7 ENVIRONMENTAL IMPACT ASSESSMENT

A detailed discussion of the existing environment, the proposed works and the interaction between the two is provided in the following sections.

The proposed works would incorporate a number of mitigation measures that are identified in this EA. Macquarie Generation would implement these measures, which would include erosion and sediment controls, hardstand areas, and noise barriers, through the selected contractor as part of the proposed project.

7.1 Energy

7.1.1 Existing energy use

The WTP currently operates at a station capacity factor of 80% and uses 74,760,000 kilowatt hours (kWh) of electricity per year. This operation results in the emission of 70,274 tonnes of carbon dioxide per annum based on an emission rate of 0.94 kg of CO_2 per kWh. The most energy-intensive components of the existing operation are the brine concentrators.

7.1.2 Assessment of effects

An 88% station capacity factor would be required under the worst-case scenario for the proposed project. This equates to an additional energy requirement of 7,463,600 kWh/yr. The proposed installation of the crystallisation stage would consume approximately 17,776,400 kWh/yr. The maximum energy consumption for the upgraded WTP is therefore predicted to be up to some 100,000,000 kWh/yr. The power stations would be able to supply this additional energy without affecting the supply to other customers. This level of consumption would result in the emission of approximately 94,000 tonnes of CO_2-e, which is around 24,000 tonnes more than that emitted by the current operations.

It is important to note that although the proposed installation of the crystalliser phase would generate greater greenhouse gas emissions, the crystalliser would reduce both the amount of waste to be disposed of and water required to be drawn from the Hunter River. Further details of these reductions are discussed in **Section 7.2** and **Section 7.3**.

7.1.3 Environmental safeguards

Macquarie Generation participates in a number of initiatives to reduce the emission of greenhouse gases from its operations. Macquarie Generation entered into a Greenhouse Challenge Cooperative Agreement with the Commonwealth of Australia in 1997 and has been active in meeting the targets set in the agreement.

An example of this is a recently completed upgrade of the low-pressure turbines on all four units at Liddell Power Station. Prior to the upgrade, the turbines utilised 1960s technology with a designed cylinder efficiency of 85 - 86%. Since the 1960s there have been significant advances in turbine design, with current design technologies achieving efficiencies of 94 - 95%. The turbine upgrade has resulted in a thermal efficiency increase at the station of 1%. This equates to a greenhouse gas abatement of approximately 300,000 tonnes of CO_2-e per annum.

Another example of greenhouse gas reducing activities undertaken by Macquarie Generation is the installation of a Distributed Control System on all four generating units at Liddell Power Station in April 2004 that replaced the analogue control system. This project has been achieving abatements of up to 30,000 tonnes of CO_2-e per year.

Macquarie Generation is also a signatory to the Commonwealth Government's Generator Efficiency Standards Program. Works undertaken for this program include the completion of a modification to the cooling tower sprays on one unit at Bayswater Power Station that has resulted in savings of some 4,000 tonnes CO_2-e. Similar modifications are planned for the other three units at Bayswater Power Station.

7.1.4 Conclusion

The greenhouse gas abatements being achieved by Macquarie Generation would more than compensate for the emission of an extra 24,000 tonnes of carbon dioxide per year. These abatements mean that the emissions from the proposed works would be offset and would not have an adverse cumulative effect on the environment.

7.2 Waste

7.2.1 Existing waste generation

The WTP has two main waste streams. The LSP produces a waste sludge made up of calcium and magnesium that has been removed from the makeup water. Up to 4,000 tonnes of sludge are produced each year at current generating capacity.

The RO trains concentrate TDS on one side of the RO membranes. The concentrated TDS or reject stream is directed to the BC Plant. The BCs recover approximately 95% of the water from the waste and produce concentrated brine. The BCs currently produce approximately 48 ML of waste brine per year. There are also minor waste streams from the RO pre-treatment equipment, including the dual media filters. The waste stream is fed to two wash water holding sumps. Most of the water in the sumps is recycled in Bayswater's main cooling system via two solid water separators. Waste sludge from the wash water holding sumps and solids water separators is directed to the LSP waste stream.

7.2.2 Existing waste disposal

Waste from the LSP and the RO pre-treatment equipment is currently gravity-fed to five sludge lagoons. The lagoons are filled one at a time, and are dried out by evaporation when full. The solid sludge is disposed of in the Pikes Gully (Bayswater Power Station) ash dam, while the supernatant is fed back to the LSP clarifiers.

Waste from the BCs is disposed of to the brine decant basin. The basin has a total capacity of some 900 ML with a Full Service Level (FSL) or brine disposal capacity of approximately 650 ML. The basin currently contains around 475 ML. **Table 4** summarises the main waste streams and their management methods.

Table 4: Waste Streams and Management Methods

Waste	Quantities	Classification	Management Method
LSP waste sludge (calcium and magnesium)	~ 4,000 tonnes/year	Currently licensed by DEC for on-site storage	Evaporation in sludge lagoons; solid sludge disposed of in Pikes Gully ash dam; supernatant fed back to LSP clarifiers.

Waste	Quantities	Classification	Management Method
Waste brine	~48 ML/year	Currently licensed by DEC for on-site storage	Disposed of in brine decant basin.
CWT sludge	~ 0.6 ML/day (~219 ML/year)	Currently licensed by DEC for on-site storage	Disposed of in brine decant basin.

7.2.3 Assessment of effects

Construction of the proposed works would see waste production and disposal continue predominantly in the current manner with some minor changes.

The amount and makeup of waste from the LSP would remain unchanged. The existing LSP sludge lagoons would be retained for settling and separation of the sludge from the LSP.

Waste would be generated from the reinstated AR process and the additional RO process. This waste would pass through the BCs and then through the additional step of crystallisation, which would reduce the amount of waste being disposed to the brine decant basin.

Modelling of the operation of the decant basin has revealed the basin has sufficient capacity to contain waste from the proposed final stage crystalliser for 17 years at full production after commissioning.

- Crystalliser waste salt addition to the decant basin — 37,400 tonnes/yr
- Crystalliser waste water addition to the decant basin — 22,000 tonnes/yr
- The current quantity of salt in the decant basin — 220,000 tonnes
- The current water content — 475 ML
- Net evaporation rate — 0.44 m/yr (which will remove 44,000 T/yr to 48,000 T/yr depending on surface area)
- Surface area of brine — 100,000 to 110,000 m^2 (depending on height)

The total volume of clear brine would reduce from the existing 475 ML to zero in 11 years. This is because the crystalliser would reduce the amount of water discharged to the basin and net evaporation rates are greater than water input rates. The total volume of precipitated brine would increase from 83 ML to a final level of 1000 ML in 30 years. The FSL of the decant basin is 650 ML, which is anticipated will be reached in 17 years.

A number of options will be assessed to manage the brine level in decant basin to ensure its serviceability after the FSL is reached. These include:

- Increasing storage capacity by raising the decant basin dam wall; and
- Terracing and capping dry salt at the back end of the dam.

Clear brine will have evaporated after 11 years, leaving an increasing volume of brine precipitate. Brine (water with soluble salts) will be present within the brine precipitate (between

the solid salt particles). The precipitate will be dry on the surface of the decant basin but will remain wet below the surface.

The proposed construction of four sludge lagoons in the Pikes Gully ash dam to receive sludge from the CWT plants is an additional step in the waste disposal process. The ash dam would be excavated in order to create a fully enclosed embankment around the lagoons. It is expected that the lagoons would not require lining as they would be located entirely within the ash dam, and any seepage would therefore be captured by the ash dam leachate control systems. The dimensions of the proposed sludge lagoons are likely to be 45 m by 110 m with a depth of 1.7 m. This would provide a total settling/evaporation area of approximately 2 hectares and a capacity of some 33.7 ML with a retention time of 63 days for the estimated 0.6 ML/d sludge flow from the CWT plant.

The supernatant in the proposed lagoons would overflow into a central sump and then be pumped to the supernatant sump of the existing LSP sludge lagoons. The existing pump arrangement at the LSP sludge lagoons would be adequate for returning the supernatant from both the LSP and the CWT back to the LSP.

7.2.4 Environmental safeguards

Waste disposal would be managed in accordance with the EMS developed for the site, and would also comply with the requirements of the existing Environment Protection Licence (EPL) for the premises.

7.2.5 Conclusion

The changes that are proposed for waste generation and disposal would not have an adverse effect on the environment. The proposed works would have a positive outcome as more water would be recycled in the power station and the quality of water in Lake Liddell would be improved by the increased salt removal efficiency.

7.3 Hydrology, Hydrogeology and Water Quality

7.3.1 Existing environment

Hydrology

The main hydrological feature of the region is the Hunter River, which drains the Hunter Valley. It originates in the Barrington Tops, passes just west and north of Muswellbrook and then discharges into the ocean at Newcastle. While the Glenbawn and Glennies Creek Dams regulate river flows, fluctuations in rainfall result in variations in the flow of this river. The Hunter River and its tributaries are known to both flood and cease to flow at times (DUAP, 1997).

Other significant water bodies within the boundaries of Macquarie Generation's land and the Lake Liddell catchment area are:

- Lake Liddell, which was created in the late 1960s and provides cooling water for Liddell and Bayswater Power Stations. The lake has a surface area of 1,133 ha and a storage capacity of 152,000 ML;
- Freshwater Dam, to the west of Bayswater Power Station, which is a domestic supply dam formed by the damming of Tinkers Creek (the nearest creek to the WTP). This dam

provides domestic water requirements and water for fire services for the Bayswater and Liddell Power Stations; and

- Plashett Dam, which is situated south of Bayswater Power Station and provides a buffer supply of untreated Hunter River water to the power stations. It has a storage area of 500 ha and a capacity of 64,000 ML.

Tinkers Creek runs into Lake Liddell and currently collects all stormwater runoff from Bayswater Power Station and the coal plant area after the water is passed through an oil-water separator. The creek also receives water from the power station processes.

Hydrogeology

The Hunter Valley holds an estimated 30 million megalitres of groundwater. Groundwater is used for a number of purposes in the area including irrigation, town water supply, domestic purposes and commercial uses. Around 30% of the Hunter's groundwater is in the Upper Hunter Alluvium and is of good quality apart from nitrate levels, which exceed human consumption guidelines (EPA State of the Environment Report, 2003). The depth to groundwater in the Upper Hunter area ranges between less than three metres to greater than 50 metres (DUAP, 1997). Due to the topography of the region, groundwater discharge comprises a good proportion of the base flow in the Hunter River.

The hydrogeological conditions of the area of the proposed works were assessed in the Environmental Impact Assessment for the Proposed Sodium Chlorate Plant (NECS, 2001) that was to be located within the Macquarie Generation Industry Zone. The assessment determined that the conditions in the area are relatively complex due to the significant faulting in the area and the rapid changes in lithology.

Water samples taken from various collieries in the region have shown that the TDS concentration is frequently in the range of 4,000 - 5,000 mg/L. The water is often highly acidic.

In general, the trend in the Muswellbrook area is for moderate to high salinity. The saline nature of the coal seams in the Hunter Valley and the presence of groundwater in these areas create the ongoing issue of salinity in the region. Groundwater flow would be relatively high in the region due to jointing associated with significant faulting and folding. Due to these background salinity levels, the groundwater in the area of the proposal is not considered to be vulnerable.

The area downstream of the brine decant basin has been subjected to some saline seepage from the basin. This situation was reported formally to DIPNR (now DOP) in the report for the year ending 30 June 2004 in accordance with the Water Management Licence requirements. This report is contained in **Appendix 1**. Following notification, the Department of Environment and Conservation (DEC) inspected the site on 9 August 2005.

Water Quality

Tinkers Creek was dammed in the 1980s to form Freshwater Dam. This action significantly modified the local hydrology, and the creek system now drains to Lake Liddell rather than the Hunter River system. The creek currently receives stormwater runoff from the power station and coal plant area, licensed water discharges from the power station (oil-water separator and the cooling towers), surface water runoff from the catchment area west of the creek line during rain events and the overflow from Freshwater Dam. The quality of discharges to the Creek by Macquarie Generation must meet the limits specified by the EPL, which are outlined in **Table 5**.

Table 5: Water Discharge Limits

Discharge Point	Parameter	Licence Limit
Oil-water Separator	Oil & grease	10 mg/L
	Total Suspended Solids	20 mg/L
Cooling water tower discharge	Conductivity	4500 μS/cm
	pH	6.5-8.5

Macquarie Generation is required to dispose of salt in water from Lake Liddell in accordance with the requirements of the HRSTS. The requirement to limit the discharge of saline water to the Hunter River would continue to apply following the improvements to the WTP.

7.3.2 Assessment of effects

Hydrology/Hydrogeology

The proposed WTP works would take place within the existing plant, with some minor changes to external features such as the proposed sludge lagoons. The hydrology and hydrogeology of the area would be unaffected by the proposed project during both the construction and operational phases. Construction would occur on an existing site, with only minimal excavation required; therefore, groundwater quality and flows are unlikely to be affected. Appropriate erosion and sediment control measures during construction would minimise potential effects on surface water quality. The existing surface water discharge regimes would be maintained for the proposed project, with the quality of the water discharges expected to improve.

The long term effect of the decant basin on groundwater in the area will be better determined once the final design of the WTP works is known. Macquarie Generation proposes to work toward a solution with the DEC and DNR once the decision on the final design is made. The treatment of the existing contamination is likely to include interception of seepage and pumping the captured material back to the decant basin.

Water balance

The proposed improvement works will not affect the amount of water drawn from Lake Liddell or the Hunter River as water use is dependent on operating capacity of the power stations. Rather, the works will result in increased water recycling within the power stations; the potential installation of a crystalliser stage would result in a 40% increase in water recovery from the waste brine. Additionally, the improvements will reduce the need to discharge salt through the Hunter River Salinity Trading Scheme.

7.3.3 Environmental safeguards

The following environmental safeguards would be implemented where earthworks occur in order to minimise potential effects on hydrology and water quality during construction:

- Clean water diversion drains would be constructed to divert runoff away from disturbed areas;
- Straw bales/sediment fences would be installed around disturbed areas;
- Land disturbance would be confined to minimum workable areas;
- Excavation works would be suspended during heavy periods of rainfall;
- Monitoring and maintenance of erosion and sediment control structures would occur throughout the life of the project;

- Disturbed areas would be watered to control dust during windy and dry weather;
- The Department of Housing's *Managing Urban Stormwater: Soils and Construction,* 4th edition (DoH, 2004) (the "blue book") would be adhered to when undertaking erosion and sediment control measures;
- Temporary soil and water management structures would be removed only after the disturbed area had been sufficiently stabilised.

7.3.4 Conclusion

Hydrology and hydrogeology are unlikely to be affected by the proposed project. The potential for temporary effects on surface water quality during construction can be mitigated through appropriate erosion and sediment control measures. The installation of the proposed crystalliser stage would also reduce the requirement for additional water supply and, over time, would reduce the effect of the brine decant basin on groundwater.

7.4 Hazards and Risks

7.4.1 Introduction

A hazard is identified as a physical situation with the potential for human injury, damage to property, damage to the environment, or some combination of these factors. Risk is determined by:

- The potential for human or environmental exposure to the hazards given the existing and proposed site land use; and
- The presence of significant ecological receptors.

7.4.2 Guidelines

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) was gazetted on 13 March 1992 and provides a merit-based assessment approach to the consideration of off-site risk and offence resulting from a proposal. Guidelines were published in 1994 by the Department of Urban Affairs and Planning (now DoP) to provide advice on the interpretation and implementation of SEPP 33.

7.4.3 Assessment of effects

As discussed in **Section 3.3.3**, the proposed WTP works are not considered to be hazardous or potentially offensive development.

The improvements to the WTP would include the replacement of storage tanks for various chemicals required in the water treatment process. There is the potential for hazardous substances to be spilt during the construction and operational phases of the project.

The volume of acid stored on site would also increase. This acid would be stored in sufficiently bunded areas in accordance with the Occupational Health and Safety regulations for dangerous goods and the EMS. Storage of soda ash was included in the original water treatment process and may again be required pursuant to the detailed design of the improvement works.

7.4.4 Environmental safeguards

The chosen construction contractor and subsequent plant operator would be required to have adequate emergency spill kit equipment on site at all times to deal with potential leaks from vehicles, equipment and construction processes. All equipment brought onto the Bayswater Power Station site is required to be in proper working order and maintained in accordance with the manufacturer's specifications to maximise performance and minimise emissions. Emergency procedures, including containment and clean up of spills, as well as the notification of these events to Macquarie Generation personnel, would be included in emergency procedures outlined in the EMP of both the construction contractor and plant operator.

All of the chemical storage areas forming part of the upgraded WTP would have adequate bunding designed in accordance with Australian Standard 1940:2004, and would be managed in accordance with Macquarie Generation's current handling procedures. Regular inspections of chemical storage areas would also be undertaken.

7.4.5 Conclusion

The construction and operational phases of the proposed WTP works would involve the storage and use of potentially hazardous materials. The implementation of the above mitigation measures would ensure that potential risks could be identified and measures put in place, such as bunding or procedural controls, so that these risks could be minimised. Emergency procedures and clean-up equipment would be on site in the event of spills.

7.5 Noise

7.5.1 Existing environment

The WTP is relatively remote from residential receivers, as shown in **Figure 6**. The nearest sensitive receptors are located at the Antiene subdivision, which is more than five kilometres from the plant and behind a ridgeline. The Drayton coal mine and rail spur lie between the subdivision and the power station. Jerrys Plains, over 10 km from the WTP, is the second closest location of residents. Discussions with the DEC confirmed that noise impacts upon the public are not an issue of concern for the proposed works.

The WTP is directly within the footprint of the Bayswater Power Station; the noise environment is therefore dominated by activities within the power station itself rather than the operation of the WTP. No community complaints regarding noise have been received at Bayswater Power Station.

7.5.2 Noise control criteria

The successful contractor for the proposed development would be required to ensure that all equipment adheres to the requirements of the relevant Australian Standards. These standards include:

- AS 1055.1-1997 : Acoustics - Description and measurement of environmental noise - General procedures;
- AS1269.0: 2005 : Occupational noise management - Overview and general requirements;
- AS1269.1: 2005 : Occupational noise management - Measurement and assessment of noise emission and exposure;
- AS1269.2: 2005 : Occupational noise management - Noise control management;

- AS1269.3: 2005 : Occupational noise management - Hearing protector program;
- AS1269.4: 2005 : Occupational noise management - Auditory assessment; and
- AS2436:1981: Guide to noise control on construction, maintenance and demolition sites.

Adherence to these Standards would ensure the protection of hearing of workers at the WTP through measures such as the installation of soundproof enclosures, which would also reduce the noise experienced outside the premises' boundary.

7.5.3 Assessment of effects

It is unlikely that noise generated from the existing development would be significantly changed by the proposed works. As all noise generating equipment would be enclosed and the nearest sensitive receptors are over five kilometres away, adverse noise impacts are not expected.

7.5.4 Environmental safeguards

In accordance with the relevant Australian Standards, all significant noise generating equipment would be enclosed in soundproof barriers to ensure the protection of the hearing of workers in the vicinity of the plant. As these barriers would fully enclose the equipment, significant noise reductions would be achieved that would also reduce the potential for noise impacts to be experienced outside of the boundaries of the premises.

7.5.5 Conclusion

Due to the remote location of the WTP, and the power station itself being the dominant noise source in the area, it is expected that the proposed WTP works would not have an effect on the surrounding existing noise environment.

7.6 Air Quality

7.6.1 Existing environment

The existing air quality in the area immediately surrounding the site is influenced by a variety of factors, including prevailing meteorological conditions, topography, current power station operations, mining and agricultural activities.

Environmental monitoring data have been sourced from dust monitors placed by Macquarie Generation at Ravensworth Village [Dust Deposition (DDR), Total Suspended Particulates (TSP) and PM_{10}] and along Hebden Road (DDR). All data were collected in accordance with the NSW EPA publication "*Approved methods for the sampling and analysis of air pollutants in New South Wales*" (July 2001).

Results of available monitoring data (12 months between May 2004 and April 2005) are summarised in **Table 6**.

Table 6: Ambient Air Quality Data

Month	Dust Deposition Rate - Ravensworth		Dust Deposition Rate - Hebden Road		TSP	PM_{10}	
	Insoluble Solids	Ash Residue	Insoluble Solids	Ash Residue		Average	Maximum

Units	g/m²/month	g/m²/month	g/m²/month	g/m²/month	µg/m³	µg/m³	µg/m³
May-04	4	2.3	3.3	2.4	112	43	99
Jun-04	2.2	1.3	1.7	1.2	79	30	43
Jul-04	2.6	1.4	2.2	1.4	64	27	43
Aug-04	2.1	1.5	3.1	2.1	73	26	40
Sep-04	1.3	0.9	1.5	1	56	25	45
Oct-04	2.7	1.8	3.2	1.7	63	25	39
Nov-04	1.4	1.1	2.2	1.5	59	26	39
Dec-04	3.1	2.3	1.7	1.3	37	20	39
Jan-05	2	1.4	2.6	1.6	46	37	58
Feb-05	5	2.9	3.3	2.3	76	30	53
Mar-05	3.5	2.4	2	1.6	92	38	64
Apr-05	3.5	2.5	3.4	2.4	74	22	30
Annual Average	**2.8**	**1.8**	**2.5**	**1.7**	**69**	**29**	**--**
Maximum	**--**	**--**	**--**	**--**	**--**	**--**	**99**

From the above table, it can be seen that the background concentrations of the relevant air quality measures are as follows:

- PM_{10} annual average concentration of 29.0 µg/m^3;
- TSP annual average concentration of 69 µg/m^3;
- DDR rate of 2.8 g/m^2 month (worst case average background DDR recorded at Ravensworth and Hebden Road);
- Annual maximum PM_{10} 24 hour average concentration of 99 µg/m^3.

There are many particulate emission sources surrounding Bayswater Power Station including coalmines, agricultural industries and roads that contribute to the high background levels of dust in the area.

7.6.2 Ambient air quality criteria

The assessment criteria relevant to the proposed WTP works are presented in **Table 7**.

Table 7: Air Quality Standards/Goals for Particulate Matter Concentration

Pollutant	Standard/Goal	Agency
Total Suspended Particulates (TSP)	90 µg/m^3 (annual mean)	NHMRC
Dust Deposition Rates (DDR)	2 g/m^2/ month (Allowable Increase) 4 g/m^2/ month (Maximum DDR)	DEC
Particulate Matter <10 µm (PM_{10})	150 µg/m^3 (average of 99th percentile of 24-hour averages over 3 years)	US EPA Primary standard
	50 µg/m^3 (annual mean)	US EPA Primary standard
	50 µg/m^3 (24-hour maximum)	DEC Reporting standard
	30 µg/m^3 (annual mean)	DEC long term goal

	50 μg/m^3 (24-hour average, 5 exceedences permitted per year)	National Environment Protection Measure (NEPM)

Each of the above goals and standards is applied in different contexts.

The NSW EPA 24-hour average PM_{10} reporting standard and 'Long-term reporting goal' are part of a suite of goals intended to both guide the development of control strategies and to be used for reporting purposes (NSW EPA, 1998 – Page 13).

The proposed modifications would be assessed using the NSW EPA 24-hour PM_{10} 50 μg/m^3 standard and annual 30 μg/m^3 long term goal (NSW EPA, 2001). Amenity criteria would be the 90 μg/m^3 goal for TSP (NSW EPA, 2001) and the 2 g/m^2/month maximum increase and 4 g/m^2/month maximum for DDR (NSW EPA, 2001).

7.6.3 Assessment of effects during construction

Construction activities associated with the proposed WTP works have the potential to cause the generation of dust as components of the existing WTP are removed or as footings are being prepared for new pieces of equipment. Machinery used to remove plant and equipment or install and replace the existing equipment may also generate air emissions.

7.6.4 Assessment of effects during operation

The operation of the WTP following installation of the proposed improvements is unlikely to have a significant effect on air quality. Wastes sent to the LSP lagoons, the brine decant basin and the proposed CWT lagoons will be in a slurry form. On drying, these wastes will form a crust that is unlikely to produce dust, even under high wind conditions.

The operation of the WTP would indirectly cause an increase in the emission of CO_2 as a result of increased energy usage. The impacts of this are discussed in **Section 7.1**.

7.6.5 Environmental safeguards

The successful contractor would be required to implement dust suppression measures during construction works. These measures would be designed in accordance with the requirements of Macquarie Generation's *Standard Requirements for Work at Site* and the *Contractor Environmental Management Plan Guidelines and Assessment Checklist* (**Appendix 4**), and would be included in the chosen contractor's EMP for the construction of the proposed WTP works. The maintenance of the safeguards discussed in **Section 7.3.3** would also ensure the prevention of dust emissions.

Successful tenderers would be required to maintain all equipment as per the manufacturer's specifications to maximise performance and minimise air emissions. These measures would also form part of the EMP for the construction of the proposed modifications.

Carbon dioxide emitted as a result of the operation of the upgraded WTP would be offset by various actions and initiatives undertaken at both Bayswater and Liddell Power Stations as part of an ongoing commitment to improve performance and reduce greenhouse gas emissions (see **Section 7.1.3**).

7.6.6 Conclusion

Emissions of dust to the air can potentially occur during the construction phase of the proposed works. The implementation of the above mitigation measures would, however, ensure that adverse impacts upon the environment were minimised.

There would be minimal air emissions during the operational phase of the WTP as a result of the proposed works. Additional CO_2 emissions would be produced as a result of the proposed improvements, but these would be offset by ongoing CO_2 abatement actions undertaken by Macquarie Generation.

7.7 Ecology

7.7.1 Existing environment

The Bayswater Power Station land sits in a mosaic of grassland and regenerating woodland. The locality has had a history of clearing due to agricultural and industrial activities. The regenerating woodlands are known to support significant species protected by the provisions of the Threatened Species Conservation (TSC) Act 1995. The local area also supports a nationally significant population of the Green and Golden Bell Frog that is protected by the provisions of the TSC Act and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

7.7.2 Assessment of effects

The Bayswater Power Station site was extensively cut and filled during its construction. As the proposed WTP works would require only minor site preparation, and most of the plant items would be installed on existing hardstand areas, no effects on flora or fauna are anticipated. Some new pieces of equipment, such as the BCs and crystalliser, may require trenching for footings, but these preparations are not expected to affect flora or fauna since they would fit within the existing footprint of the WTP.

No clearing of native vegetation would be required for this proposal. No additional ground disturbance would affect woodland vegetation or aquatic habitats. No expansion to the existing brine concentration pond area would be required. Additional sludge ponds may be required, but these would be located within the Pikes Gully ash dam, which is a highly modified environment. No adverse ecological effects would be expected from this action.

7.7.3 Environmental safeguards

As no ecological effects are anticipated from the proposed project, no environmental safeguards are required.

7.7.4 Conclusion

The proposed WTP works would not result in adverse effects on flora or fauna.

7.8 Social and Economic

7.8.1 Regional setting / overview

The site of the proposed WTP works is located in the Muswellbrook Shire in the Hunter Valley of NSW. The Hunter Region comprises approximately 4 percent of the area of New South

Wales, and contains around 8.8 percent of the State's population. The proposed WTP works would be located wholly within the Bayswater Power Station site, which is surrounded by intensive coal mining and pockets of grazing land.

Nearly half the population of the Upper Hunter region is found in the Muswellbrook and neighbouring Singleton Local Government Areas (LGAs). The population of the Muswellbrook LGA declined slightly between 1996 and 2001, while that of the Singleton LGA increased slightly. Changes in population distributions have been attributed to changes in the mining and electricity generating industries, where job losses and restructuring have resulted from increased efficiencies of plant and equipment. Over the same period, the population of the Hunter Region and NSW as a whole both increased, as can be seen in **Table 8**.

Table 8: Population Distribution

	1991		1996			2001		
	Population	% Total Hunter	Population	% Total Hunter	Av. Annual Growth 1991-1996	Population	% Total Hunter	Av. Annual Growth 1996-2001
Muswellbrook	15,109	2.9	15,562	2.9	0.6%	14,796	2.6	-1.0%
Singleton	18,661	3.6	20,133	3.7	1.5%	20,383	3.6	0.2%
Total Hunter	513,701	100	540,490	100	1.0%	563,586	100	0.8%
NSW	5,732,032		6,038,696		1.0%	6,371,745		1.1%

Source: Australian Bureau of Statistics, Population Census 1991, 1996, 2001.

Population growth projections performed by the Hunter Valley Research Foundation show a continual declining trend for the Muswellbrook area, with an expected average decline of 3.4% over the years to 2026. This expected decline is partly the result of the ageing baby-boomer population and low birth rates.

Employment levels in the Muswellbrook area are high, with over 10% employed by the mining industry. The other main industries in the area are electricity generation, wine manufacturing, horse farming and beef cattle farming. Mining is also a large employer in Singleton, accounting for 14% of the working population. An additional 5.6% is employed in Defence.

7.8.2 Services

The Muswellbrook LGA is well serviced by recreational, educational, community and health facilities, as well as commercial and professional services. Muswellbrook provides an extensive range of recreational, sporting and cultural activities, including all major sports, arts and crafts, music and dance, youth clubs, licensed clubs and hotels, restaurants, and service clubs, such as Rotary and Lions clubs. Muswellbrook also has services such as Police, Fire Brigade, SES, and a courthouse, and is the main commercial centre in the area. It contains a large modern shopping mall, supermarkets, and a wide range of professional, banking and other commercial services.

Public transport in the area consists of a local bus service and a railway station on the State Rail Network. A taxi service is also available.

7.8.3 Existing employment

Employment statistics as published in Macquarie Generation's 2004 Annual Report indicate that the electricity generator employed a total of 608 people at its Bayswater, Liddell and Lambton sites.

7.8.4 Assessment of effects

The WTP improvements would have a beneficial effect on employment and the economy. Services in the area are capable of accommodating the additional requirements of contractors or permanent employees of the new facilities, and the additional investment in the area would have flow-on effects to local businesses.

Approximately 80 people would be employed during the construction phase of approximately 18 months. It would therefore not have a significant effect on the local socio-economic environment as employment, housing and community services would not be affected in the long term. The injection of a large amount of capital into the region during construction would, however, benefit engineering firms and construction workers, which would have flow-on effects for the local communities. Experience from similarly sized projects has indicated that sufficient temporary accommodation is available in the area should these workers wish to reside close to the project site for periods of time. Local residents are also likely to benefit from the short-term employment opportunities created by the development.

The operation of the WTP following the proposed works would require an additional fifteen personnel supplied by the contractors operating the plant. This small number of employees would not significantly affect the socio-economic environment of the region.

The deregulation of the electricity market requires electricity generators to maintain competitiveness in their production, marketing and sale of electricity if they wish to maintain their profitability. The proposed project would enable Macquarie Generation to increase the salt removal capacity of the WTP and optimise the plant's performance over the next thirty years, ensuring the ongoing profitability of the power stations and improving the sustainability of operations.

7.8.5 Environmental safeguards

As no negative social or economic effects are anticipated from the proposed project, no safeguards are required.

7.8.6 Conclusion

The proposed works would enhance the operational and environmental performance of the WTP. The proposed works would not result in adverse social effects and would have beneficial economic effects for the region.

7.9 Heritage and Archaeology

7.9.1 Existing environment

The WTP sits wholly within an area disturbed by the initial construction of the Bayswater Power Station. No Aboriginal artefacts requiring salvage were identified in the area during the assessment for the original Bayswater Power Station EIS. There are no items of significant European heritage value located in the immediate vicinity of the existing WTP.

7.9.2 Assessment of effects

As the proposed WTP works would require only minor site preparation, and most of the plant items would be installed on existing hardstand areas, no effects on heritage and archaeological items are anticipated. Some new pieces of equipment may require trenching for footings, but these preparations are not expected to affect heritage or archaeological items as they would occur within the existing disturbed footprint of the WTP.

The proposed CWT sludge dams would be constructed within the ash dam and as such would be unlikely to affect heritage items.

7.9.3 Environmental safeguards

The EMP of the chosen contractor would incorporate a requirement for work to immediately cease if a suspected Aboriginal artefact was discovered, and work would not recommence until advice had been sought and received from the DEC.

7.9.4 Conclusion

The proposed WTP works would not result in adverse effects on heritage and archaeology.

7.10 Landform and Soils

7.10.1 Existing environment

Regional Geology

The geology of the area has been mapped on the Hunter Coalfield Regional Geology 1:100,000 map (1987). The study area is in the vicinity of the Greta Coal Measure, just within the north-eastern boundary of the Sydney Basin, which is marked by the Hunter Thrust System. The most extensive outcropping in the area is the Narrabeen Group, which is mostly sandstone with some conglomerate, claystone and shale. Other rocks present are quartz sandstone (Hawkesbury Sandstone), siltstone, tuff, limestone and basalt. The Greta Coal Measure also has coal measures containing a mixture of sandstone, shale, mudstone, conglomerate and coal seams, with minor amounts of tuff and chert.

Two broad geological formations exist in the study area. Both are Permian period formations: Pmm (Mulbring Siltstone) and Pmb (the Branxton formation). The WTP sits partially in the Pmm formation, which consists of siltstone, claystone, and minor fine-grained sandstone, and partially in the Pmb formation. This consists of conglomerate, sandstone and siltstone.

Many major structural features are located in the vicinity of the WTP, including the Hunter Thrust (to the north east of the WTP), the Bayswater Syncline (to the east of the WTP) and the Muswellbrook Anticline (found to the west of the area). The WTP does not overlie any of these features.

The study area also falls within the Central Lowlands topographic zone in the Liddell soil landscape. This landscape is characterised by undulating low hills and undulating hills, with elevations of 60-120 m, and slopes of 4-7%.

Seismicity

The Australian Geological Survey Organisation developed an earthquake hazard map of Australia for use in the Australian Building Code. The earthquake hazard is defined as the maximum ground movement predicted to occur in the next 500 years with a ten percent chance of it happening within the next 50 years. The Muswellbrook area has an earthquake hazard of 0.08. As a reference, an earthquake hazard of 0.05 is the point at which damage typically starts to occur. The extent of damage is dependent upon local ground conditions; alluvium and fill typically amplify earthquake waves and cause structures overlying these materials to fail.

Soils and Land Capability

The WTP is located within the Liddell soil landscape. The Liddell soil landscape is characterised by yellow Soloth soils that are found on slopes and yellow Solodic soils found on concave slopes. Minor to severe sheet erosion is common in this soil landscape, with some minor rill erosion. Drainage lines may experience moderate gully erosion (to 1.5 m) with salting (Kovac & Lawrie, 1991).

The land on which the WTP is located is classified Class V under the Soil Conservation Service of NSW Capability Assessment System. Class V land is considered to be suitable for grazing and occasional cultivation, but requires intensive soil conservation measures for grassland. This type of land is characterised by problems with erosion. The area has a low flood hazard potential (Kovac & Lawrie, 1991).

7.10.2 Assessment of effects

The Bayswater Power Station site was excavated during its construction. As such, the area of the proposed WTP works is level and the proposed works would be located primarily on existing hardstand areas with no need for excavation. While some pieces of plant may require trenching for footings, this work would be minimal.

The proposed construction of sludge dams in the ash dam would require some earthworks. The ash dam, however, is a fully contained system designed to ensure that no sediment escapes. There is therefore little potential for effects to occur outside the ash dam.

7.10.3 Environmental safeguards

The safeguards outlined in **Section 7.3.3** would ensure that soil erosion is minimised. These safeguards would be incorporated into the contractor's EMP for construction.

7.10.4 Conclusion

The potential for soil erosion is minimal as most new pieces of plant would be located on areas that are already paved. The implementation of mitigation measures in excavation areas would ensure that there are no adverse effects upon the environment as a consequence of the proposed WTP works.

7.11 Land Use

7.11.1 Surrounding land use

The Upper Hunter Valley of NSW is an area known primarily for its coal deposits. Coal mining is the principal land use activity and employer in the region, particularly in the Muswellbrook Shire. Agricultural activities such as dairy and cattle farming, oilseed and hay production, together with viticulture and horse studs, are other major industries in the area. The region is of great economic significance to the State and country due to its large volume of exports. Open cut mines in the area produce the majority of the State's coal, with current production rates of approximately 80 million tonnes per annum that have an associated export value of around $8 billion. The two power stations produce approximately 40% of the State's electricity, and are a primary consumer of the area's coal. Land use in the area surrounding the location of the proposed WTP works is shown in **Figure 7**.

7.11.2 Existing land use

The WTP is located within the Bayswater Power Station site. The proposed works would be located in an area that is currently used for water treatment purposes and ash disposal.

7.11.3 Assessment of effects

The proposed improvements would only affect land that is already used by the Bayswater Power Station, such as areas used for water treatment purposes and some unused areas directly under the cooling towers of the power station. Option 1 may also require the construction of four sludge dams in the Pikes Gully ash dam for the disposal of sludge from the CWT plants. The ash dam is highly alkaline and would provide a buffering environment for the acid waste from the CWT, and is therefore a sound option for the disposal of the waste. Discussions held between HLA and regional DEC representatives confirmed that the use of the ash dam for the disposal of the CWT waste is an acceptable use of the land.

As the proposed WTP works would occur only in areas that are currently used by the power station, there would be no significant effect on land use in the area. The proposed improvements are considered to be consistent with the existing surrounding land uses, and would have negligible effect on existing or potential future uses.

7.11.4 Conclusion

The proposed WTP works would not change or limit the range of existing land uses currently occurring in the locality, nor would it preclude other uses that are consistent with the land use provisions of the local environmental planning instrument. The land is suitably zoned for the existing development and the proposed WTP works.

7.12 Landscape Character and Visual Factors

7.12.1 Existing environment

The proposed works are to be located on the site of the existing WTP, which has been previously cleared and developed. The site is located at Bayswater Power Station, and is surrounded by the plant and equipment used to generate electricity from the combustion of coal. The surrounding area is characterised by its industrial nature, including coalmines and the Liddell Power Station, together with the major transport arteries of the New England Highway

and the Main Northern Rail Line. Both industry and agricultural clearing have substantially modified the area.

7.12.2 Assessment of effects

As the proposed WTP works are to fit within the existing footprint of the WTP, which is located beneath the existing cooling towers, no additional impacts on landscape character or visual amenity will occur. The plant will not be visible to road users or residents.

7.12.3 Environmental safeguards

As no impacts are anticipated from the proposed project, no environmental safeguards are required.

7.12.4 Conclusion

The proposed WTP works would not result in an adverse effect on landscape character or visual amenity.

7.13 Traffic and Transportation

7.13.1 Existing transport network

The New England Highway (State Highway 9) is the main road transport route between Newcastle and the New England area of NSW, and traverses the eastern edge of the Bayswater Power Station. The speed limit in the area is 100 km/h.

7.13.2 Existing traffic

An average of 12,084 vehicles per day utilise this section of the New England Highway according to the most recent data from the RTA (Traffic Volume Data for the Hunter Region – 2001). Counting station 05.244, located on the Muswellbrook southern town boundary, indicates only a slight increase in traffic since 1998, when 10,114 vehicles per day were recorded.

Peak traffic movements in the area historically correlate with mining shift changes between 7am and 3pm. Coal-related transport decreases after 4pm. Other heavy truck movements are consistent throughout the day (Christopher Hallam & Associates, 1996).

A traffic study was conducted for the EIS prepared for the Sodium Chlorate Plant (NECS, 2001). This study estimated that 600 vehicles access the Bayswater and Liddell Power Stations each weekday. Peak traffic movements are seen between 6 -7 am and 3 -4 pm.

7.13.3 Traffic generated by the project

Construction of the proposed WTP works would be undertaken over an 18 month period, with activity occurring on weekdays between 7am and 6pm. A maximum of 80 construction personnel are expected for the construction works.

Operation of the upgraded WTP is unlikely to result in a discernible increase in traffic to the power station, as only fifteen additional staff members are required.

7.13.4 Assessment of effects

Construction of the proposed project is unlikely to significantly increase traffic volumes in the area considering the current high volume of traffic. It is believed that the existing access facilities to the power station will be sufficient to cope with construction traffic.

7.13.5 Environmental safeguards

As no significant changes to traffic volumes are anticipated, no environmental safeguards are required.

7.13.6 Conclusion

The modification of the WTP would not result in adverse impacts on traffic and transportation in the area.

7.14 Environmental Management

Regular inspections and environmental audits would be undertaken as part of an environmental compliance programme at and around the WTP to identify and rectify any adverse environmental changes that may occur. These activities would be incorporated into the site Environmental Management System (EMS). The environmental compliance programme would include regular inspections of all water treatment operations to identify potential issues, such as maintenance of the brine decant basin and any leakage;

Auditing of Bayswater Power Station occurs on a regular basis as part of Macquarie Generation's EMS. Auditing of the upgraded WTP would be incorporated into these audits, and any issues arising would be dealt with in accordance with the company's standard operating procedures.

Operation of the WTP is currently part of the Macquarie Generation EMS, which is certified under the international standard ISO14001 Environmental Management Systems – Requirements with Guidance for Use. Any changes to the plant and equipment would be updated in this EMS. The EMS incorporates training in environmental management for relevant staff.

7.15 Ecological Sustainability

Ecologically Sustainable Development (ESD) is defined as:

> *"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future can be increased".*

In NSW, the concept of ESD has been given legal definition by the Protection of the Environment Administration Act 1991 (NSW), which sets up the NSW EPA. Section 6(1) (a) of the Act provides that the NSW EPA, in protecting, restoring and enhancing the quality of the environment in NSW, should have *'regard to the need to maintain ecologically sustainable development'*. This would require '*the effective integration of economic and environmental considerations in decision making processes'*. The principles that would assist in the achievement of ESD have been clearly set out in Schedule 2 of the EP&A Regulation 2000. These principles are:

(a) *The precautionary principle* – namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

(b) *Inter-generational equity* - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

(c) *Conservation of biological diversity and ecological integrity* – namely, that a full and diverse range of plant and animal species should be maintained.

(d) *Improved valuation, pricing and incentive mechanisms* – these mechanisms would enable environmental factors to be included in the valuation of assets and services.

Draft guidelines prepared by PlanningNSW for the consideration of sustainability in environmental impact assessment refer to the EPBC Act as adopting a fifth principle, being:

> *decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.*

These five principles form the basis of sustainability against which this proposal has been assessed. The issues of climatic change and greenhouse effect are also addressed.

7.15.1 Precautionary principle

This EA demonstrates that the proposed WTP works, by incorporating safeguards identified in this document, would have minimal impact on the surrounding environment and would improve the environmental performance of the existing facility. The EA has not identified threats of serious or irreversible environmental damage associated with the construction or operation of the upgraded WTP.

7.15.2 Intergenerational equity

The proposed WTP works would be constructed and operated in such a way as to ensure that the surrounding environment is not degraded for existing or future generations. The WTP improvements would also result in better environmental outcomes, such as improved quality in discharges to Lake Liddell and the Hunter River, which would reduce impacts in the locality.

7.15.3 Biological diversity and ecological integrity

The proposed works will not have an adverse effect on flora or fauna and will not result in the diminution of biological diversity or ecological integrity.

7.15.4 Valuation and pricing of environmental resources

The integration of environmental and economic goals is one of the key principles of ESD set out by the Commonwealth Government. It is difficult to assign a monetary value to the environment of the locality, given the lack of precedence and guidelines in the valuation of environmental resources not considered for commercial use. A monetary value could not be placed against the greatest proportion of environmental attributes that may be affected. Instead, the approach taken on this project was to manage environmental impact by identifying appropriate safeguards to mitigate adverse environmental effects and including the cost of implementing these safeguards in the total project cost. This approach allowed the value and price of environmental resources and their protection to be reflected more accurately.

7.15.5 Decision making processes

The proposed WTP works require approval under NSW legislation. As part of this approval process the views and requirements of relevant government agencies are coordinated and integrated by a single approval authority.

The integration of economic, environmental and social considerations into a single whole of government process is a function of Part 3A of the EP&A Act and will be achieved in the assessment of this EA.

The framework provided by Part 3A of the EP&A Act ensures that decision-making at all levels is properly integrated and is based on a full understanding of considerations within a temporal context.

7.15.6 Climate change and Greenhouse Effect

The Greenhouse Effect is the phenomenon whereby certain gases, known as greenhouse gases (GHG), capture heat radiated from the earth and re-radiate it back to the earth. This mechanism maintains the thermal balance that controls the earth's climate. The thermal balance may be disturbed by steadily increasing concentrations of certain greenhouse gases, principally CO_2. This change is known as the enhanced greenhouse effect and it is predicted that it may change global climate patterns.

CO_2 is the main GHG of concern. It is the inevitable product of the combustion of fossil fuels and accounts for approximately half of the total enhanced greenhouse effect.

The proposed WTP works will result in an increase in carbon dioxide emissions due to the requirement for more energy to be consumed in the operation of the modified system. It has been calculated that the modified plant will result in some 24,000 additional tonnes of CO_2 per year.

Macquarie Generation participates in a number of initiatives to reduce the emission of greenhouse gases from its operations. Macquarie Generation entered into a Greenhouse Challenge Cooperative Agreement with the Commonwealth in 1997 and has been active in meeting the targets set in the agreement. These initiatives are discussed further in **Section 7.1**. The implementation of these initiatives means there will be no net increase in greenhouse gas emissions.

8 CUMULATIVE IMPACTS

The proposed WTP works would primarily comprise improvements and refurbishments of existing plant and equipment, with some external additions. As such, the proposed works would sit within the existing footprint of the WTP and power station. No decrease in the quality of the receiving environment is expected, and no adverse effects on ecology, heritage, or land are expected. No cumulative adverse impacts are therefore expected for these environmental issues.

Similarly, the proposed improvements would not result in additional air quality or noise impacts. While the carbon dioxide emissions of the development would be greater than those currently occurring from the existing plant, the greenhouse gas reduction measures being undertaken and planned by Macquarie Generation would more than offset this increase.

The proposed project is designed to improve the water quality in Lake Liddell and reduce the amount of water being disposed of with waste products. The project would therefore have a beneficial effect rather than a negative cumulative impact.

In summary, the proposed improvements would not result in adverse cumulative environmental effects.

9 DRAFT STATEMENT OF ENVIRONMENTAL COMMITMENT

This Draft Statement of Environmental Commitment (SoEC) has been prepared in accordance with section 75F (6) of the EP&A Act. The SoEC states Macquarie Generation's environmental commitments and details the environmental management and monitoring to be undertaken during the construction and operation of the proposed project.

9.1 Environmental Management

Environmental management during the construction phase of the proposed project would be directed by a Construction Environmental Management Plan (CEMP). A CEMP is a procedural document that outlines the environmental goals of the project, the safeguard measures to be implemented, the timing of the implementation in relation to the progress of the project, responsibilities for implementation and management, and a review process. The chosen contractor would be required to produce a CEMP in accordance with the documents contained in **Appendix 4** prior to commencement of construction of the proposed project. This would be a requirement of the contract between Macquarie Generation and the contractor.

Environmental management of the operation of the upgraded WTP would be directed by Macquarie Generation's Environmental Management System (EMS), certified to the international standard ISO 14001:2004. The EMS includes the requirement to assess plant modifications and apply appropriate environmental management processes. Therefore, the EMS would cover the operation of the WTP following the proposed upgrade.

The production of a CEMP for construction and the update of the EMS for operation of the proposed upgraded WTP would ensure that:

- Works are carried out in accordance with appropriate environmental statutory requirements and relevant non-statutory policy as is detailed throughout this EA;
- Works are carried out in accordance with the goals and requirements presented in this EA;
- Works are carried out in such a way as to minimise the likelihood of environmental degradation occurring;
- Employees engaged in the works comply with the terms and conditions of the CEMP and EMS;
- Clear procedures for management of environmental impact including corrective actions are provided; and
- Management responsibilities and reporting requirements to demonstrate compliance with the CEMP and EMS are identified.

Key components to be included in the CEMP and the EMS would be the environmental safeguards developed for this project as summarised in **Table 9**, and the monitoring requirements outlined in **Table 10**.

To ensure the full implementation of the EMS all contractor staff are required to undergo induction training, which includes the requirements of the EMS.

9.2 Environmental Reporting

Environmental performance reporting is a key decision-making tool that provides management with the information to make meaningful and positive change. It is also an integral part of ISO14001. To ensure that relevant authorities are appropriately informed of how Macquarie Generation is managing its environmental performance, periodic reports would be prepared by the construction contractor during the construction phase and the operational contractor during the operational phase, in accordance with each party's Quality System. Macquarie Generation would then use this information to report to the DEC regarding licence compliance requirements.

If the reports identify shortcomings regarding construction activities, the manner in which operational activities are being conducted or in the performance of environmental control measures, the necessary changes would be made. The CEMP and EMS would be updated to reflect these changes if necessary.

9.3 Environmental Safeguards

A number of environmental safeguards/mitigation measures to prevent or minimise environmental impacts that may be generated by the proposed upgrade are proposed. These measures would be incorporated into the EMP and EMS and be implemented throughout the duration of the project.

Table 9 summarises these safeguard measures, sets out priorities for implementation (construction and operation), and lists the responsibility for ensuring that these safeguard procedures are undertaken.

Table 9: Proposed Environmental Safeguards

Issue	Environmental Safeguard	Implementation Stage	Responsibility
Energy Consumption			
Increased Greenhouse Gas Emissions	Macquarie Generation would continue to actively meet the targets set in its Greenhouse Challenge Cooperative Agreement with the Commonwealth of Australia. Macquarie Generation would also continue to meet the targets set by the Commonwealth Government's Generator Efficiency Standards Program.	Ongoing Ongoing	Macquarie Generation Macquarie Generation
Waste			
EPL Compliance	Only the following hazardous and/or industrial and/or Group A and/or Group B listed below would be treated, processed, reprocessed or disposed of at the premises: • Acid solutions or acids in solid form; • Asbestos; • Fly Ash and Bottom Ash; • Waste mineral oils unfit for their original use; • Waste oil/water hydrocarbon/water mixtures or emulsions; • Boiler cleaning residues; • Filter bags; and	Construction and Operation	Macquarie Generation

Issue	Environmental Safeguard	Implementation Stage	Responsibility
	• Water treatment residues.		
Hydrology, Hydrogeology and Water Quality			
Surface Water Management	• All water discharges will be monitored and controlled in accordance with relevant licences and legislation	Construction and Operation	Macquarie Generation
	• Clean water diversion drains would be constructed to divert runoff away from areas to be disturbed;	Pre-construction	Contractor
	• Straw bales/sediment fences will be installed around areas to be disturbed;	Pre-construction	Contractor
	• Land disturbance would be confined to minimum workable areas;	Construction	Contractor
	• Excavation works would be suspended during heavy periods of rainfall;	Construction	Contractor
	• Monitoring and maintenance of erosion and sediment control structures would occur throughout the life of the project;	Construction	Contractor
	• Disturbed areas would be watered to control dust during windy and dry weather;	Construction	Contractor
	• The Department of Housing's *Managing Urban Stormwater: Soils and Construction,* 4th edition (DoH, 2004) (the "blue book") would be adhered to when undertaking erosion and sediment control measures; and	Construction	Contractor
	• Temporary soil and water management structures would be removed only after the disturbed area had been sufficiently stabilised.	Construction	Contractor
Groundwater Impacts	Macquarie Generation will discuss methods for the treatment of existing groundwater contamination with the DEC and DoNR and will commit to works in the form of a Pollution Reduction Program attached to EPL 779.	Operation	Macquarie Generation
Hazards and Risks			
Leaks/Spills	Emergency procedures, including containment and clean up of spills, as well as the notification of these events to Macquarie Generation personnel, would be included in emergency procedures outlined in the CEMP of both the construction contractor and plant operator.	Pre-construction	Contractor/ Macquarie Generation
	Adequate emergency spill kit equipment would be located on site at all times.	Construction and Operation	Macquarie Generation
	Equipment brought onto the site would be required to be in proper working order and maintained in accordance with the manufacturer's specifications.	Construction and Operation	Contractor/ Macquarie Generation
	Chemical storage areas forming part of the upgraded WTP would have adequate bunding designed in accordance with Australian Standard 1940:2004, and would be managed in accordance with Macquarie Generation's current handling procedures. Regular inspections of chemical storage areas would also be	Operation	Macquarie Generation

Issue	Environmental Safeguard	Implementation Stage	Responsibility
	undertaken.		
Noise			
Construction Noise	All works would be carried out Monday to Friday between 7 am and 6 pm (Except in cases where safety reasons require work outside of these times).	Construction	Contractor
Operation Noise	All significant noise generating equipment would be enclosed in soundproof barriers.	Operation	Macquarie Generation
Air Quality			
Emissions to Air	Dust suppression measures to be utilised include: • Land disturbance would be confined to minimum workable areas; • Excavation works would be suspended during periods of strong winds; • Monitoring and maintenance of erosion and sediment control structures would occur throughout the life of the project; and • Disturbed areas would be watered to control dust during windy and dry weather. All equipment would be maintained as per the manufacturer's specifications.	Construction Construction and Operation	Contractor Contractor/ Macquarie Generation
Greenhouse Gas Emissions	Macquarie Generation will continue to actively meet the targets set in its Greenhouse Challenge Cooperative Agreement with the Commonwealth of Australia. Macquarie Generation will also continue to meet the targets set by the Commonwealth Government's Generator Efficiency Standards Program.	Operation	Macquarie Generation
Heritage and Archaeology			
Protection of Aboriginal Objects	Aboriginal objects are protected under the NPW Act (as amended), regardless of location. Should any objects be identified during the course of site works, all works must cease and the DEC (North Eastern Branch, Environment Protection and Regulation Division, Regional Archaeologist) contacted in regard to appropriate permit requirements before any further impact is undertaken. All works must cease if **suspected** skeletal material is uncovered during the course of site works, and the DEC, the NSW Police and the NSW Coroners office must be contacted immediately.	Construction Construction	Contractor Contractor
Training	All contractors who work on site would be made aware of the NPW Act 1974 (as amended) and the fact that it is an offence to move, disturb or destroy Aboriginal objects without the written permission of the Director General of the DEC during their induction training.	Construction and Operation	Contractor/ Macquarie Generation

Issue	Environmental Safeguard	Implementation Stage	Responsibility
Landform and Soils			
Erosion and Sedimentation	• Clean water diversion drains would be constructed to divert runoff away from areas to be disturbed; • Straw bales/sediment fences will be installed around areas to be disturbed; • Land disturbance would be confined to minimum workable areas;	Pre-construction Pre-construction Construction	Contractor Contractor Contractor
	• Excavation works would be suspended during heavy periods of rainfall; • Monitoring and maintenance of erosion and sediment control structures would occur throughout the life of the project; • Disturbed areas would be watered to control dust during windy and dry weather; • The Department of Housing's *Managing Urban Stormwater: Soils and Construction,* 4th edition (DoH, 2004) (the "blue book") would be adhered to when undertaking erosion and sediment control measures; and • Temporary soil and water management structures would be removed only after the disturbed area had been sufficiently stabilised.	Construction Construction Construction Construction Construction	Contractor Contractor Contractor Contractor Contractor

9.4 Environmental Monitoring

The requirements for environmental monitoring of the proposed works are provided in **Table 10**.

Table 10: Monitoring Requirements

Monitoring Requirements	Frequency	Parameters	Implementation
Air Quality			
Visually monitor work zones to ensure that excessive dust is not being produced.	Daily	No visible dust leaving site.	Construction
Inspect sites to ensure that adequate dust controls are being used such as regularly watering soil stockpiles.	Daily	No visible dust leaving site.	Construction
Surface Water			
Inspect the site prior to the commencement of each stage of works, to ensure the necessary erosion and sediment control measures are in place.	As required	N/A	Prior to commencement of each stage of works
Monitor discharge waters from the cooling towers to Tinkers Creek.	Daily during discharge	Conductivity (µS/cm)	Ongoing
Inspect erosion and sediment controls to ensure they are installed and operating correctly. Corrective action would be instituted if necessary, and follow up inspection would be undertaken to verify outcome of the corrective action.	Weekly and within 24 hours of rainfall event	N/A	Site preparation and Construction
Monitor level of brine in decant basin in accordance with Dam Safety Committee requirements.	Weekly	Height	Ongoing

Monitoring Requirements	Frequency	Parameters	Implementation
Ground Water			
Monitor ground water quality 200m downstream of the decant basin at bore BWGM1/D10.	Monthly	pH and electrical conductivity	Ongoing
Monitor ground water quality 200m downstream of the decant basin at bore BWGM1/D10.	Bimonthly	Trace metals (Iron, Copper, Chromium, Manganese, Lead, Aluminium, Zinc, Arsenic, Selenium and Nickel)	Ongoing
Landform, Geology and Soils			
Monitor the condition of areas affected by construction activities	Weekly	N/A	Construction
Inspect disturbed areas that have the potential for wind and water erosion to confirm stability of prepared construction sites.	Weekly	N/A	Construction
Indigenous Heritage			
Report any archaeological sites discovered during construction activities to the Regional Archaeologist of DEC. Cease works pending consideration.	As necessary	N/A	Site preparation and Construction
Hazard and Risk			
Bunds will be inspected to ensure they comply with the appropriate standards.	One off	AS1940	Prior to commencement of operations
Traffic Management			
Visual inspection of construction zones to ensure construction vehicles are using defined roads and access points.	Weekly	N/A	Site Preparation/ Construction

9.5 Environmental Commitment

The environmental commitments outlined in **Table 11** have been compiled on an issues basis, informed by the environmental risk analysis and impact assessment undertaken as part of this EA.

Table 11: Statement of Environmental Commitment

Environmental Issue	Commitment
General	Macquarie Generation will carry out the development generally in accordance with the: (a) Project Application; (b) Environmental Assessment for the Proposed Bayswater Power Station Upgrade prepared by HLA-Envirosciences; and (c) Statement of Environmental Commitment.

Environmental Issue	Commitment
Structural Adequacy	Macquarie Generation will ensure that all new buildings and structures, and any alterations and additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the Building Code of Australia. Notes: • *Under Part 4A of the EP&A Act, Macquarie Generation will be required to obtain construction and occupation certificates for the proposed building works.* • *Part 8 of the EP&A Regulation sets out the requirements for the certification of development.* • *The development is located in the Muswellbrook Mine Subsidence District. Under section 15 of the Mine Subsidence Compensation Act 1961, Macquarie Generation is required to obtain the Mine Subsidence Board's approval before constructing or relocating any improvements in a Mine Subsidence District.*
Demolition	Macquarie Generation will ensure that all demolition work is carried out in accordance with *Australian Standard AS 2601-2001: The Demolition of Structures*, or its latest version.
Operation of Plant and Equipment	Macquarie Generation will ensure that all plant and equipment used at the site is: (a) Maintained in a proper and efficient condition; and (b) Operated in a proper and efficient manner.
Waste Management	Except as provided for by the conditions of an Environment Protection Licence, only the hazardous and/or industrial and/or group A and/or group B wastes listed below may be treated, processed, reprocessed or disposed of at the premises. a) Acid solutions or acids in solid form, b) Asbestos, c) Fly ash and Bottom Ash d) Waste mineral oils unfit for their original use, and e) Waste oil/water hydrocarbon/water mixtures or emulsions, f) Boiler cleaning residues. g) Filter bags h) Water treatment residues

Environmental Issue	Commitment
Water and Soils	As part of the detailed design of the proposed improvement works, Macquarie Generation will undertake a hydrological study of the site in order to ensure that the proposed works do not significantly alter site hydrology or the local flooding regime. These details will be submitted to the Director-General's satisfaction. Except as may be expressly provided by an Environment Protection Licence, Macquarie Generation will comply with Section 120 of the *Protection of the Environment Operations Act 1997* during the carrying out of the development. Prior to carrying out any development, Macquarie Generation will prepare, and then subsequently implement, an Erosion and Sediment Control Plan for the development, to the satisfaction of the Director-General. This plan must include an Erosion and Sediment Control Plan that: - is consistent with the requirements of *Landcom's Managing Urban Stormwater: Soils and Construction* manual; - identifies activities that could cause soil erosion and generate sediment; - describes the location, function and capacity of erosion and sediment control structures; and - describes measures to minimise soil erosion and the potential for the migration of sediments to downstream waters. Macquarie Generation will take all practicable measures to minimise erosion and the potential discharge of sediments from the site.
Hazards and Risks	Macquarie Generation will undertake all works associated with the construction works and operation of the WTP in accordance their Occupational Health and Safety Management system.
Air Quality	Macquarie Generation will use all practicable measures to minimise air pollutant emissions from the development.
Indigenous Heritage	In the event that an Aboriginal site or object is discovered during the carrying out of the development, Macquarie Generation will cease work immediately and make contact with the Department of Environment and Conservation. Macquarie Generation will obtain section 90 consents under the *National Parks and Wildlife Act 1974* prior to destroying any Aboriginal sites or objects found during the carrying out of the development.

10 RESIDUAL ENVIRONMENTAL RISK ANALYSIS

10.1 Approach

The Environmental Risk Analysis for the proposed project is based on a process adapted from Australian Standard AS 4369:1999 Risk Management, as well as environmental risk tools developed by other organisations. The process is qualitative and is based on the Residual Risk Matrix shown in **Table 12**.

Residual Environmental Risk is assessed on the basis of the significance of environmental effects of the proposed project and the ability to confidently manage those effects to minimise harm to the environment.

The significance of environmental effects is given a numerical value between 1 and 5 based on the receiving environment, the level of understanding of the type and extent of impacts, and community response to the environmental consequences of the project. This enables both actual and perceived impacts to be considered. The manageability of environmental effects is similarly given a numerical value between 1 and 5 based on the complexity of mitigation measures, the known level of performance of the safeguards proposed, and the opportunity for adaptive management. The numbers are added together to provide a result that provides a ranking of potential residual effects of the project when the safeguards identified in this EA are implemented.

Table 12: Residual Risk Matrix

Significance of Effects	Manageability of Effects				
	5 Complex	4 Substantial	3 Straightforward	2 Standard	1 Minimal
1 Low	**6 (Medium)**	**5 (Low/Medium)**	**4 (Low/Medium)**	**3 (Low)**	**2 (Low)**
2 Minor	**7 (High/Medium)**	**6 (Medium)**	**5 (Low/Medium)**	**4 (Low/Medium)**	**3 (Low)**
3 Moderate	**8 (High/Medium)**	**7 (High/Medium)**	**6 (Medium)**	**5 (Low/Medium)**	**4 (Low/Medium)**
4 High	**9 (High)**	**8 (High/Medium)**	**7 (High/Medium)**	**6 (Medium)**	**5 (Low/Medium)**
5 Extreme	**10 (High)**	**9 (High)**	**8 (High/Medium)**	**7 (High/Medium)**	**6 (Medium)**

10.2 Analysis

The analysis of residual environmental risk for issues related to the proposed project is shown in **Table 13**. This analysis indicates the environmental risk profile for the proposed project based on the assessment of environmental effects, the identification of appropriate safeguards, and the Draft Statement of Commitments provided in this EA.

Table 13: Residual Environmental Risk

Issue	Significance	Manageability	Residual Risk
Energy (including greenhouse gases)	2	3	5 (Low/Medium)
Waste	2	2	4 (Low/Medium)
Hydrology, hydrogeology & water quality	2	1	3 (Low)
Hazards	1	2	3 (Low)
Noise	1	2	3 (Low)
Air quality	2	1	3 (Low)
Ecology	1	1	2 (Low)
Social and economic	1	1	2 (Low)
Heritage and archaeology	1	1	2 (Low)
Landform and soils	1	1	2 (Low)
Land use	1	1	2 (Low)
Landscape character and visual factors	1	1	2 (Low)
Traffic and transportation	1	1	2 (Low)

The above residual risk analysis indicates that the greatest potential environmental risks are from greenhouse gas emissions, which will be offset through Macquarie Generation's Greenhouse Challenge actions. The disposal of the waste brine is an issue of low/medium risk, but can be effectively managed through the mitigation measures outlined in this EA. The potential risks in relation to other identified environmental issues are considered to be low with the implementation of recommended mitigation measures.

11 FINDINGS

The construction phase of the proposed WTP works would have little effect on the environment in terms of water quality, flora, fauna, noise, air quality, waste, soils, land capability, cultural heritage, visual amenity or transport. When operational, the upgraded WTP would result in minimal environmental impacts, which would be similar to those from the existing WTP. The cumulative impact of the project on the environment is negligible.

The construction phase of the proposed WTP works would result in some 80 construction jobs over an 18 month period and the employment of an additional fifteen personnel supplied by the contractor operating the WTP. The project would improve the water quality for use in the power stations and subsequent discharge to Lake Liddell and the Hunter River. It would also result in associated competitive electricity supply costs for consumers.

The greatest potential residual environmental risk comes from greenhouse gas emissions, which can be effectively offset. The overall environmental impact of the proposed WTP improvements is considered to be minimal.

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