing into mine workings. The Department understands that the general behaviour of goafing and fracturing above a longwall void is expressed in a tall, inwards-facing arch of broken or fractured rock above the void. This suggests that the crucial zone that requires protection is well within the footprint of the longwall void. However, the Reynolds recommendations are based on an extensive footprint outside of this void. Under the Reynolds formula, this footprint also increases with depth of over, whereas it is straightforward that the risk of hydraulic connection must lessen as depth of cover increases. Based on this changed understanding, mine owners have successfully petitioned the DSC and other government regulators on a number of occasions to approve less-conservative mine layouts than those recommended by Justice Reynolds.

The PAC concluded that the mine parameters suggest that the proposed mine layout is a "very conservative" approach to extraction under and adjacent to stored waters, and also that sterilising large reserves of coal in this way may provide economic reasons for HCPL to seek to undermine other significant natural features, such as the Waratah Rivulet. The PAC then suggested that, given the much-improved geotechnical knowledge base, there may be potential to move further away from the Reynolds guidelines and modify the proposed mine layout to offset coal sterilised for environmental reasons in other parts of the lease.

The necessary DSC approval for a proposed mine layout currently stands outside of the Part 3A approval process. The DSC recommends conditions to the Minister for Mineral Resources which are then included within the mining lease. These conditions must relate to the safety of the prescribed dam. The Department agrees with the PAC that the assessment of dam safety should focus solely on the standards necessary to satisfactorily ensure dam safety, so as to otherwise ensure an appropriate degree of recovery of the valuable resource which lies beneath the stored waters of the Reservoir and its surrounding notification area. As the PAC has noted, this may offset some of the mine design constraints necessary to protect other significant surface features in the project area.

5.3 Subsidence Impacts on Upland Swamps

The vegetation mapping undertaken for the EA by Bangalay Botanical Surveys demonstrates that there is a large number of upland swamps within and adjacent to the project area. These 123 swamps are numbered (generally consecutively) as S01 – S134 in MSEC's SIA (see Figure 10). However, only one such swamp (S21, located above the previously-mined Longwalls 7 and 8, and potentially further impacted by the proposed mining of Longwall 20) is classified in the EA as a "valley infill" swamp. All others are classified in the EA as headwater swamps.

In considering the swamps in the project area, the PAC first examined whether any were of such value that they should be accorded "special significance". It concluded that the swamps are of high conservation significance as a group of related (but variable) habitats, but that there was "no convincing evidence ... that identifies any individual swamp or group of swamps ... as being sufficiently unique or different so as to require identification as being of 'special significance' and thus requiring special consideration in a risk assessment framework."

The PAC was also of the view that the available evidence strongly supported the position that, for swamps to experience adverse environmental consequences, changes to swamp hydrology would have to occur that were large enough and of sufficient duration to create conditions that were favourable for drying, erosion, fire, or changes in species composition. It also noted that, in the case of species compositional change, there may be substantial biological lag (up to decades) before such impacts were apparent.

For conventional subsidence, the SIA provides estimates of tensile and compressive strains for all potentially-affected swamps. Both compressive and tensile strains are generally predicted to be low. However, the SIA predicts that, under the original mine plan, a substantial percentage of swamps would have been subject to tensile strains in excess of 0.5 mm/m. Twelve swamps were predicted to be subject to tensile strains in excess of 0.8 mm/m, with six of these in excess of 1.0 mm/m.

MSEC reports that tensile strains in excess of 0.5 mm/m may lead to cracking of the bedrock (including rockbars and similar rock outcrops). However, the PAC accepted the view put forward by MSEC that, because of the depth of cover, relatively narrow width of the longwalls and the location of most swamps high in the catchment on relatively flat terrain; tensile strains are unlikely to produce hydrological impacts on a scale that would lead to negative environmental consequences. Cracking is expected to be minimal and any cracking that does occur is predicted to be shallow. Fracture networks are also predicted to be localised and unlikely to connect to groundwater aquifers. The PAC considered that the sediment profile is probably sufficient to either seal or impede leakage to any cracks that do occur. Tilts are also likely to be of little hydrological significance. The PAC considered that these factors make it unlikely (but not impossible) that an individual swamp could suffer negative environmental consequences from conventional subsidence impacts, but extremely unlikely that a significant number of swamps could suffer such consequences.

However, the potential impact from non-conventional subsidence (ie valley closure and upsidence) is far less clear. The EA essentially relies on its assessment that nearly all swamps in the project area are headwater swamps, and the proposition that headwater swamps are generally subject to minimal valley-related upsidence and closure.

The PAC was concerned that the EA's characterisation of all but one swamp as headwater swamps may have been simplistic. It therefore spent considerable effort in seeking a more nuanced classification from HCPL and, in particular, further information on which swamps may be subject to some degree of valley closure.

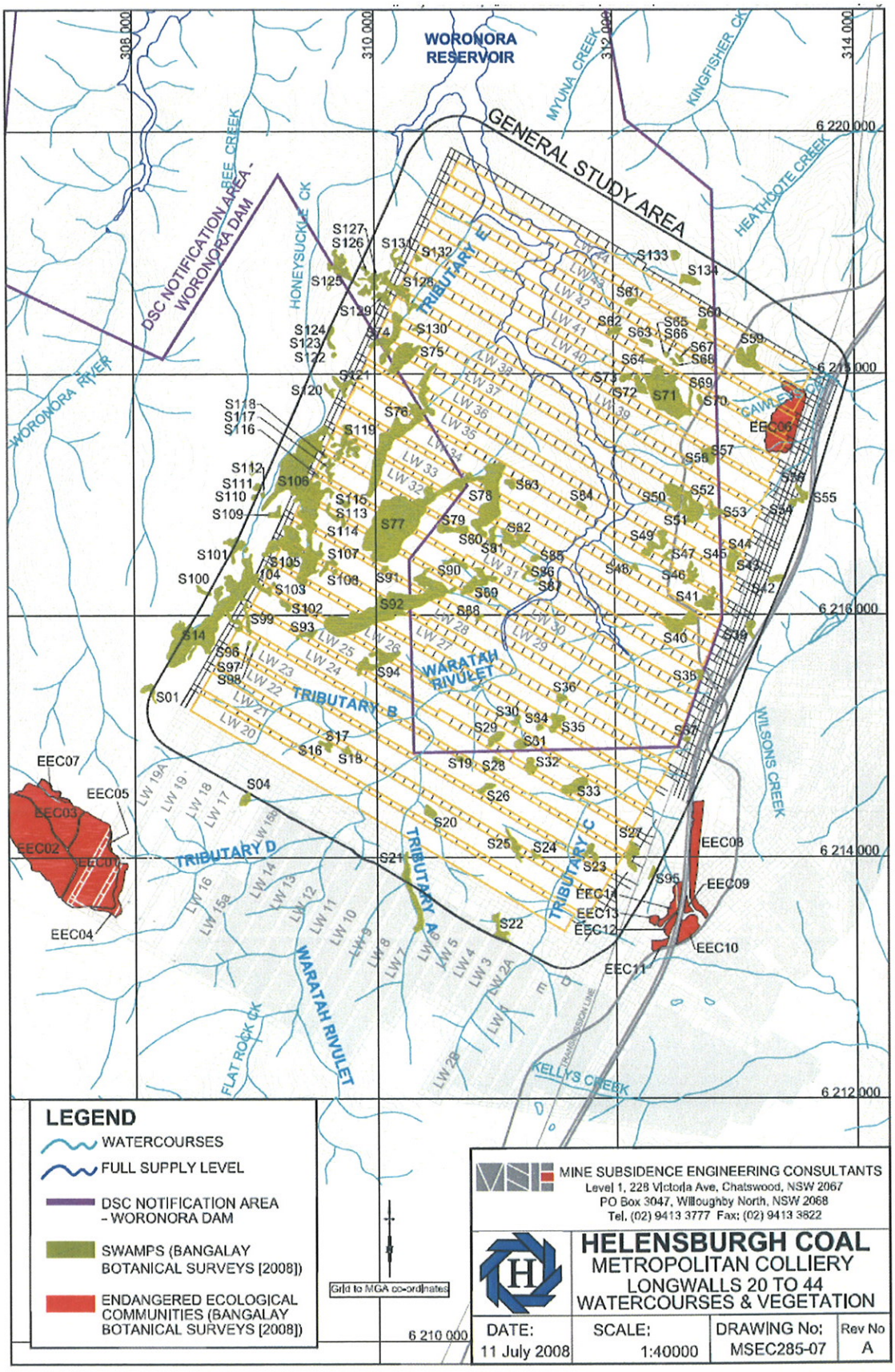

Figure 10: *Upland Swamps within the Proposed Mining Area*

This endeavour was not supported by the nature of the vegetation mapping undertaken for HCPL. The principal means by which the swamps had been classified in the EA was on the basis of a number of geomorphological indicators together with vegetation associations. There are six key vegetation associations associated with upland swamps on the Woronora Plateau (Keith, 1994; NPWS, 2003). All six of these are found in headwater swamps, but four are typically absent from valley infill swamps. Thus the presence of the remaining two communities is one key indicator that valley infill swamps may be present. However, the vegetation surveys combined one of these two key communities (Cyperoid Heath) into a broader community (Sedgeland-Heath Complex). It then noted that the second of them (Tea Tree Thicket) was found in close association with a third community (Banksia Thicket), with which it shared many species. Consequently, Bangalay noted that "it is not always possible at the scale of current vegetation mapping to accurately delineate smaller occurrences of [Banksia Thicket or Tea Tree Thicket] in many upland swamp drainage lines". Vegetation mapping of this nature does not provide a sufficient degree of confidence in the presence or not of key indicators of valley infill swamps.

Further, the classification in the EA did not adequately address the matter of transitional or composite swamps. It is readily conceivable that a large headwater swamp may drape both sides of a headwater valley. Its contained drainage line may be characterised by relatively permanent saturation and accumulating sediment and peat. If the valley is sufficiently deep, then that swamp would be subject to valley closure strains, just as with any other watercourse.

The PAC expressed concern that there are at least three large swamps within the project area that may carry some of these characteristics. Swamps S76, S77 and S92 are large swamps on the plateau west of the Waratah Rivulet. Each has a defined drainage line; an elongate, valley-contained shape; a moderate longitudinal slope and a relatively large catchment. The Surface Water Assessment associates them with sub-catchments 12, 13 and 14 and reports that each of them is also characterised by terminating at rockbar-type outcrops, upstream of plunge points where the watercourses descend from the plateau via steep chutes and waterfalls to the Waratah Rivulet or Woronora Reservoir below.

Faced with this situation, which it called "unsatisfactory", the PAC sought substantial additional information from HCPL. This led to the identification of 22 swamps which MSEC considered could potentially be affected by upsidence and valley closure under the PPR, due to their steeper valley profiles. These 22 swamps represent 20% of the swamps in the project area. Elsewhere, MSEC suggests that cracking of rockbars and similar surface features may take place where compressive strains are in excess of 2 mm/m. It can be seen from Table 4 that predicted closure strain for all but two of these swamps is >2.0 mm/m. For 15 of them, closure strain is in excess of 3.0 mm/m, and for 7 of them it is in excess of 5 mm/m. The PAC consequently concluded that, on current knowledge, some of the predicted closure strains would be sufficient to cause significant impacts at these swamps.

It is noted that the swamp with the highest predicted closure is S21, the valley infill swamp on Tributary A. However, this closure has already taken place, due to the previous mining of Longwalls 7 and 8. The EA reports that there was no apparent damage to this swamp at that time, and no further closure is predicted from the new longwalls. The headwater swamps which might be affected by closure strains include swamps S76, S77 and S92 and their downstream rock features, which were separately assessed by MSEC. The PAC considered that these higher strains must increase the risk of impacts in at least the lower reaches of the drainage lines in which the swamps are located. It can be seen that this is especially the case at S77.

HCPL also provided additional supporting material to the PAC from MSEC (attached to the final version of the PPR) which indicated that currently there is no completely reliable way to predict total (compressive plus tensile) strain along the relevant drainage lines, and argued credibly that the conventional subsidence impacts are likely to be small in these swamps. It also noted that the predicted closure strains in the steeper parts of the swamps are higher than would reasonably be expected and questioned the applicability of MSEC's existing methodology for predicting closure strains in these shallower valleys, as used in both the EA and the PPR. Some lower incremental closure predictions, using an experimental prediction method that will be the subject of further research and development by MSEC, were then put forward. However, the PAC concluded that these additional predictions are of limited value because a revised prediction method has yet to be developed for total strains.

Table 4: *Predicted Closure Strains for Selected Swamps, Metropolitan Coal Project*

Swamp ID Listed in PPR	Closure Strain Predicted[1] (mm/m)
S14	3.4
S20	8.6
S21	10.6[2]
S22	2.2
S30	2.2
S31	2.1
S38	2.6
S52	5.7
S53	5.8
S57	3.8
S58	3.7
S74	2.3
S76	4.2
S76 Rock outcrop	4.1
S77	7.7
S77 Rock outcrop	7.3
S81	2.1
S82	5.8
S85	3.5
S90	1.6
S92	3.7
S92 Rock outcrop	3.7
S93	0.2
S106	2.2
S128	5.4
S134	2.1

Notes: 1) Closure strains reported in the PPR.
2) Existing impact from Longwalls 7 and 8, no further closure impact predicted.

The PAC considered that HCPL's assessment of potential impacts on upland swamps left much to be desired. The Department supports this position. There was insufficient information in the EA to identify areas within swamps that may have some valley infill characteristic, and there was no attempt in the EA to provide valley closure and upsidence predictions for individual swamps. This situation was only addressed to a limited degree by the additional information provided in the PPR. While additional information on closure strains was provided, this was inadequately discussed. There was no discussion of the possible impacts and consequences for swamps from the predicted closure strains, even though the strains appear high enough to cause locally significant impacts. The potential for the predicted tensile strains (which are themselves capable of producing bedrock cracking) to interact with closure strains was also not addressed. It appears that methodology for predicting closure strains in shallow valleys that contain swamps, and associated subsidence impacts, is still unreliable.

The PAC recommended that further studies in relation to swamps S76, S77 and S92 should be carried out prior to a final decision regarding undermining them. The Department notes that these swamps are all in the proposed northern domain. S92 is located above Longwalls 311 - 313, S77 is located above Longwalls 312 - 315 and S76 is located above Longwalls 313 - 316. It would be many years until these longwalls are mined under the proposed mine plan.

In respect of other upland swamps, the PAC recommended that mining be allowed to proceed subject to monitoring of a sample of swamps from early in the mining process to determine whether predicted subsidence impacts from both conventional and non-conventional sources are producing significant environmental consequences. Part of this sample should include swamps subject to higher levels of predicted impacts from non-conventional subsidence. The Department notes that few of the swamps predicted by MSEC to be subject to higher levels of valley closure are in the early years of the mine plan (only swamps S14, S20, S21, S22, S30 and S31). Of these, only one (S20) is predicted to be subject to high closure strains which have not already taken place.

The Department has recommended conditions to the effect that, prior to carrying out any underground mining operations that could cause subsidence impacts on Swamps 76, 77 and 92; HCPL must submit a revised and expanded impact assessment addressing both subsidence impacts and environmental consequences. This assessment must include proposed performance measures and means to achieve them.

5.4 Subsidence Impacts on Cliffs and Overhangs

The SIA lists 16 cliffs and significant overhangs within the project area, with a total length of 590 m. MSEC has defined a cliff as a continuous rock face having a minimum height of 10 m and a minimum slope of 2 to 1; however its list also includes a number of shorter features because MSEC considers that they may also be sensitive to subsidence effects. Nearly all the listed cliffs and major overhangs are located along the alignment of the Waratah Rivulet.

The SIA also includes a review of field experience in the Southern Coalfield regarding undermining of cliffs and overhangs, which confirms the current difficulties in predicting subsidence impacts on these features. It also draws significant differences between Metropolitan Colliery and the Dendrobium Coal Mine, where there have been significant cliff falls associated with recent longwalls. In essence, the cliff lines at Dendrobium are substantially higher (up to 30 m), the longwall voids are substantially wider (245 m) and the depth of cover is substantially less. These factors have led to falls up to 14% of the overall length of cliffs undermined. The SIA reports that, on the other hand, no cliff falls have been observed at Metropolitan by HCPL, although Longwalls 1 - 8 were extracted beneath cliff lines and Longwalls 9 - 15 were extracted under the Waratah Rivulet and its adjacent cliffs. Nonetheless, based on field experience in the Southern Coalfield, the SIA concludes that "the lengths of potential cliff instabilities [are] expected to be less than 3% of the lengths of these cliffs and overhangs."

The PAC considered this estimate of subsidence impacts to be reasonable, and noted that this probabilistic approach goes some way to quantifying potential impacts on cliff lines. However, it was concerned that this approach provides limited insight into which specific cliffs and overhangs may be more vulnerable to impacts, the likely scale of individual impacts, the spatial density of likely impacts and the consequences of the impacts. The SIA does contain a table listing the 16 cliffs and their length, height and the size of any overhang present, but there is no resulting discussion of the sensitivity of these various cliff forms to various subsidence effects or impacts. The PAC considered that its aerial inspection of the project area suggested that there was a range of significance and vulnerability associated with the cliff lines and overhangs, with some features being more susceptible to impact and more sensitive to consequences.

The PAC accepted the current limitations of subsidence engineering in predicting impacts and consequences for cliff lines and overhangs and the reasonableness of the impact predictions in the EA. However, on the basis of the draft of the PPR which it considered, the PAC also recommended that an updated subsidence assessment should include more detailed, site-specific characterisation of the cliff lines and their vulnerability to subsidence impacts.

Following the finalisation of that recommendation, HCPL provided additional supporting material for the final draft of the PPR. This included a new table comparing predicted conventional subsidence effects under the original mine plan and the preferred mine plan. Because most cliffs are located within the valley of the Waratah Rivulet, it is apparent that subsidence impacts on the nearby cliffs are substantially reduced under the revised mine plan. In fact, of the 16 cliffs, nine have vertical subsidence reduced to less than 50 mm. Only one (COH2) now has predicted vertical subsidence in excess of 500 mm. Only COH2 has predicted tilt (a key subsidence parameter for cliff stability) in excess of 2 mm/m. Only COH2 and one other cliff (COH13) have predicted tensile strains in excess of 0.5 mm/m, and only COH2 is in excess of 0.6 mm/m.

It is apparent that only COH2 is now predicted to be at significant risk of cliff fall. COH2 is a small cliff well up the Waratah Rivulet valley, located directly above the tailgate of Longwall 20. It is the shortest of the 16 cliff sites (20 m in length) and is about 7 m in height. However, it does have a substantial overhang (4 – 5 m), and therefore must be judged as being at significant risk of impact. There appears to be no Aboriginal heritage site located in this overhang, although FRC 20 (a small shelter with one indeterminate charcoal drawing in poor condition) is nearby. Overall, the estimate within the EA of "less than 3%" of the overall cliff length being at risk of subsidence impact now appears conservative. The Department judges this risk to be acceptable.

It would appear that the additional conventional subsidence predictions provided as part of the final version of the PPR satisfy the PAC's request for additional subsidence assessment. The Department is satisfied with the additional material provided and considers that there would be little purpose served by requiring additional assessment of the potential for subsidence impacts and consequences for cliffs and overhangs. Conditions are therefore recommended which focus on monitoring of impacts and consequences.

5.5 Subsidence Impacts on Aboriginal Heritage Features

The EA contains an Aboriginal Cultural Heritage Assessment (ACHA) prepared by Kayandel Archaeological Services. The AHCA identified 188 Aboriginal heritage sites within the proposed mining area and its surroundings, of which 142 sites are sandstone overhangs and the remainder are open sites. Art and/or artefacts are associated with almost 83% of the sandstone overhangs, and grinding grooves are associated with some 98% of the open sites. The ACHA has ranked the significance of the sites on the basis of four criteria – scientific, aesthetic, social and historical. Nine sites were deemed to be of high archaeological significance, 23 of moderate significance and 156 of low significance. Five sites are listed on the Register of the National Estate, only one of which had high archaeological significance.

The SIA for the sites undertaken by MSEC contains an overview of conventional subsidence effects that could impact the sites. This assessment is generic in nature, but subsidence predictions specific to each Aboriginal heritage site are then provided in the AHCA. The PAC noted that neither assessment provided an analysis of non-conventional subsidence effects, although some open sites are located in or close to drainage lines and location plans show a number of sites as associated with watercourses. The Panel considered that this was not an adequate degree of assessment.

The AHCA reports that monitoring of approximately 41 Aboriginal heritage sites subject to longwall mining at Metropolitan Colliery has been undertaken between 1995 and 2008. Of these, 21 had predicted maximum tensile or compressive strains greater than 0.5 mm/m and/or 2 mm/m respectively. These levels of strain are considered to be the usual threshold values for cracking of bedrock. Impacts were identified at six of these sites. The AHCA also reported that the collapse of two wet overhangs has been observed by an archaeologist, although these sites were not subject to formal monitoring at the time. One of these overhangs contained Aboriginal artefacts and archaeological deposits. Thus a total of seven sites are known to have been impacted.

In 2001, Shepherd and Sefton published research on the impact of longwall mining on 13 rock shelters at Metropolitan Colliery. Rock art at two of these shelters was damaged by spalling of the back wall following longwall mining. They identified a number of factors associated with these impacts; being shelter volume, degree of wetness and weathering, 'half-on' orientation between the shelter long axis and the long axis of the longwall and compressional strains in the back wall of the shelter. Shepherd and Sefton indicated that these strains tended to occur over and adjacent to chain pillars, and that the spalling followed the passage of the first longwall adjacent to that pillar (ie damage occurred over the maingate).

Of the 142 sandstone overhangs in the study area, 51 were predicted in the EA to be subject to tensile strain exceeding 0.5 mm/m. However, under the PPR, only 25 sites are predicted to be subject to tensile strain equal to or greater than 0.5 mm/m.[2] All but two of these are shelters, with either art, artefacts or archaeological deposits present. None of the nine sites judged as being of "high archaeological significance" are amongst these 25. Nonetheless, as reported by the PAC, the SIA concludes that:

- it is possible that maximum predicted conventional and valley related movements could result in some fracturing of the exposed sandstone at open archaeological sites;
- some open sites are located in or close to drainage lines, and therefore have a higher risk of fracturing;
- it is possible that the maximum predicted tensile strain could result in fracturing of sandstone. Where fracturing is coincident with an overhang, it is possible that there could be an isolated rock fall as the result of mining, or in the extreme case, collapse. Where the overhangs are located in valleys, they would also be subjected to upsidence and valley closure. However, compressive strains from valley closure along watercourses act perpendicular to the alignment of the

[2] It should be noted that this material was not available to the PAC, as it was only included in the final version of the PPR.

watercourse and are, therefore, perpendicular to many of the cliffs and overhangs, reducing the likelihood of instability due to upsidence and closure.

The PPR contains fully-revised predictions for conventional subsidence (vertical subsidence, tensile and compressional strains and tilt) for all potentially affected Aboriginal heritage sites.[3] It also reports that, of the 188 known sites, 26 are located within the proposed barrier pillar (ie Areas A1 and A2). This includes a number of the nine highly-significant sites. It can be anticipated that potential impacts for these sites are either substantially reduced, or else eliminated, under the PPR. It should also be noted that a number of the other highly-significant sites are located above already-approved or already-extracted mining areas, to the south of the proposed mining area.

The PPR also reports (for the first time) that up to "10% of sites experience [impacts] such as cracking, accelerated weathering or blockfall." It is unclear where this figure derives from, but it may relate to Shepherd and Sefton's paper which reported observable damage at five of 51 monitored rock shelters throughout the Southern Coalfield. It clearly does not accurately reflect the seven sites known to have been affected at Metropolitan Colliery.

The Panel concluded that:

- some sites of Aboriginal heritage and cultural significance are likely to be impacted by the project;
- however, the preferred mine plan is likely to result in a considerable reduction in overall risk to highly-significant Aboriginal heritage sites;
- project approval should be conditional on the production of a new subsidence assessment for the preferred mine plan that incorporates a more-detailed assessment of impacts and consequences for Aboriginal heritage sites, including better quantified physical attributes for archaeological sites (with particular regard to shape, dimension, structure and composition); and
- approval conditions should require monitoring of all highly-significant Aboriginal sites for the purpose of comparing predicted and measured effects and impacts and implementing mitigation and remediation measures where practical.

The Department has included conditions which require the preparation of a Heritage Management Plan to manage the potential environmental consequences of longwall extraction, including a detailed description of measures to remediate any predicted impacts and a contingency plan providing for adaptive management.

5.6 Subsidence Impacts on Groundwater Resources

Groundwater systems within the project area can be broadly defined as:

- *Shallow and surficial systems* - including soils and the underlying weathered bedrock on hill slopes, plateaus, swamps and minor alluvial deposits; and
- *Deeper consolidated rocks* - comprising rock strata with a porous matrix (commonly sandstone units), sometimes enhanced by fracturing.

These two groundwater systems are recharged by rainfall and runoff over geologic time. The process involves infiltration of rainwater, first to the surficial regolith and swamp lands, and then downwards percolation from these mostly-perched systems to a deeper, fully saturated zone. The Hawkesbury Sandstone is a regionally extensive rock unit hosting deep aquifers. The Scarborough Sandstone and Bulgo Sandstone (both lower in the stratigraphy) also contain aquifers. Siltstones and claystones act as aquitards or aquicludes between the various sandstone units, as a result of their low permeability. The Bald Hill Claystone, which separates the Hawkesbury Sandstone from the Bulgo Sandstone, is an example of an aquitard. The geometry of this deeper water table is governed largely by the incised regional drainage system that provides a seepage pathway for relief of groundwater pressures along the various creek beds.

The PAC gave careful consideration to HCPL's groundwater studies, and found them to be wanting in a number of respects. For example, hydrogeological studies of the deep groundwater system included just two deep piezometers to monitor groundwater. A further two piezometers were installed subsequent to the EA. However, testing to provide estimates of strata permeability has since been undertaken at only one of these four piezometers, located outside of the area of proposed mining, and only to a depth of about 287 m (within the Bulgo Sandstone, at about 70% of the depth of cover). No permeability tests have been conducted in strata at deeper levels to establish the hydrological characteristics of the Bulli Coal Seam within the area of proposed mining, nor the overlying Coal Cliff

[3] See Note 2.

Sandstone, Wombarra Claystone, Scarborough Sandstone or Stanwell Park Claystone. The PAC also considered that there had been extremely limited monitoring of the hydrology of the swamps. Only three shallow piezometers have been installed in swamps, only one of which is located within the area of proposed mining. No deeper co-located piezometers have been installed to verify perching and to monitor the underlying hardrock water table. Overall, the PAC was of the view that "the density and duration of [groundwater] observations ... are limited, especially with respect to swamp hydrology, redirected stream flows and regional strata depressurisation."

Further, the PAC considered that inappropriate software had been used to model predicted groundwater responses to the proposed mining. The PAC reported that this software program had "a number of well known limitations that can affect the accuracy of simulating underground mining operations. These limitations largely relate to the steep hydraulic gradients that typically evolve adjacent to, and above underground mining operations, and the evolution of depressurised and dewatered zones within the fractured subsidence regime." At the PAC's request, HCPL provided fully-revised groundwater modelling using a more modern program (Modflow-Surfact). The PAC accepted the general outcomes of this model and in particular its predictions regarding depressurisation of strata overlying the proposed mining area.

However, predicted seepage into the mine generated by the new model ranges from 0.4 Ml/day at the commencement of Longwall 20 to 3.5 Ml/day at the completion of mining. The bulk of this seepage is predicted to come from depressurisation of the collapsed and fractured zones (ie from the Scarborough and Bulgo Sandstones, rather than the overlying Hawkesbury Sandstone or the surface). Once depressurised, contributions from these zones are then predicted to decline.

The predicted groundwater inflows are significantly greater than current groundwater inflows to the mine (<0.1 Ml/day), and the range of future inflows predicted in the EA (0.1 to 0.5 Ml/day). They are also much greater than the groundwater component of 0.15 Ml/day used in the mine water balance shown in the EA's Surface Water Assessment. Nevertheless, both the PAC and the Department accept that Metropolitan Colliery is currently a very "dry mine", with minimal groundwater seepage compared with most other underground coal mines in the State. There is a significant possibility that the model has therefore over-predicted groundwater inflows to the mine.

The PAC also considered that there is minimal risk of measurable leakage from surface drainage systems or the stored waters of Woronora Reservoir down to the mining operations, due to the presence of the significant aquitards. There remains a slim possibility that geological structures (eg faults, dykes, etc) could provide a leakage conduit from surface to depths below the identified aquitards. The PAC stated that the possibility of such features occurring should be subject to further examination by HCPL during mine development.

Neither the PAC nor the Department consider that the deficiencies in HCPL's groundwater assessment are such as to stand in the way of an approval for the project. What is really required is improved information. This information can be applied during the various stages of mine development. This is particularly important in respect of mining within the northern domain, adjacent to and beneath the stored waters of Woronora Reservoir.

The PAC made detailed recommendations concerning improved groundwater monitoring and better analysis and prediction of impacts. These are set out in full in section 8.5 of the PAC's report, but are summarised as follows:

- *shallow piezometer installations* for the monitoring of groundwater levels/pressures within significant upland swamps, drainages and any connected alluvium;
- *deep piezometer installations* for the monitoring of pore pressures within the natural rock strata with a high level of confidence;
- *groundwater quality classification* through regular sampling and analyses at installed piezometers;
- *strata hydraulic property measurements* to facilitate calculation of sub-surface flows. While such properties (porosity and permeability) are unlikely to change naturally over time and hence regular monitoring is not required, a properties database is required for impacts assessment and in this context, such measurement constitutes baseline data. Additional core sampling and testing is recommended to confirm the presence and continuity of aquitards beneath Woronora Reservoir;
- *mine water balance* for existing and extended operations. Regular, ongoing monitoring of the components of the mine water balance (eg groundwater inflows) is an especially important part of baseline data measurements. It provides a first indication of potentially anomalous mine water

seepage that might be initiated by faulting or fracturing associated with igneous intrusions, and increased connectivity to surface drainage systems;
- *long hole gas drainage*. These holes should be used to identify the presence of any significant structures in the coal seam (faults, dykes etc) that may act as flow conduits – possibly from surface; and
- *predictive aquifer numerical modelling* as a management tool for the ongoing prediction of impacts attributed to longwall extraction.

The Department supports these recommendations and has proposed conditions requiring HCPL to prepare a catchment monitoring program, including detailed baseline data for groundwater resources and ongoing development and use of appropriate groundwater models.

5.7 Subsidence Impacts on Flora and Fauna

The EA contains a substantial amount of information setting out the results of baseline terrestrial flora and fauna surveys (Appendices E and F), a Terrestrial Flora and Fauna Impact Assessment (Appendix G) and an Aquatic Ecology Assessment (Appendix D). In considering both potential terrestrial and aquatic flora and fauna impacts, the PAC examined two key issues:
- whether there are project-related risks of significant impacts on native species, habitats or ecological communities; and
- whether there are risks that trigger action in regard to threatened species under relevant legislation, in particular the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995* (TSC Act).

5.7.1 Terrestrial Flora and Fauna

There are several sources of potential impacts on terrestrial species and habitats in the project area apart from those induced by subsidence. These include surface disturbance, importation of feral species or diseases and increased risk of fire. The PAC considered that these issues are covered adequately in the EA and could be adequately managed under a mine Flora and Fauna Management Plan, which HCPL proposes to develop as part of its Statement of Commitments (SoC).

However, the key issue for the PAC was whether the potential subsidence impacts would have negative consequences for native species, their habitats and ecological communities. The potential impact and consequences for upland swamps has been dealt with in section 5.3. The PAC's conclusion was that, as a system of habitat units, swamps in the project area were extremely unlikely to suffer significant negative environmental consequences, even if limited subsidence impacts were experienced at some individual swamps.

The PAC's conclusion in relation to other habitat types is similar. While there may be isolated instances or areas where consequences occur, the likelihood of these consequences being on a scale sufficient to threaten a habitat type in the project area is extremely remote. The PAC was also of the view that the likely impact on individual threatened or protected flora and fauna species would generally follow the same pattern. Its only potential caveat was if a species was rare and its occurrence was confined to one or a few units of the habitat type within the project area. Negative environmental consequences for the habitat unit (of itself not significant in terms of overall security of the habitat type) could then produce a negative species outcome that was highly significant. However, no such circumstance was brought to the attention of the PAC.

One Endangered Ecological Community (EEC) listed under the TSC Act (the *Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC*) was shown in the EA as occurring in one small location in the far northeast of the original mine plan and in two other areas just southeast and southwest of the mine plan. However, the EEC within the original mine plan (mapped in the SIA as EEC06) now appears to be outside the proposed northern domain, and located north of the footprint of Longwall 301 (see Figure 5). In any case, the EA argued that the terrain occupied by EEC06, combined with the mine parameters, would mean that subsidence impacts would be minor and isolated and insufficient to alter the hydrological processes on which the EEC depends.

There are four confirmed threatened flora species in the project area, and a further two listed as potentially occurring on the basis that fruiting and flowering parts were not available to confirm identity and separate them from close relatives. The EA states that none of these threatened flora species is likely to be significantly affected. The PAC agrees that none of these species is likely to be significantly impacted and that any risks that might emerge to specific sub-populations (eg Bynoe's Wattle) can be dealt with adequately by the Flora and Fauna Management Plan.

There were 13 threatened fauna species recorded in the project area during surveys for the proposal. Only the Eastern Ground Parrot is considered by DECC to be of the highest conservation priority in the Greater Southern Region, although three other species (Broad-headed Snake, Squirrel Glider and Large-footed Myotis) are regarded as high priority. The PAC reported that the main focus of attention in agency and other submissions was on the Eastern Ground Parrot, which was "re-discovered" in the project area during surveys undertaken for the project.

This species' range extends from South-Eastern Queensland to Tasmania, with strong populations in both Victoria and Tasmania. It is listed under the TSC Act as "vulnerable", with only three isolated populations known. Although the species was once numerous on the Woronora Plateau, frequent burning regimes were introduced after the 1968 bushfires and the species was thought to have disappeared from the region. The primary habitat for this species is upland swamps and dense heathlands. The three sightings recorded in the project area were in two upland swamps.

Mine-related negative consequences for this species could come from subsidence impacts on swamps and from any surface-related activities that disturbed swamps, increased the risk of fire, or introduced predators. However, the PAC concluded that "it is difficult to see how the remnant population ... can be impacted from [mine-related impacts] unless the predicted subsidence impacts provided by HCPL are so much in error that a high proportion of swamps suffer significant negative environmental consequences and the remaining swamp habitat will not support the population. A scenario of this kind would also increase the risk of fires which are another source of potential impact on the ground parrot. The EA argues cogently that the surface-related activities are unlikely to increase the risks for this species and the Panel accepts this."

The PAC was of the view that its proposed approval conditions relating to swamps would provide an adequate level of habitat protection from subsidence impacts for the Eastern Ground Parrot and that the mine's Flora and Fauna Management Plan could deal adequately with the surface-related risks from mining. The Department's proposed conditions also require that HCPL develops a Biodiversity Management Plan which addresses terrestrial flora and fauna, with a specific focus on swamps.

The DECC submission to the PAC requested that further survey and population monitoring work for the parrot is undertaken. The PAC recommended that this survey and population monitoring work should be required under any project approval. The Department supports this proposal and has proposed conditions requiring a research program on conservation of the Eastern Ground Parrot on the Woronora Plateau.

5.7.2 Aquatic Flora and Fauna

The EA contains an Aquatic Ecology Assessment (AEA) undertaken by Bio-Analysis. Baseline aquatic ecology surveys were conducted in Spring 2006 (streams) and Summer 2007 (Woronora Reservoir). These surveys resulted in a biophysical description of the river and tributary system including a description of aquatic macrophytes, macroinvertebrates and fish communities.

The AEA identifies a number of potential threats to aquatic dependent species, but in all cases concludes that the likely impact of the project is low. The PAC acknowledged a significant debate between HCPL and its consultants and DECC on particular aspects of the AEA. For example, DECC questioned the sampling methodology and noted that other data (eg from SCA, DECC, Marine Pollution Research 2003-2005, Ecology Lab 2005-2006) was not reported in the EA. DECC also considered that the project could lead to major changes in species composition and hence loss of genetic variability and, in extreme cases, localised species extinctions. In the face of this debate, the PAC concluded that the hydrologic and water quality changes described in the EA were likely to lead to changes in water-dependent plant and macroinvertebrate communities but was unable to reach a clear judgement on the significance or importance of those changes.

The relevance of this debate has been substantially lessened by the submission of the PPR, since the debate was conducted on the basis of the originally-exhibited mine plan. The preferred mine plan substantially reduces subsidence impacts, and therefore environmental consequences, for about 1750 m of the Waratah Rivulet and around 1200 m of the Eastern Tributary, as well as for a number of tributaries and swamps. Nonetheless, substantial impacts would continue to occur, particularly in the upper sections of both Waratah Rivulet and the Eastern Tributary, and smaller streams in the proposed northern domain. These impacts and their resultant consequences must be considered.

According to the EA, localised and "transient" changes in some metal concentrations (particularly iron and manganese and to a lesser extent aluminium) occur following new cracking of streambed. Large areas of rocky substrate in the Waratah Rivulet and other watercourses have been observed to be covered by orange-red iron staining for many hundreds of metres downstream of mine subsidence fractures. If the iron concentration is sufficiently high, and the aquatic environment is suitable, then orange, bacterially-based iron flocs may also form in ponds. Potential ecological effects of such flocs are reported to include smothering of benthic habitat and biota and reduced light available for aquatic plants. Bacterially-catalysed oxidation of iron also consumes dissolved oxygen from the water column.

In addition, the water in many pools appears to be stained by a generally pale-green milkiness or opacity. This is commonly associated with either iron staining on the substrate or iron flocs. In response to the PAC's Query No 36, HCPL provided information that this opacity was caused by colloidal ferric iron precipitating in the water column. The colloidal iron (as with the iron staining and iron flocs that it leads to) derives from ferrous iron, which is mostly leached from freshly-fractured rock by upwelling, oxygen-poor groundwater. Each of these iron-based phenomena also occur naturally in the Southern Coalfield and many other places. What is at issue in the Waratah Rivulet and other areas impacted by mine subsidence in the Southern Coalfield is the extent of these phenomena when compared with natural occurrences. It is also of interest that the orange-red staining (ferrihydrite) is expected to convert to the crystalline form of another iron mineral (goethite, or hydrated iron oxide), some months or years after the source of fresh iron precipitate ceases. Goethite is much darker in colour (a dark reddish-brown). Goethite staining occurs both naturally and commonly and can be seen in many similar watercourses throughout the Southern Coalfield.

DECC has also reported that aquatic organisms are highly sensitive to changes in ion concentrations in the environment and such changes can significantly impact on fish and other wildlife. However, no clear evidence was presented to the PAC that iron staining of the substrate, iron flocs or colloidal iron was likely to have a significant impact on any aquatic species.

The diversion of surface water flows to sub-surface fractures also has the potential to reduce available habitat for fish and to reduce stream connectivity, which may impede fish passage. However the baseline aquatic surveys found few species of fish in the watercourses in the project area. The most likely reason for this is the presence of the Woronora Reservoir, which impedes fish passage for all migratory species. Given the limited fish fauna assemblage, the AEA concluded that the project is unlikely to significantly impact on fish fauna. The PAC and the Department accept this conclusion.

No threatened aquatic biota listed under the TSC Act, the *Fisheries Management Act 1994* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* are known to occur in streams within the proposed mining area or in the Woronora Reservoir. DECC does identify a number of significant water-dependent species, including the Giant Burrowing Frog, Red Crowned Toadlet, Littlejohn's Tree Frog, Sydney Hawk Dragonfly and Platypus. It also points out that a number of other species, such as the freshwater spiny crayfish *Euastacus*, have recently been shown to have very restricted populations on the Woronora Plateau. *Euastacus* was found in both the Woronora River and Waratah Rivulet in 2004. The surveys conducted as part of the AEA found a small number of individuals identified as being in the family to which this species belongs (*Parastacidae*) in three streams in the project area. Unfortunately, these individuals were not then identified to species level. Nonetheless, it must be considered that there is a substantial likelihood that *Euastacus* is present in the project area. The AEA concluded, however, that the project was unlikely to impact it significantly.

The AEA reports that abundant macroinvertebrate taxa were sampled in the project area including *Atyidae* (shrimps), *Leptophlebediiae* (mayflies), *Ceinidae* (amphipods), *Leptoceridae* (caddis flies), *Dytiscidae* (beetles), *Libellulidae* (dragonflies) and *Physidae* (gastropods). Data collected from reference locations unaffected by mining show similar patterns in richness and abundance of macroinvertebrate assemblages. The AEA concluded that, while localised impacts on assemblages of aquatic macroinvertebrates are likely to occur as a result of changes in aquatic habitat, the project is unlikely to have any significant long-term impacts on assemblages of macroinvertebrates in Waratah Rivulet and its tributaries.

Fifty-four species of macrophytes were located during the aquatic ecology surveys. Relatively low macrophyte species diversity is reported. Based on the response of macrophyte communities to existing mining, the AEA concluded that the project is unlikely to have a significant impact on the composition or distribution of aquatic macrophytes.

The Department considers that its proposed approval conditions relating to the Waratah Rivulet, Eastern Tributary and swamps provide a very substantial level of habitat protection from subsidence impacts for aquatic species. HCPL has also made the commitment that its Flora and Fauna Management Plan would include measures to minimise impacts on aquatic ecology and a substantial aquatic ecology monitoring program. The Department's proposed conditions also require that HCPL develops a Biodiversity Management Plan which addresses aquatic ecology. The Department considers that this condition is sufficient to manage potential aquatic ecology impacts of the project.

5.8 Subsidence Impacts on Built Features

5.8.1 Transport Infrastructure

Transport infrastructure within and adjacent to the project area consists of the Illawarra Railway, the Southern Freeway and Princes Highway and associated bridges and culverts, together with various fire trails and four wheel drive tracks (see Figure 11).

The Illawarra Railway is east of the surface facilities area and is remote from proposed longwall mining. The Southern Freeway is not proposed to be directly undermined and as a result is not predicted to experience significant subsidence impacts. However, the Princes Highway passes directly over the proposed northern domain. As a result, the Highway would be subject to subsidence effects. However, the scale of these effects (and resultant impacts) would be diminished by the depth of cover and narrow longwalls. The SIA reports that maximum predicted tilt at the road, at any time during or after the extraction of the proposed longwalls, is 4.5 mm/m (ie 0.5 %), or a change in grade of 1 in 220. The existing gradients along the alignment of the road vary up to a maximum of about 65 mm/m (ie 7 %). It is unlikely, therefore, that the predicted tilts at the road surface would result in significant changes in surface water drainage.

The maximum predicted total tensile and compressive strains at the road, at any time during or after the extraction of the proposed longwalls, are 0.7 mm/m and 1.1 mm/m respectively. The SIA reports that the road is of flexible construction with a bitumen seal and is likely to tolerate strains of these magnitudes without significant impact. The SIA concludes that it is possible that minor cracking could occur in some places along the road, due to localised concentrations of tensile strains, and that minor rippling of the road surface could occur in other places, due to localised concentrations of compressive strains. As the magnitudes of the maximum predicted strains are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature.

There are four bridges and two road culverts along the Southern Freeway, two of which are located within the area of influence of the mining area as originally exhibited, namely the Princes Highway Underpass 2 and the Cawleys Creek Culvert (shown in Figure 11). However, it appears that subsidence impacts at these two sites are substantially reduced (if not eliminated) under the preferred mine plan. The Princes Highway Underpass 2 is adjacent to the proposed barrier pillar between Areas 1 and 2, and the Cawleys Creek Culvert is well north of the relatively short Longwall 301.

Many fire trails and four wheel drive tracks are located directly above the proposed longwalls and are therefore expected to be subject to the full range of subsidence movements. In particular, trails and tracks located near the top of slopes would be susceptible to cracking, which has previously been observed over mined longwalls at Metropolitan Colliery. HCPL proposes that any surface cracking over trails and tracks would be quickly remediated.

5.8.2 Service Infrastructure

Service infrastructure potentially affected by the project includes a 330 kV transmission line, a 132 kV power line, Sydney Water pipelines, optical fibre cables and copper telecommunications cables (see Figure 11).

The 330 kV transmission line and the 132 kV power line are in a co-linear easement between the eastern edge of the proposed mining area and the Southern Freeway. They would not be directly undermined, and the SIA predicts that potential subsidence effects and impacts are very low. The SIA recommends that, as part of detailed mine design, a monitoring, management and response plan is established, to the satisfaction of TransGrid and Integral Energy, so that the transmission lines can be maintained in a safe and serviceable condition throughout the mining period. With the implementation of this management strategy, MSEC concludes that it is unlikely that there would be a significant impact on the transmission lines resulting from the extraction of the proposed longwalls.

Sydney Water owns a number of pipelines over the proposed northern domain. These include 100 mm to 300 mm diameter, cast iron/cement lined (CICL) watermains that extend from Woronora Dam to Helensburgh, and a 150 mm diameter PVC pressure main sewer which extends northward from the Garrawarra Complex. Sydney Subsidence predictions indicate the pipelines would only be subject to low levels of tilt and strain and are unlikely to be significantly affected. Minor impacts may include leaking joints, which are likely to be isolated to valley areas susceptible to upsidence, closure and strain movements. The SIA recommends that, as part of detailed mine design, specific management measures are developed by HCPL in conjunction with Sydney Water. The SIA states that, with the implementation of these management measures, the pipelines can be maintained in a serviceable condition during and after the extraction of the proposed longwalls.

Based on previous experience, the predicted subsidence impacts on optical fibre and copper telecommunications cables are considered to be relatively low and it is therefore expected that the cables would be able to tolerate the predicted subsidence effects without significant impact.

5.8.3 Garrawarra Centre and Other Structures

The Garrawarra Centre is an aged care facility, listed as a heritage conservation area, located in the northeast of the proposed northern domain (see Figure 11). There are a total of 85 buildings located within the Garrawarra Complex, comprising 57 residential or hospital buildings and 28 structures that have been labelled as sheds.

The Garrawarra Complex is owned by the NSW Department of Health and is listed with the Heritage Office of the Department of Planning as a heritage conservation area with a number of items of heritage significance. The SIA reports that a preliminary study was undertaken by MSEC to assess the minimisation of impacts on the Garrawarra Complex. This preliminary study looked at minimising the impacts from subsidence effects by limiting the assessed impact categories for the buildings to a tilt impact category of no greater than Category A or B, and a strain impact category of no greater than Category 0 or 1.

Since the assessed tilt impacts were already no greater than Category A or B (due to the depth of mining and narrow longwalls), MSEC considered that in order to achieve a strain impact of no greater than Category 0 or 1, the maximum predicted tensile or compressive strain at the large buildings should not exceed 0.3 mm/m. However, in order to limit the maximum predicted tensile or compressive strain at the large buildings to no greater than 0.3 mm/m, Longwalls 40, 41 and 42 (under the original mine plan) would need to be reduced in length by at least 700 m, 610 m and 580 m respectively.

HCPL has not yet undertaken a structural analysis of the buildings at Garrawarra or discussed with either the Department of Health or the Heritage Office which particular buildings and values require to be protected. The SIA recommended that, as part of detailed mine design studies, a structural analysis of the buildings and a design review should be undertaken to determine any specific management measures and a final longwall layout. The design review should take into consideration monitoring results from previous longwalls at Metropolitan Colliery. A management and response plan, developed to the satisfaction of the Department of Health, should include the requirement for all residential and hospital buildings located above the proposed longwalls to be inspected prior to mining, to assess the existing condition. The residential and hospital buildings should also be visually monitored during extraction of the proposed longwalls. It concludes that the assessed potential impacts on the residential and hospital buildings in the Garrawarra Complex resulting from the predicted conventional subsidence parameters can be managed if suitable management strategies are implemented.

The PPR states that the same standards as were set out in the SoC provided in the EA would apply to the preferred mine plan, ie HCPL would limits impacts to structures within the Garrawarra Complex to Category A or B for tilt and Category 0 or 1 for strain, by adjustments to the longwall layout to limit impacts to the structures. The Department considers that this commitment should be applied only in the case of buildings that have important heritage values, and has recommended conditions to this effect. HCPL has committed to inspecting buildings at Garrawarra and other structures within the mining area prior to extraction of nearby longwalls to assess their existing condition and to ascertain whether any management measures may be required. HCPL has also committed to regularly visually monitor the buildings and structures during extraction and remediate any impacts as required.

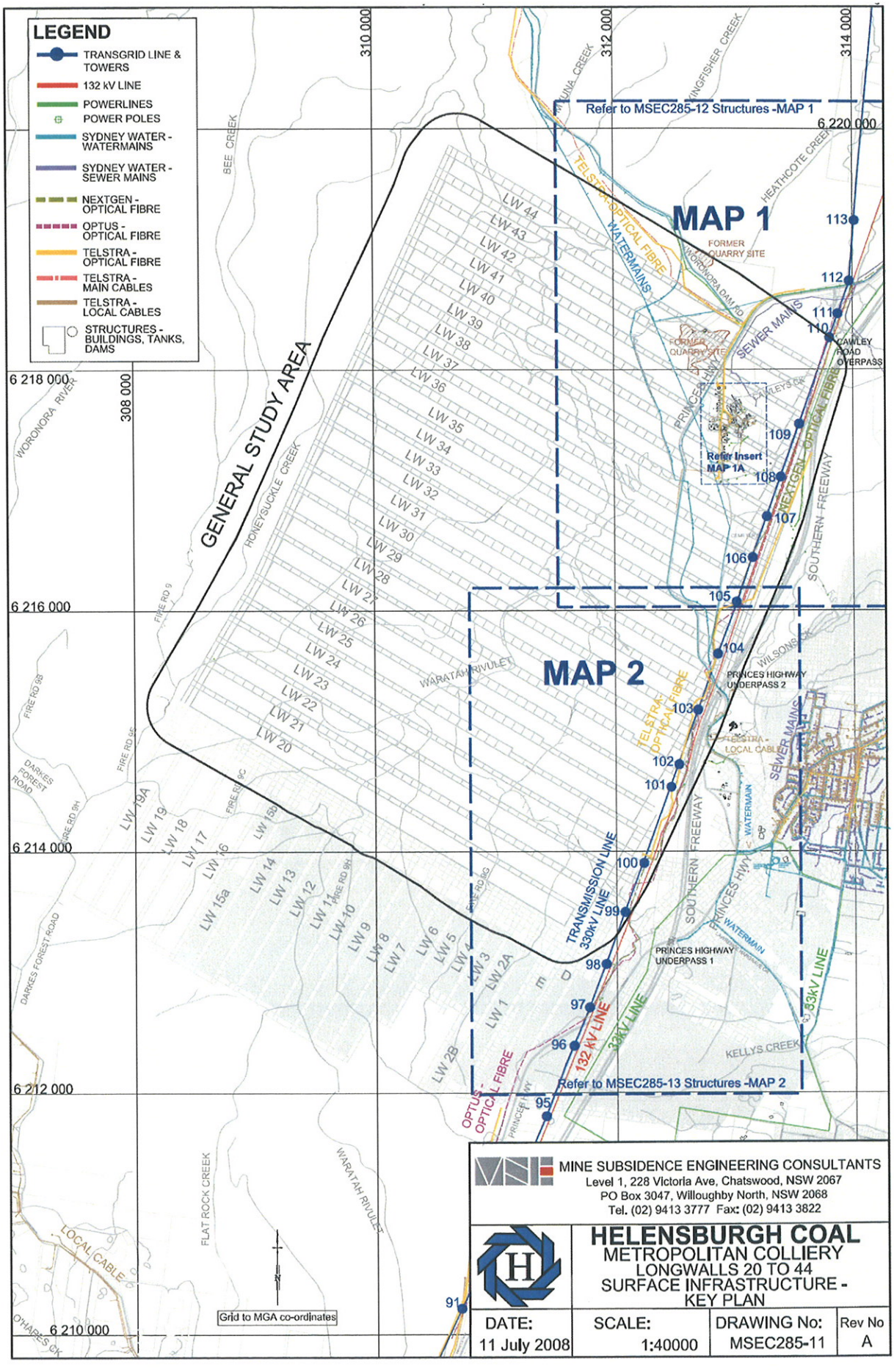

Figure 11: *Built Features*

Other structures within and surrounding the project underground mining area are unlikely to be impacted and any potential impacts are predicted to be minor and remediated if required through the conditions of approval.

5.8.4 Conclusions

The Department is generally satisfied with HCPL's assessment of potential subsidence impacts on built features within and surrounding the project area. The Department is confident that with regular monitoring and the implementation of management and response plans, surface infrastructure features would be maintained in a safe, serviceable and repairable condition throughout the mining period. The Department has proposed conditions requiring that all built features be maintained in a safe, serviceable and repairable condition, except with the agreement of the owner and the Mine Subsidence Board. HCPL would also be required to develop a Built Features Management Plan, prepared in consultation with relevant owners, to manage potential environmental consequences.

5.9 Noise

The EA includes a noise impact assessment (NIA) undertaken by specialist acoustic consultants Heggies Pty Ltd in accordance with requirements of DECC's *Industrial Noise Policy* (INP) and *Environmental Criteria for Road Traffic Noise* (ECRTN).

Residences at Helensburgh have historically been exposed to fairly high levels of noise associated with the operation of the Colliery. Much of this noise is generated by the operation of fixed plant such as the CHPP, as well as mobile plant such as front end loaders, water carts and dozers. The project would see a continuation of these activities for the currently-proposed life of the mine (ie to 2032).

Environmental impacts of the project are currently managed by an Environmental Protection Licence (EPL 767) issued by DECC. This licence does not set noise limits. Where an existing industrial facility, such as the Colliery, exceeds established criteria and no major modification is proposed, the facility would generally be permitted to continue to maintain current operations by way of existing use rights. However, DECC generally then applies a Pollution Reduction Program (PRP) to the facility's EPL, aimed at improving environmental performance. In reflection of this policy framework, Metropolitan Colliery is required to implement a program of noise reductions under its PRP 12. However, in recognition of uncertainties associated with noise mitigation, there is no fixed timeframe for implementing the noise controls and management measures identified, nor is there an end date set to achieve these PRP noise goals. The Department does not view this situation as entirely satisfactory.

5.9.1 Construction Noise

The main construction activities are proposed at the mine's surface facilities area. They include upgrades to the existing CHPP and the materials handling system and the construction of a coal reject paste plant. The EA indicates that the sound power levels associated with the construction of these facilities would be no greater than the current operational noise emitted from the surface facilities area. Given that construction works would only be undertaken during the daytime period, the EA concludes that the noise emissions associated with construction would not be perceivable above the ongoing operational activities. The Department is satisfied that the construction noise impacts associated with the project can be managed within the context of the operational noise assessment.

5.9.2 Operational Noise

The extraction of ROM coal is carried out underground and then transported to the surface via a series of underground conveyors. These activities do not generate noise for residential receivers. The coal is then washed in the CHPP before being stockpiled and loaded onto trucks and trains for dispatch. These activities take place at the pit-top in Helensburgh, and associated operational noise may impact on the amenity of residential receivers.

Operational noise emissions have been modelled for the following 3 representative periods of the project life at all residential receivers within the vicinity of the surface facilities area:

- the existing Metropolitan Colliery operations;
- Project Year 3 (combined operational and construction noise); and
- Project Year 15 (peak operational production period).

The INP sets two separate noise criteria to meet environmental noise objectives, one to account for intrusive noise and the other to protect the amenity of particular land uses. The more stringent of the two criteria should then used to establish Project Specific Noise Levels (PSNLs), which, in turn, are used to determine the noise impact assessment criteria that should apply at each residential receiver,

and what management measures are required at each receiver in the event of an exceedance of the criteria.

A strict interpretation and application of the INP (ie for a greenfield site) would result in the adoption of intrusive noise criteria. The PSNL would be set at 5dB(A) above the measured Rating Background Level (RBL) for day, evening and night-time periods. In its submission, DECC indicated that the project (ie both existing and proposed operations) should be assessed on this basis through the establishment of intrusive criteria (RBL + 5dB(A)). However, DECC has subsequently accepted that this project may merit a different approach for reasons set out below.

Helensburgh developed as a mining town as a result of the Metropolitan Colliery, which commenced its operations in the 1880s. The mine is therefore an integral component of the township and forms part of the established noise catchment. Current practice results in the intrusive criteria being established in the absence of the noise being generated by the facility under assessment (ie the Colliery). This may work in practice for industrial estates where there are several individual industries that contribute to an overall noise catchment, but where there is only one major industrial source, "turning off" this noise source may result in a background level that has never been experienced in the lifetime of any surrounding resident. Background noise levels measured in the absence of any mine noise are very low and it is the Department's view that existing mine noise should be considered as part of the local background noise environment. In other words, the project should not be treated as if it were a greenfields site.

Secondly, the report accompanying PRP 12 identified a number of potential retrofits that could potentially result in significant noise reductions. However, the report concluded that, even if all technically achievable noise controls were implemented, it was still unlikely that intrusive noise criteria could be met. Finally, predictive modelling indicates that no privately-owned residences would experience an increase in operational noise over the life of the project. In fact, the majority of privately-owned residences located in close proximity to the surface facilities area would experience significant noise reductions as the requirements of PRP 12 are implemented as older equipment is replaced over time as part of the project.

For these reasons, the Department is of the view that it would be unreasonable and unrealistic to expect the project to meet the intrusive criteria and for HCPL to provide extensive noise receiver controls through a large number of potential property acquisitions at this stage. Instead, the Department is of the view that the company should focus on implementing source controls over time that would reduce noise impacts within the catchment as a whole at both residential and non-residential receivers.

To achieve this aim, both the Department and DECC agree that within 5 years, HCPL should demonstrate that noise levels are within 5 dB of the Leq(15 min) levels recommended in PRP 12. Furthermore, HCPL must ensure that the noise generated by the project does not exceed these levels, nor should it exceed the maximum night-time noise level as shown in Table 5.

Table 5: *Intrusive Noise Impact Assessment Criteria*

Period	*Day Leq(15 min)*	*Evening Leq(15 min)*	*Evening Leq(15 min)*	*Night L1(l min)*
Noise Level dB(A)	55	45	45	50

In recognition that there is a level of uncertainty associated with noise prediction models and estimations of potential noise reductions, the Department typically applies policy as set out in Table 6.

Table 6: *Noise Impact Management Measures*

Noise Impact	*Criteria Exceedance*	*Management Required*
Marginal	1-2dB(A)	Noise mitigation, if possible
Moderate	3-5dB(A)	Noise mitigation, inc noise mitigation at residence
Significant	>5 dB(A)	Acquisition on request

Within 5 years the Department would require an audit which would identify residences exposed to noise levels in excess of those listed in Table 5. Based on this audit, the Department would apply the following:

- marginal exceedances - considered minor and not resulting in any significant noise impacts, since exceedances of 1 to 2 decibels are not readily perceptible to the human ear. Where possible noise mitigation should be undertaken at these residences;
- moderately-impacted residences - HCPL should be required to offer architectural treatments (such as double glazing, insulation and/or air conditioning) at affected residences; and
- significantly-impacted properties - provided with acquisition rights and/or noise mitigation measures on request under the terms of the project approval.

In addition, it is recommended that HCPL be required to prepare and implement a noise management plan for the project. The plan would aim to drive noise emissions down as much as possible within this initial 5-year period. Implementation and the need to upgrade the plan would be reviewed by a noise expert during each 3-year independent environmental audit. In addition to the standard management plan and annual review requirements under the approval, this particular plan must include a description of all reasonable and feasible management and mitigation measures to be implemented to ensure that the intrusive noise impact criteria are met, a monitoring program to gauge the effectiveness of these measures (including real time noise monitoring) and a contingency plan to be triggered in the event of systemic exceedances and a continuous improvement program.

5.9.3 Road Noise

Some 120,000 tpa of coal is currently dispatched from Metropolitan to Corrimal Coke Works and Coal Cliff Coke Works to be made into coke. This movement of coal is proposed to continue. Coal reject material is also trucked to Glenlee Washery, south of Narellan. It is predicted in the EA that transport of coal reject to Glenlee would vary from 250 – 320 ktpa over the first 12 years of the project.

The EA reports that road traffic noise measurements were taken at 3 residential locations along the existing off-site haulage route; on Lawrence Hargrave Drive and Parkes Street (see Table 7). The EA indicates that the ECRTN criteria are already exceeded at residences located in close proximity to these local roads. However, the ECRTN establishes that in cases where the relevant traffic noise criteria are already exceeded, traffic associated with proposed operations should not lead to an increase in the existing traffic noise of more than 2 dB. The project is expected to easily meet this criterion. Maximum predicted increases are very low, seeing as road transport of coal and coal reject is not anticipated to change significantly, if at all.

Table 7: *Traffic Noise Impacts*

Location	Existing Traffic Noise (dB)		Criteria (Existing plus 2 dB)		Maximum Predicted Increase (dB)	Meet Criteria
	Day	Night	Day	Night		
171 Lawrence Hargrave Drive	66[1]	59[1]	68	61	< 0.1	Yes
170 Parkes Street	66[2]	63[2]	68	65	0.1	Yes
83 Parkes Street	67[2]	54[2]	69	56	0.1	Yes

[1] Day = $L_{Aeq(15hour)}$, Night = $L_{Aeq(9hour)}$
[2] Day = $L_{Aeq(1hour)}$, Night = $L_{Aeq(1hour)}$

5.9.4 Rail Noise

Most product coal dispatched from Metropolitan is dispatched by rail on the Illawarra Railway to Port Kembla Coal Terminal (PKCT). It is proposed to load product coal onto trains and rail it to PKCT 24 hours a day, 7 days a week. Rail dispatch currently takes place only between 4 am and 10 pm. The EA reports that no residence in Helensburgh currently experiences rail noise in excess of DECC criteria and that any increase resulting from the project would be negligible (<1 dB(A)) and would not be discernible at any residential receiver.

The Department is satisfied that the project is unlikely to result in any significant additional rail noise impacts, and that noise emissions would be within the noise objectives set for the rail operator. However, to manage noise emissions from the Metropolitan rail spur, it is recommended that conditions require that HCPL only use locomotives provided by a rail service provider that has received an approval to operate on the NSW rail network in accordance with the noise limits L6.1 to L6.4 in RailCorp's EPL 12208 and ARTC's EPL 3142.

5.9.5 Conclusion

The Department has assessed noise impacts associated with the project and found that:

- construction activities will take place during day time hours and will not generally be perceivable above the operational noise emissions;
- residents in Helensburgh have experienced fairly high levels of noise associated with the operation of the colliery;
- noise emissions would reduce over time at all residential and non-residential receivers where mine noise is audible; and
- transport-related noise currently meets relevant DECC criteria and would continue to do so for the life of the project.

The Department recommends a series of conditions to ensure that these outcomes are achieved. Most notably, intrusive noise criteria have been set, in consultation with DECC, which HCPL would be required to meet before the first audit takes place (by the end of 2014). In the event that this is not achieved within this timeframe, HCPL would be required to implement management and mitigation controls and/or acquire those properties where moderate or significant exceedances occur.

5.10 Air Quality

The project has the potential to result in dust-related impacts, particularly to residential receivers located in close proximity to the surface facilities area in Helensburgh. The EA includes a specialist air quality impact assessment (AQIA) undertaken by Holmes Air Sciences. The AQIA was prepared in accordance with DECC's *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales*.

Dust emissions come from a range of activities carried out at the surface facilities area, as extracted ROM coal is washed and stockpiled before leaving the site by rail or road. Natural shielding offered by the valley in which the surface facilities are located has a significant dampening effect on the dispersion of dust and also effectively blocks many of the winds experienced at the higher elevations where residential receivers are located. The speed and direction of dust plumes are then contingent on meteorological conditions, such as prevailing wind direction and atmospheric stability class.

HCPL has monitored dust emissions in Helensburgh township since the early 2000s and has monitored fine particulate matter (PM_{10}) concentrations since 2007. Currently, there are six dust deposition gauges (of which one is used as a control or background site) and one High Volume Air Sampler located around the township (see Figure 12).

Data sourced from this existing monitoring network has been used to determine the current ambient air environment in Helensburgh. For assessment purposes, this has been categorised into dust deposition, fine particulate matter (PM_{10}) and total suspended particulates (TSP), with reference to 24-hour, monthly and annual air quality health and amenity criteria. Analysis of this data shows that dust emissions and concentrations are all well within contemporary air quality criteria.

Since 2003, HCPL has implemented 4 successive PRPs imposed on its EPL by DECC following various complaints received from residents in the vicinity of the surface facilities area. This has resulted in the development of a monitoring and management system for dust emissions, and an improvement in dust suppression systems in operation, such as the installation of six water sprays along the rail line. There has been a corresponding reduction in the number of complaints received from local residents from 2003 (11 complaints) to 2007 (4 complaints), which suggests that these measures have been largely effective.

The AQIA modelled the volume of dust that would be generated by the project in the context of existing background levels. Project impacts were modelled for the most intensive periods of the project's life. These were Year 3, when construction activities would peak, and Year 15, when it is anticipated that the mine would be operating at peak production.

Table 8 shows that it is predicted that the project would not cause exceedances of dust deposition or TSP criteria. However, in Year 15, the three closest residences in Parkes Street (namely 48, 50 and 52/54 Parkes Street, see Figure 13) were predicted to experience maximum 24-hour PM_{10} concentrations of 49 $\mu g/m^3$, which is very close to the criterion of 50 $\mu g/m^3$. The modelling also indicated that the 24-hour PM_{10} criterion may potentially be exceeded under adverse weather conditions or during atypical events such as bushfires, dust storms or sea fog.

Table 8: *Year 3 and Year 15 Predicted Air Quality Impacts*

Pollutant	Averaging Period/Units	Criterion	Maximum Predicted Total Dust	
			Year 3	Year 15
Total suspended particulate (TSP)	Annual/µg/m^3	90	40	42
Particulate matter < 10 µm (PM_{10})	Annual/µg/m^3	30	17	18
	24-hour/µg/m^3	50	33	49
Deposited Dust	Annual/g/m^2/month	4	2.7	2.7

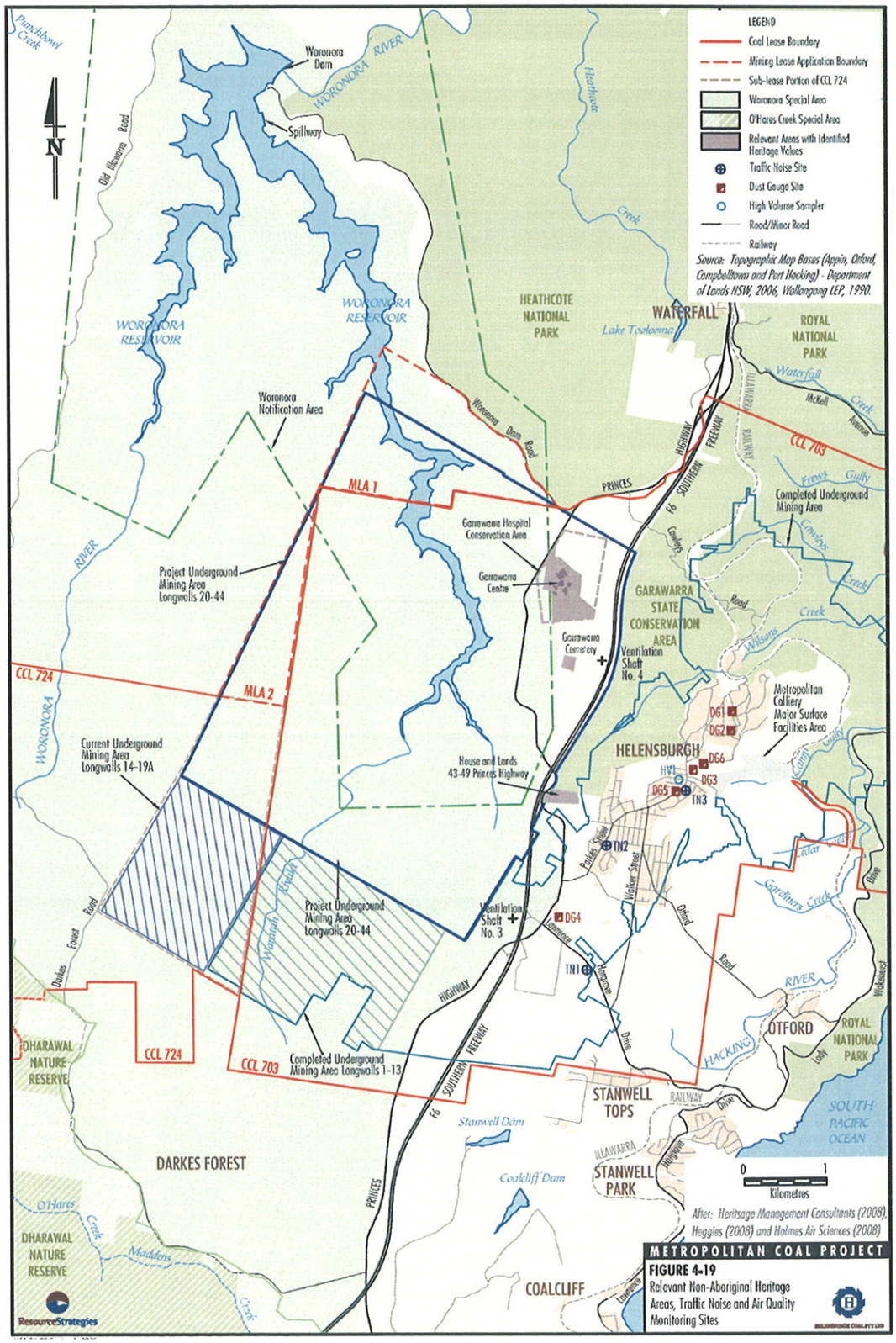

Figure 12: *Traffic Noise and Air Quality Monitoring Sites*

The Department considers that these predictions are overly conservative and represent a "worst-case" scenario for two reasons. Firstly, the background dust levels relied upon in the AQIA comprise the total amount of dust that is present within the local air shed of Helensburgh, including dust generated from current activities at the project. Consequently, adding the total background dust levels to the project-related dust emissions results in double-counting. Secondly, as noted above, the AQIA has modelled the years when most intensive activity would be taking place (ie Years 3 and 15), so this volume of dust would not be experienced during the majority of the project life.

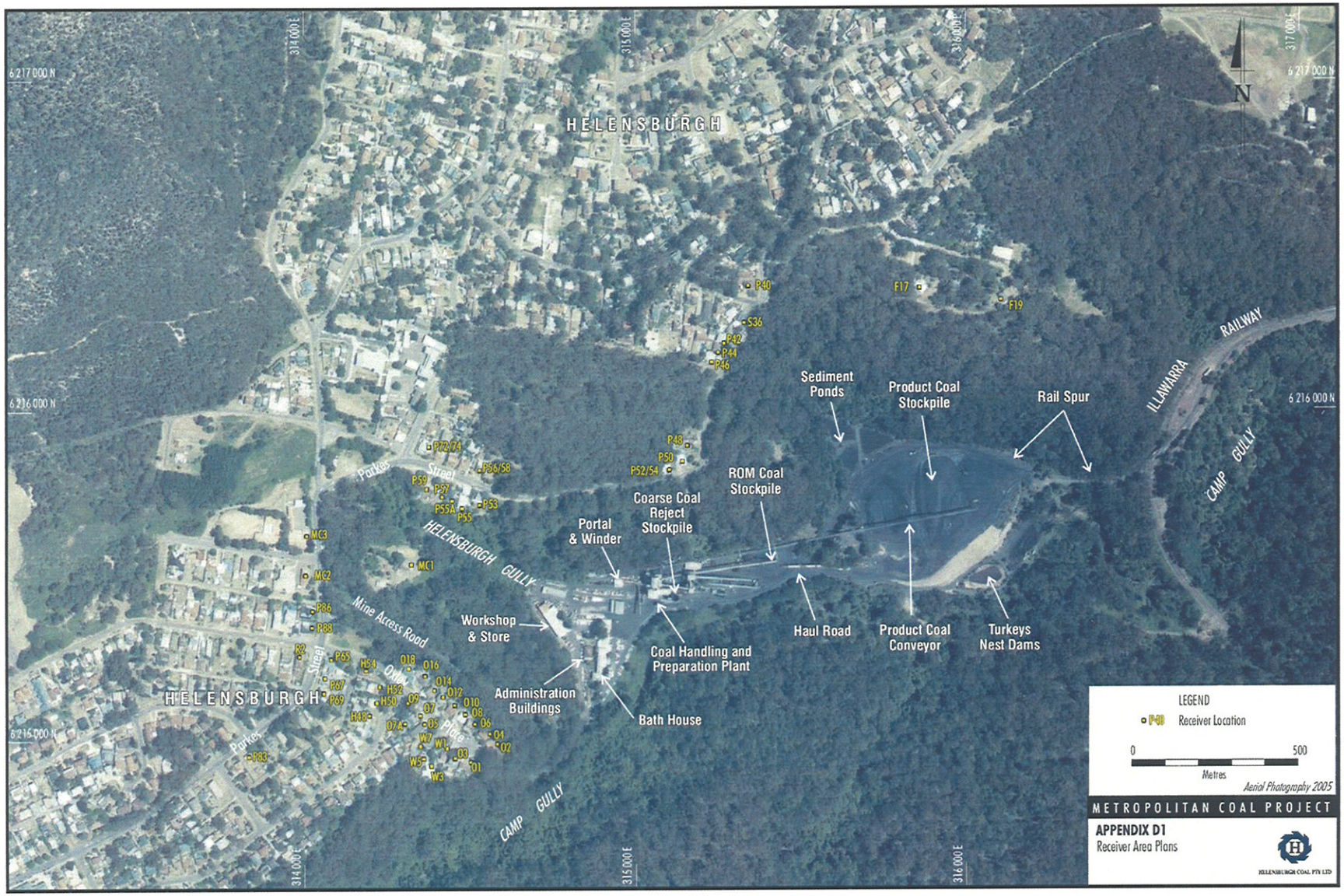

Figure 13: *Landowner/Receiver Plan*

HCPL has recently augmented its existing monitoring system to include an additional dust gauge at Old Station Road and has made a commitment to develop and implement a real-time dust monitoring system at the mine. The Department and DECC are satisfied that the project is unlikely to result in any exceedances of applicable air quality criteria. The Department recommends that contemporary air quality impact assessment criteria land acquisition criteria be imposed as conditions of approval to protect the amenity and health of the residential receivers near to the surface facilities area. The Department also recommends that conditions of approval should require the preparation and implementation of an air quality management plan.

5.11 Greenhouse Gas Emissions

The proposed project would generate direct and indirect greenhouse gas emissions (GHGEs) that would contribute to global warming and climate change. The EA includes a detailed Greenhouse Gas Emissions Assessment, undertaken by Holmes Air Sciences. This assessment was undertaken in accordance with the Commonwealth Government's *National Greenhouse Accounts Factors*.

The assessment calculates direct and indirect GHGEs associated with the project, including Scope 1 emissions (direct GHGEs from sources controlled by HCPL), Scope 2 emissions (indirect emissions associated with the import of electricity to the project) and Scope 3 emissions (other indirect emissions, such as those associated with the downstream combustion of product coal). The estimated GHGEs generated by the project are set out in Tables 9, 10 and 11.

Table 9: *Estimated Annual Greenhouse Gas Emissions Associated with Coal Mining Activities*

Estimated annual CO_{2-e} emissions (Scope 1, 2 and 3 – on-site)

GHG Source	Diesel use		Electricity consumption		Coal Extracted	Generator (LPG)	
Scope	Scope 1	Scope 3	Scope 2	Scope 3	Scope 1	Scope 1	Scope 3
Total (t)	78,681	5,832	2,876,862	549,513	4,945,072	1,286,585	113,840
Total (Mt)	0.079	0.006	2.877	0.550	4.945	1.287	0.114

Table 10: *Estimated Annual Greenhouse Gas Emissions from Export and End Use Activities*

Estimated annual CO_{2-e} emissions (Scope 3 – off-site)

GHG Source	Coal reject by truck	Product coal by truck	Rail transport	Steelmaking	Coal burning
Total (t)	28,735	6,463	50,813	183,486,110	2,266,434
Total (Mt)	0.029	0.006	0.050	183.486	2.266

Table 11: *Summary of Estimated Annual Greenhouse Gas Emissions*

Summary of estimated total CO_{2-e} emissions (direct and indirect)

Scope	Scope 1 emissions (tonnes CO_{2-e})	Scope 2 emissions (tonnes Co_{2-e})	Scope 3 emissions (tonnes CO_{2-e})	
			On-site - use of fuel and electricity	Off-site - transport, steel making and coal burning
*Project Life Total**	6,310,336	2,876,862	669,185	185,838,567
Annual Average#	262,931 (0.26 Mt)	119,869 (0.12 Mt)	27,883 (0.03 Mt)	8,079,938 (8.08 Mt)

** Excluding rounding differences*
 # Based on 24 years, including decommissioning, for on-site activities and 23 years for off-site activities.

Annual average on-site Scope 1, 2 and 3 emissions for the project (0.41 Mt CO_{2-e}) represents around 0.073% of the total annual 2005 Australian emissions, and about 0.0008% of total annual 2004 global emissions. Total off-site Scope 3 emissions from the export and end use of product coal by other parties represents around 98% of the total CO_{2-e} emissions generated by the project. This is around 0.016% of total annual global emissions in 2004.

The Department acknowledges concerns raised in submissions over GHGEs and resultant impacts on global warming and climate change, but it is satisfied that the project's contribution to global GHGEs, even when assessed on a full life cycle basis (ie including export and end use emissions), would be very low. Further, there is a clear need for the continued supply of coking coal to meet international iron and steel making needs. Bulli Coal Seam coal is highly sought after in the production of coke for steel making. It is used in the Port Kembla and Whyalla Steelworks and is a valuable export commodity. Refusal of the project application would not alleviate the current international demand for coking coal, the need for mines to supply that demand or the resultant GHGEs from its combustion. In other words, if the project was not allowed to proceed, the gap in the coking coal supply would be filled by coal supplied from another mine in the Southern Coalfield, Queensland or overseas. A refusal would only result in closure of the project and the loss of socio-economic benefits that would have been otherwise realised to the local, regional, State and national economies.

The Department acknowledges that global warming and climate change present a clear threat of serious or irreversible environmental damage, as well as a threat to intergenerational equity and a threat to the conservation of biological diversity. However, it must also be acknowledged that the continued production of iron and steel and other socio-economic benefits generated by the project would also benefit future generations. The Department accepts that the predicted downstream Scope 3 GHGEs are likely to eventuate whether or not the project is approved. GHGEs and their global impacts must be addressed outside and above the scope of the NSW planning system. How best to address GHGEs and global warming requires concerted effort at national and international levels, and is clearly a matter that is independent of whether or not the current project application is approved.

The Department has weighed the greenhouse gas impacts of the project against a range of matters, including its contribution to global GHGEs, the need for the project and its socio-economic benefits, and the GHG impact mitigation measures available. The Department is satisfied that the project's potential GHG impacts are acceptable. Notwithstanding this, the Department and DECC recommend that HCPL should prepare and implement a Greenhouse Gas Management Plan. HCPL has made a commitment to this end and would integrate into that Plan the existing measures at the project to minimise on-site energy use.

5.12 Traffic and Transport

Potential impacts on the road and rail network may occur due to the continued operation of Metropolitan Colliery at an increased rate of production. The EA includes a Traffic Impact Assessment (TIA), undertaken by Masson Wilson Twiney, which assesses the impact of the project on the existing road and rail network.

5.12.1 Road Traffic

Metropolitan Colliery uses a number of roads to haul coal to the Corrimal and Coalcliff Coke Works and its coal reject material to Glenlee Washery in Narellan. All the trucks leaving the site use Colliery (or "Mine") Road and Parkes Street/Old Princes Highway in Helensburgh. From there, they either take coal to Coalcliff Coke Works via Lawrence Hargrave Drive or to Corrimal Coke Works via the F6 Southern Freeway, Princes Highway (Bulli Pass), Bellambi Lane, Northern Distributor and Railway Street. Coal reject is trucked to Glenlee Washery via the F6 Southern Freeway, Appin Road, Narellan Road, Camden Bypass Macarthur Road and Springs Road (see Figure 14).

The roads serving the project are major regional roads which are classified and generally function as arterial roads or sub-arterial roads, apart from Parkes Street/Old Princes Highway in Helensburgh and Springs Road in Narellan, which function as collector roads. No local roads are used by the project. All roads generally carry the volume of traffic they are intended to under current RTA guidelines. It is proposed that the existing haul routes would continue to be used at the same rate. Other alternative haulage routes were assessed as part of the TIA but it was concluded that the existing haulage routes were optimal.

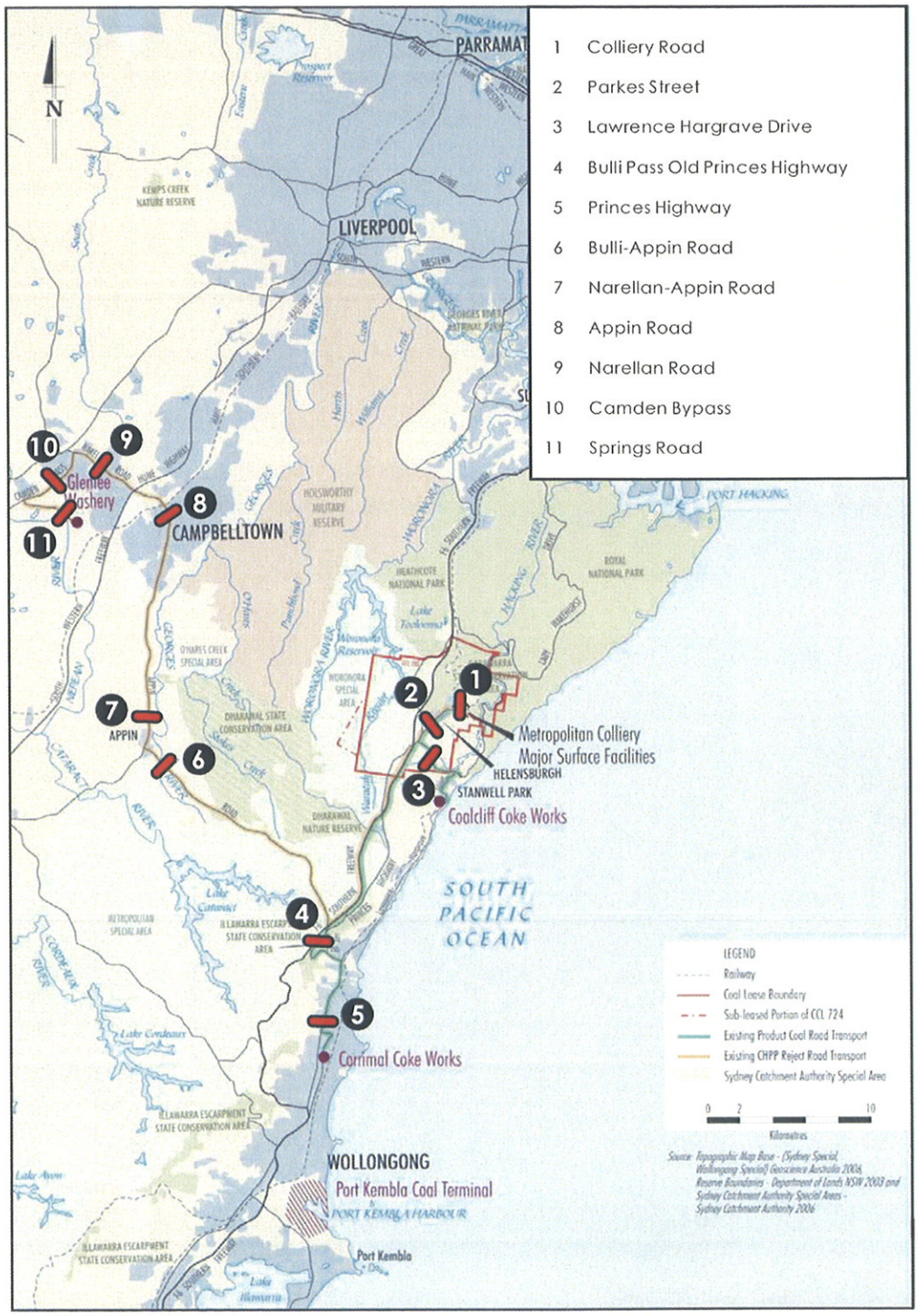

Figure 14: *Coal and Coal Reject Road Haulage Routes and Tube Count Survey Locations (see Table 13)*

Tube count surveys indicated a total of 829 vehicle movements are generated by the colliery per day. This would increase by about 12 vehicle movements to 841 vehicle movements over the life of the project (a 1.4% increase). During the 5 year construction period between 2010 and 2014, there would be an additional 82 vehicle movements (a 9.9% increase) (see Table 12), but this would revert back to pre-construction traffic levels from 2015 onwards.

The contribution of project-related traffic in the context of existing vehicle traffic volumes would be marginally higher during the initial 5-year construction period and would thereafter fluctuate during the life of the project as coal production varies. It is forecast that the use of these roads by both project-related and non-project-related traffic would generally increase, primarily due to background growth on these roads. Despite these changes the amount of vehicle traffic on these roads as a result of the project is considered to be either low or negligible (see Table 13).

Table 12: *Project-Related Daily Vehicle Traffic Generation*

Trip Generator	*Number of additional trips during operation (2010 – 2032)*	*Type of Vehicle*	*Number of additional trips during peak construction (2010 – 2014)*	*Type of Vehicle*
Employees	-	-	50	Car
Large deliveries	4	Truck	12	Truck
Oversize loads	-	-	2	Semitrailer/oversize
Visitors and sales reps	2	Car and small truck	6	Car and small truck
Small deliveries	6	Van and small truck	12	Van and small truck
Total	**12**		**82**	

Table 13: *Existing and Future Construction and Operational Average Weekday Traffic on Haulage Routes*

*Site**	*Road and Location*	*Colliery Vehicles 2007 to 2010*			*Colliery Vehicles 2010 to 2014*			*Colliery Vehicles 2014 to 2032*		
		Total	*Colliery*	*Colliery % of Total*	*Total*	*Colliery*	*Colliery % of Total*	*Total*	*Colliery*	*Colliery % of Total*
Through Helensburgh (All Routes)										
1	Mine Access Road	829	829	100	923	923	100	841	841	100
2	Parkes Street	7,486	488	6.5	8,058	570	7.1	9,248	500	5.4
Route to/from Coalcliff										
3	Lawrence Hargrave Drive at Stanwell Tops	5,871	198	3.4	7,878	210	2.7	12,997	198	1.5
Route to/from Corrimal										
4	Old Princes Highway at Bulli Pass	10,516	94	0.9	12,519	110	0.9	17,614	96	0.5
5	Princes Highway at Russell Vale	25,780	60	0.2	27,557	72	0.3	32,085	62	0.2
Route to/from Glenlee Washery										
6	Bulli-Appin Rd at Kings Fall Bridge	8,174	84	1.0	8,727	98	1.1	10,102	86	0.9
7	Narellan-Appin Road at Appin	9,916	82	0.8	10,445	88	0.8	11,783	82	0.7
8	Appin Road at Bradbury	29,729	82	0.3	31,184	86	0.3	31,042	82	0.3
9	Appin Road at Narellan Vale	55,613	82	0.1	75,311	82	0.1	82,475	82	0.1
10	Camden Bypass at Elderslie	19,292	82	0.4	33,066	82	0.2	35,397	82	0.2
11	Springs Road at Spring Farm	2,924	82	2.8	7,982	82	1.0	7,982	82	1.0

Note: For site locations, see Figure 14.

The TIA conservatively assumed that vehicle movements to and from Glenlee Washery would not change over the first 12 years of the project. However, completion of the paste plant in 2014 would mean that heavy trucks transporting coal reject material to and from Glenlee Washery for emplacement would cease. This would eliminate road usage by the project from Bulli Pass to Narellan and significantly reduce traffic volumes to and from the project.

The Department is satisfied that the existing road network is capable of accommodating all traffic movements generated by the project and that any additional traffic generated by the project is negligible. The potential impacts of the project on the performance and safety of the road network are therefore concluded to be minor. Through a combination of commitments by HCPL and conditions

recommended by the Department, road haulage of product coal and coal reject would be capped at the existing annual maximum rates and the project would only be permitted to use certain nominated routes.

A number of submissions raised concerns about the potential impact of increased local traffic around the project and the safety aspects associated with this. To address this issue, the Department recommends that a traffic management plan be prepared and implemented for the project which includes traffic control measures for truck movements through residential areas and provides heavy vehicle speed limits, particularly through Helensburgh.

SIDRA (Signalised and Unsignalised Intersection Design and Research Aid) analysis of the key intersections in Helensburgh indicates that they operate at good levels of service during peak hours, with short delays and spare capacity. However, the Department has concerns about the safety of the Parkes Street – Colliery Road intersection, given the narrowness of Parkes St (one lane each direction), its location on a downhill bend, the absence of a turning land into Colliery Road and its close proximity to a public school. The Department recommends a condition that would require HCPL to complete a road safety audit of this intersection and to implement any recommendations of this audit accordingly.

5.12.2 Rail Traffic

The great majority of Metropolitan's product coal is railed to PKCT on the Illawarra Railway. This situation will continue, and all increased production under the project would also be railed to PKCT. Currently, train loading occurs on a daily basis and is generally undertaken at 5 am, 11 am and 7 pm. However, the increase in coal production and the requirements of train scheduling indicates that the project would require approval for train loading 24 hours per day, 7 days a week.

The number of trains using the railway would increase from 1.5 to 3 trains per day during periods of average production and from 3 to 6 trains during peak production. This equates to 3 additional train movements per day during average production and 6 additional train movements per day during peak production, as shown in Table 14. This corresponds to an average net rail traffic increase on the Illawarra Railway of 2.6% to 3.8% during mid-week and weekend periods. This is considered very low in the context of cumulative rail usage.

Table 14: *Existing, Additional and Cumulative Train Movements*

Scenario	*Train Type*	*24 hour Train Movements**			
		Midweek		*Weekend*	
		Average	*Peak*	*Average*	*Peak*
Existing	Inter-Urban	71	71	40	40
	General Freight	16	16	10	10
	Coal Trains	22	33	23	52
	HCPL	3	6	3	6
Additional	HCPL	3 (2.6%)	6 (4.5%)	3 (3.8%)	6 (5.3%)
Cumulative	All	115	132	79	114

** One train is equivalent to two train movements (ie it arrives and departs).*

Any associated environmental impacts arising from the operation of the rail line are separately regulated by EPL 12208, held by RailCorp, and EPL 3142, held by ARTC. That said, part of the Metropolitan rail spur (from west of the product coal stockpile) is owned and operated by HCPL, so environmental impacts associated with that part would need to be regulated under either the project approval and/or amendments to HCPL's EPL 767. The Department has recommended a condition to manage noise emissions from the rail spur, which are summarised in section 5.9.

5.12.3 Conclusion

The Department is satisfied that the road and rail networks are capable of accommodating existing and proposed road and rail traffic associated with the project. Through the imposition of conditions, combined with commitments made by HCPL, the Department is satisfied that any residual environmental impacts can be satisfactorily managed.

5.13 Socio-Economic Benefits and Impacts

The EA includes a specialist socio-economic assessment of the project undertaken by Gillespie Economics. The PAC gave careful review to this assessment, which includes two forms of socio-economic assessment. The first considers the impact of the project on social welfare through a cost benefit analysis (CBA) while the second uses a regional economic impact assessment (IA) model to predict changes to the structure of the regional and state economies, including employment effects.

The two approaches have different purposes. CBA investigates the economic efficiency of the option to proceed with the project relative to the situation if the project was not permitted to go ahead. The Impact Assessment (IA) model allows for the consideration of the overall size and composition of changes that the project would impose on the economy at different scales. The CBA provides a basis for decision-making that applies the principles of welfare economics and is the tool of assessment most widely used internationally for such decisions. The IA modelling allows for assessment of distributional issues and depicts the compositional changes to the economy resulting from the proposed project. Levels of changes in rates of employment can be considered along with 'stress' points in the structure of the economy.

Both analyses present results that are supportive of the project. The CBA estimates the net production benefits of the mine (in present value terms at a 7% discount rate) to be $592m. Costs are estimated to be $156m, comprising predominantly payments made for the theoretical purchase of emissions permits relating to operational releases of greenhouse gases. The assessment indicates that the project would maintain a large number of jobs and inject considerable capital investment into Helensburgh and the broader Illawarra Region. The project would also provide considerable socio-economic benefits to the State.

This result is supported by further analysis undertaken to estimate the social impacts of mining. Choice modelling was used to estimate the social costs associated with mine closure at $756m. These costs are taken to be benefits of the continuation of mining as proposed, using the logic that avoiding a cost of mine closure is a benefit of the mine continuing. Choice modelling was also used to estimate the value in the community's eyes of the environmental costs to the Waratah Rivulet potentially arising from the project (as originally exhibited). The present value of these environmental costs of the mine was calculated to be $145m. With these benefits of the proposal incorporated, the net impact on the welfare of the society is estimated at $1047m ($596m - $156m - $145m + $756m).

The PAC considered that the CBA had probably under-estimated the net present value of the project. It substituted an alternative price forecast for coking coal, to reflect increasing resource scarcity and/or demand. Based on this alternative costing, the net present value of the project increases to $839m, rather than $436m.

The results of the IA were similarly supportive of the proposal. Over the life of the project, the mine is forecast to provide 700 direct and indirect jobs; including continued direct employment for 320 people. It would pay directly $56 million in annual household incomes and generate $372 million worth of annual business turnover in the Illawarra Region. The contributions to the NSW-wide economy are greater, with 1,951 jobs, $154 million annual household incomes and $687 million annual business turnover predicted to be generated. Other negative consequences would be felt in terms of lost community infrastructure such as housing, schools and hospitals.

The PAC accepted that the contribution of the mine to the local economy is significant and that there would be substantial costs of adjustment associated with any early mine closure. These adjustment costs, which are not accounted for in the IA, may include monetary costs associated with re-training of the workforce and relocation expenses. They may also include costs such as those relating to increased crime incidence, marital breakdowns and stress-related health issues resulting from unemployment, loss of job security and job futures.

The PAC also considered a variety of alternative mine plans and their associated net costs (ie the loss of coal production versus the environmental benefit achieved through watercourse protection, as estimated via choice modelling). These do not require to be reported as they do not relate directly to the preferred mine plan and do not include potential coal production in Areas A2 and A3. Just as significantly, they do not include the environmental benefits associated with protection of the Eastern Tributary and various Aboriginal sites and cliffs. The Department notes, as pointed out by the PAC, that these additional benefits may be sufficient to ensure that the environmental benefits of the PPR exceed the costs associated with loss of coal production.

In its submission, WCC did not request payment of Section 94 contributions. Given the static predictions for employment at the project, the ongoing growth of Helensburgh and the context of broader mine-derived socio-economic benefits, the Department does not consider that the project is likely to require the additional provision of public amenities and services within the area.

The Department is satisfied that HCPL has adequately assessed the social and economic impacts of the project, and that the social and economic benefits that would accrue from approval of the project would outweigh the social and environmental impacts that are likely to occur. Further, there are very significant social and economic costs that would result if the project was refused.

5.14 Other issues

Other issues relating to the project are outlined in Table 15.

Table 15: *Other issues*

Issue	*Features/Impacts*	*Conclusion/Mitigating Factors*
Site Water Management	Surface water management, particularly at the surface facilities	• The project currently has an extensive Water Management System in place at the surface facilities, comprising a series of collection dams and treatment systems. Runoff from the CHPP, workshop and stockpile areas is collected in the site water management system. Runoff from the administration and bathhouse area drains to Camp Gully. Runoff from other areas of the catchment upslope of the CHPP, workshop and stockpile areas is diverted around the north of the site, either into Helensburgh Gully or Camp Gully. • Water that is collected in the site water management system is treated and used to supply the CHPP and for dust suppression. It is also proposed to be used in the paste plant. Surplus water is managed and discharged off site via camp Gully, in accordance with EPL 767. This EPL has limits on discharge water quality but is unlimited in regard to volume. HCPL treats water prior to discharge off site. • HCPL would continue to operate in accordance with the Metropolitan Colliery Water Savings Action Plan, by undertaking initiatives to increase the efficiency of water use and minimise the requirements for make-up water and off-site water releases. • The Department believes the Water Management System would be capable of handling additional water inflows associated with upgrades of the CHPP and operation of the yet to be constructed paste plant and goaf injection technique. • However, the PAC had specific concerns with regard to the mine water balance and the likelihood of a system surplus as a result of potentially higher groundwater seepage than predicted in the EA. Future groundwater contributions to the mine water system were reported in the EA to average 55 Ml/year. However this contribution was revised upwards after groundwater re-modelling, and is now predicted to rise from 146 Ml/year at the commencement of Longwall 20 to 1277 Ml/year at the completion of mining. The PAC noted a potential need for increased water storage on site since there is currently only 0.6 Ml of storage with a further 1 Ml proposed. Adherence to this storage capacity may lead to a significantly increased number of discharges off site. • The PAC recommended that a comprehensive review of site water management should be conducted in consultation with DECC, covering the various stages in mine development of the mine. After the review is completed, then - the project EPL should be reviewed (focussing on whether an unlimited volume discharge remains appropriate in light of the revised mine water make estimates); and - any required infrastructure improvements be incorporated within the mine's Water Management System. • The Department agrees with these recommendations and has proposed conditions to this effect.
Coal Reject	Management of coal reject	• Approximately 8.5 Mt of coal reject would be produced over the life of the project, the majority of which would be in years 2021 through to 2030. Management of reject is proposed in two stages. Up until 2021, approximately 3.5 Mt of coal reject would continue to be trucked to Glenlee for emplacement. Following construction of the paste plant in year 2021, HCPL is proposing underground goaf injection of all coal reject material. • Approximately 700,000 tpa of coal reject could be injected into the voids and spaces of the underground mine goaf which is well above the annual coal reject volumes to be generated by the project. This technological advancement is an excellent environmental outcome which would eliminate the need to road haul to Narellan beyond 2021. • HCPL currently hold a development consent which permits it to emplace

		approximately 1 Mt of coal reject in Camp Gully, adjacent to the surface facilities. The Department recommends a condition which requires a further approval from the Director-General before any emplacement is permitted to take place on the surface of the site (including Camp Gully). • Part of the surface facilities area would be used to stockpile approximately 50kt of coal reject for the first few years of the project, prior to commissioning the full scale underground goaf system, and is excluded from this provision.
Odour	Odour impacts	• Coking coal extracted at Metropolitan Colliery is not susceptible to spontaneous combustion and associated odour generation. • The only source of odour impacts from the project would be coal seam gas emissions from existing Ventilation Shaft No 3 and the proposed Ventilation Shaft No 4. • Predicted odour emissions from operation of these shafts are predicted to be below the DECC odour assessment criterion. • Any odour generated from coal seam gas emissions is well within relevant criteria.
Vibration	Road and rail vibration impacts	• The project would not result in significant increases in the total number or type of heavy vehicle movements on the public road network or total rail movements on the rail network and existing road and rail vibration effects are not expected to change. • Neither truck nor train vibration levels were predicted to be above the damage vibration criteria of 5 mm/s. Truck vibration levels were predicted to be slightly above the annoyance vibration criteria of 0.5 mm/s when trucks travel at 60 km/hr and 80 km/hr at residential receivers less than 3.8 m away. Given that residences in Helensburgh are located between 7.5 and 15 m from the road and the speed limit is 50 km/hr, both criteria would be met. • Train vibration levels were predicted to be above the annoyance vibration criteria of 0.5 mm/s at some receivers less than 45 m away depending on the speed of the train. The closest residential receivers along the Illawarra Railway and the Metropolitan rail spur are approximately 500 m away and therefore train vibration should be well below the annoyance level.
Visual impacts	Visual impacts from the surface facilities area	• There are three surface areas that would be visible: the surface facilities area in Helensburgh, the existing Vent Shaft No 3 (including the proposed methane flare unit) and the proposed Vent Shaft No 4. • The existing surface facilities area is located in Helensburgh Gully, surrounded by steep valley sides to the north, west and south and shielded by vegetation. At present, the surface facilities area can not be seen by local residents, except during the night when a visible light glow exists. • Vent Shafts No 3 and No 4 would be located on the eastern side of the mining area with potential fleeting views from drivers using the F6 Freeway and Princes Highway (methane flare units would be enclosed). • The Department is satisfied that visual impacts are unlikely to be significant. HCPL has committed to implement a range of visual impact mitigation, which the Department recommends should be formalised by a condition of approval.
Rehabilitation	Rehabilitation of surface disturbance areas	• Rehabilitation of minor project surface disturbance areas would take place progressively throughout the project. • Rehabilitation of the surface facilities area, Vent Shaft Nos 3 and 4 and any residual minor surface disturbance areas would take place at the completion of the project. • A Rehabilitation Management Plan is to be prepared and implemented for the project in consultation with relevant stakeholders which would be required to meet a series of agreed rehabilitation objectives.
Waste	Management of general waste production	• HCPL would continue to apply general waste minimisation principles (ie re-use and recycling where practical) to reduce the quantity of waste that requires off-site disposal, and would produce a Waste Management Plan.

6 RECOMMENDED CONDITIONS

The Department has prepared recommended conditions of approval for the project (see Appendix A). These conditions are required to:

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

HCPL accepts the imposition of these conditions.

7 CONCLUSION

The Department has assessed the project application, EA, submissions on the project, the response to submissions and PPR in accordance with the relevant requirements of the EP&A Act, including the objects of the Act and the principles of ESD. The Department has also closely considered the PAC's findings and recommendations as part of its assessment of the merits of the project.

The assessment has found that the project (as amended by the PPR) would result in some adverse residual environmental impacts, primarily by way of subsidence impacts on natural features, particularly on limited sections of Waratah Rivulet and the Eastern Tributary and other watercourses. Other impacts are not predicted to be significant, and the Department is satisfied that they can be minimised, mitigated or managed through the imposition of a comprehensive range of conditions of approval.

The assessment has also found that the project offers a number of social and economic benefits for the region, as it would:

- extend the life of the Metropolitan Colliery by up to 23 years;
- provide increased security for 320 employees over the course of the mine life;
- attract $50 million in capital investment;
- directly produce $56 million in wages and salaries;
- lead to $372 million in annual business turnover in the Illawarra Region; and
- generate significant royalty and tax income for the Government.

On balance, the Department believes that the project represents a logical progression of existing mining operations at Metropolitan, is satisfied that its benefits sufficiently outweigh its costs and is able to be conducted in a manner that is consistent with the objects of the EP&A Act. Consequently, it believes the project is in the public interest and should be approved subject to conditions.

8 RECOMMENDATION

It is RECOMMENDED that the Minister:

- consider the findings and recommendations of this report;
- approve the project application, subject to conditions; and
- sign the attached instrument of approval (Appendix A).

19/6/09

David Kitto
Director, MDA

19.6.09

Chris Wilson
Executive Director, MPA

19/6/09

Richard Pearson
Deputy Director-General, DASP

20/6/2009.

Sam Haddad
Director-General