RAVENSWORTH
OPEN CUT

GLENCORE

Water Management Plan

Number:	RAVOC-1007099517-67	**Status:**	Draft	**Effective:**	[Effective Date]
Owner:	Environment and Community Manager	**Version:**	7.0	**Review:**	[Planned Review Date]

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1. Introduction

1.1 Background

The Ravensworth Complex is located between the townships of Singleton and Muswellbrook in the Upper Hunter Valley region of New South Wales (NSW) (refer to **Figure 1.1**).

The Ravensworth Complex Project Approval (09_0176) was granted on 11 February 2011 by the then NSW Minister for Planning and subsequently modified August 2013, December 2014 and February 2016. The approval allows for the expansion of existing approved mining operations at Ravensworth Complex and enables the consolidation of existing approvals for open cut mining and infrastructure within the Ravensworth area. Specifically, the approval consolidates existing Project Approvals for the Narama Mine, Ravensworth West Mine, Cumnock Open Cut, Ravensworth Underground Mine (RUM) surface facilities and Ravensworth Coal Handling Preparation Plant (RCHPP). The Ravensworth Complex is shown in **Figure 1.2**. A number of company entities and joint venture partners are responsible for managing the operations that are undertaken at the respective facilities which comprise the Ravensworth Complex (RC).

Project Approval (09_0176) has been provided for the integration of operational aspects of the mining operations in the area, allowing for a consistent and integrated approach to environmental management and mine planning. RC is committed to implementing continued mining operations in the context of updated and contemporary environmental management requirements. Ravensworth Underground Mine (RUM) remains as a separate operating facility within the Ravensworth Mine Complex and operates under Development Consent DA 104/96. The RUM water management plan has been incorporated into this Mine complex management plan. All management commitments for RUM are outlined in **Table 2.1**

1.1.1 Project Approval

The Project Approval for Ravensworth Complex was assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The requirement for this Water Management Plan (WMP) arises from Condition 31, Schedule 3 of the Project Approval.

The Project Approval for Ravensworth Underground Mine (RUM) (DA 104/96) was assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The requirement for this Water Management Plan (WMP) arises from Condition 23, Schedule 3 of the Project Approval.

A detailed list of the Project Approval conditions and the relevant Statement of Commitments and where they are addressed in this document is included in **Appendix A**.

1.1.2 Environment Protection Licence (EPL)

This WMP has been prepared to detail the water management requirements for all sites within the Ravensworth Complex. As such, Ravensworth Complex holds a single EPL (2652) for the RC (i.e. Cumnock, Ravensworth Operations and RUM). The Project Approval allows for the consolidation of the water quality-monitoring network for Glencore Coal Assets Australia (GCAA) operations in the RC.

RC monitors all discharges from the site in accordance with the requirements of the *Protection of the Environment Operations (POEO) Act 1997* and the relevant EPL conditions for the site.

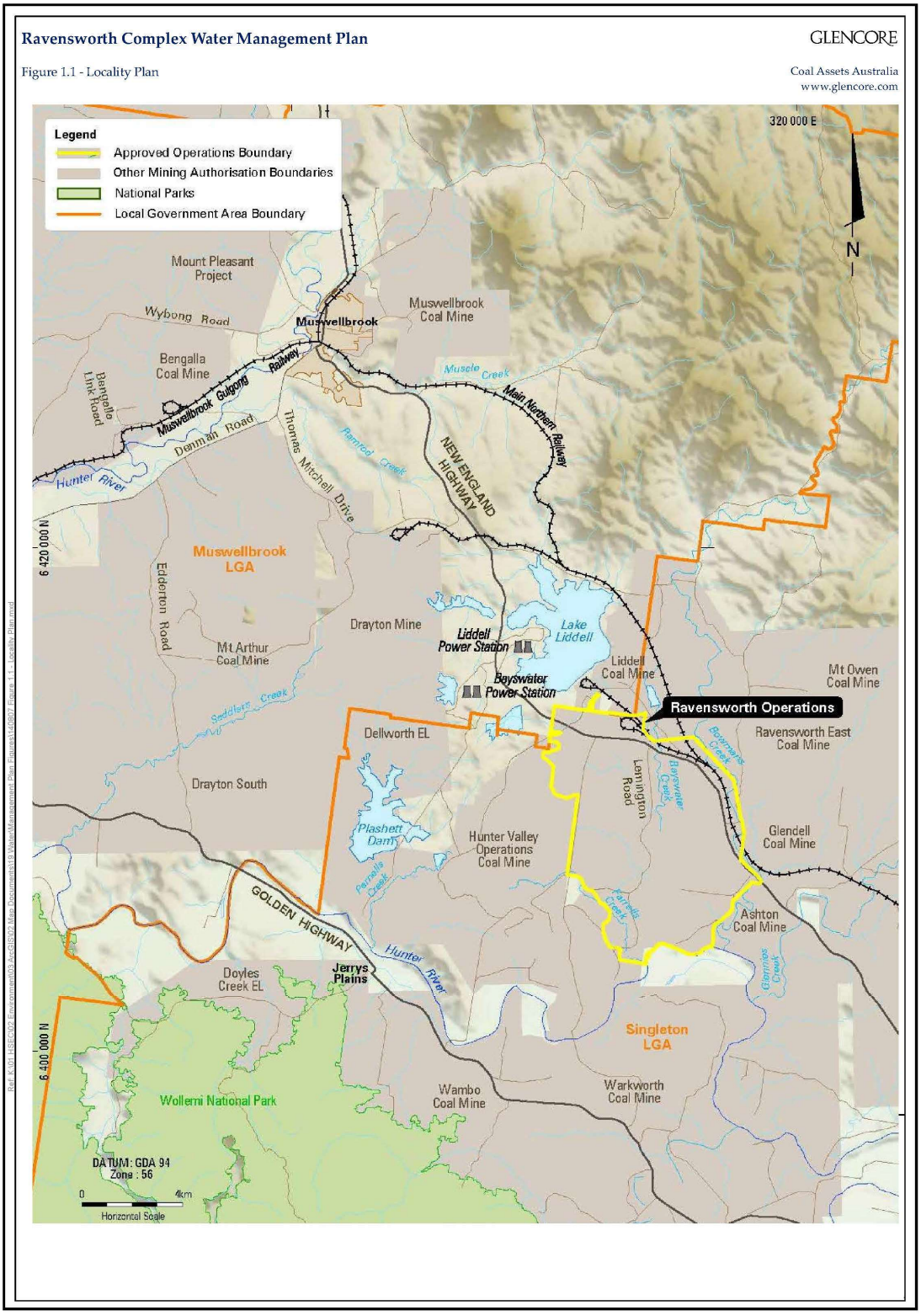


Figure 1.1 Locality Plan

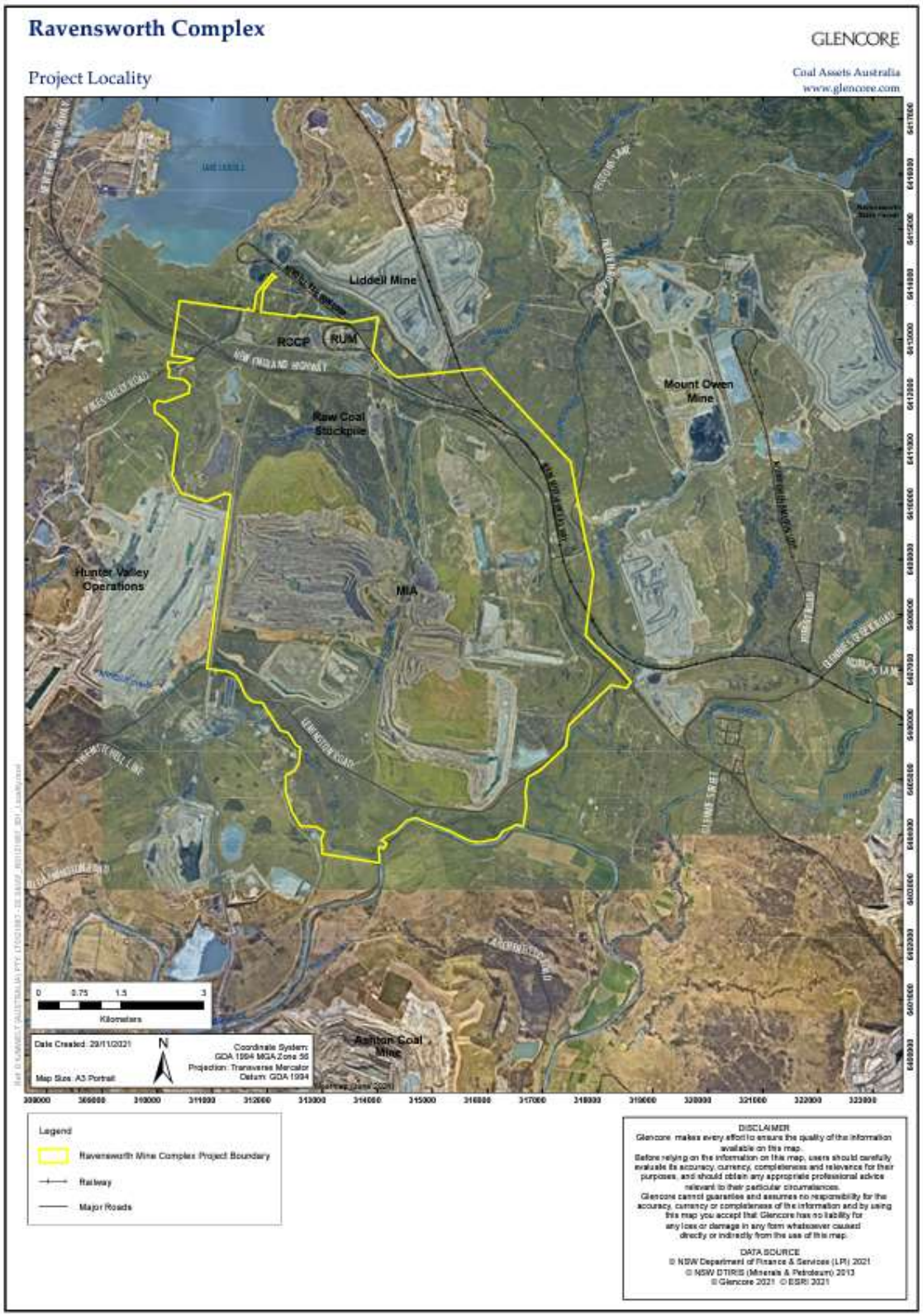


Figure 1.2 – Ravensworth Mine Complex Layout

1.2 Stakeholder Consultation Regarding this Document

In accordance with Condition 31, Schedule 3 of the Project Approval (09_0176), and Condition 23 of Schedule 3 of DA 104/96; the WMP is to be prepared in consultation with Environment Protection Authority (EPA), Department of Planning, Industry & Environment Water (DPIE Water) and the Department of Planning, Industry and Environment (DPIE) for consultation see **Appendix F**. The consultation process is to involve the submission of the document to EPA and DPIE Water concurrently with its submission to DPIE. As such, any comments provided by these stakeholders following submission will be subsequently addressed in a revised document, which will be re-submitted to DPIE.

1.3 Responsibilities Regarding this Document

The responsibilities for actions under the WMP are summarised in **Table 1.1**.

Table 1.1 Roles and Responsibilities

Role	Responsibility
Operations Manager	1. Implement this plan so the mining operation maintains compliance with consent requirements; and 2. Provide adequate resources to undertake the activities required by this plan.
Environment and Community Manager (ECM)	3. Shall use best endeavours so the requirements of this plan are effectively implemented; 4. Implement processes to review the results of monitoring which are systematically evaluated and reported to relevant personnel; 5. Review monitoring data as it becomes available to assess compliance with the requirements of this plan; 6. Coordinate incident investigation processes including associated reporting requirements; 7. Coordinate the implementation of corrective actions and evaluate their effectiveness; 8. All internal and external reporting requirements are met in a timely manner; 9. Provide advice to employees and managers regarding water management initiatives; 10. Monitoring records are effectively maintained onsite in a timely manner; 11. Should maintain and review this plan; and 12. Provide adequate training to employees and contractors regarding their requirements under this plan.

Role	Responsibility
Environment and Community Coordinator (ECC)	13. Investigate non-compliances or near non-compliances in consultation with the Environment and Community Manager/or relevant Site Manager; 14. Investigate community complaints and/or enquiries in consultation with the ECM and/or relevant Site Manager; 15. Direct routine and additional monitoring as required; 16. Complete monthly reporting requirements regarding water monitoring; 17. Provide advice to employees and managers regarding water management initiatives; 18. Monitor corrective actions from inspections or noncompliance and ensuring they are closed out and effective; 19. Manage and respond to community complaints/enquiries relating to water; 20. Complete notifications and manage responses from the community in relation to mitigation measures associated with potential water impacts; and 21. Oversee external communications with all stakeholders.
All employees and contractors	22. Undertake all activities in accordance with this plan.
Department Managers	23. Comply with the requirements of this management plan.

2. Commitment Table

All management commitments outlined within the WMP including timing are outlined in **Table 2.1** below and **Appendix A**. Management commitments requiring actioning will be entered into the Ravensworth Compliance Management system (CMO) and actioned, records of documentation associated with the management commitments will be maintained within the compliance management system.

Table 2.1 Commitments within this management plan Table 1.1 - Roles and Responsibilities

Commitment No.	Management Plan Commitment	Location in Document
1	Where possible, runoff from undisturbed areas of the complex will be diverted around disturbed areas using diversion drains.	3.1
2	Monitoring of the mine WMS is undertaken through the Ravensworth Opencut and Ravensworth Central Coal Processing (RCCP) Citect control system and the RC site water balance.	3.2
4	Runoff from maintenance areas and hardstands in the MIA will be collected in the industrial water system. Industrial water is treated in an oil and water separator. Oil and grease will be collected and disposed of offsite by a licensed waste contractor. Treated water is sampled on a monthly basis for oil and grease and is reused in the mine WMS.	3.7
5	Water usage, rainfall, dam volumes and discharges (including transfers) at the RC will continue to be monitored to assist in the management of the mine WMS.	4.2.1
6	EPL No. 2652 permits a maximum discharge of 400 ML/day from the Narama Inpit Storage Dam under the HRSTS regulations.	4.3
7	The results of the water balance will be reported in the Annual Review, which will include a comparison against the predictions in the EA.	4.4
8	A Ground Disturbance Permit must be completed for all construction or clearing activities on undisturbed land to detail the erosion and sediment control measures to be implemented for that activity.	5.0
9	The construction of a flood levee on Emu Creek immediately upstream of the confluence of Emu Creek and Bayswater Creek.	5.3 and 5.7
10	Scheduled surface water monitoring is to be undertaken at the monitoring locations shown in **Figure 6.1** and **Tables 6.1 to 6.4**.	6.1
11	Monitoring of channel stability in Bowmans Creek, Bayswater Creek, Emu Creek, Pikes Gully and Davis Creek will be undertaken annually.	6.1.2
12	Monitoring of onsite water storages at RC, including water supply dams, mine voids, irrigation water storages and sediment dams is undertaken as required to identify any potential surface water impacts caused by the mining operation and assist in water balance calculations.	6.1.3

Commitment No.	Management Plan Commitment	Location in Document
13	In the event that any successive water quality measurement is found to deviate from background trends and/or is outside the adopted trigger values, the RC ECC (or delegate) will initiate further site-specific investigations.	6.2.1
14	An annual assessment will be conducted of the channel stability and stream health in Bowmans Creek, Bayswater Creek, Emu Creek, Pikes Gully and Davis Creek.	6.2.1
15	The monitoring results will be assessed against previous monitoring results to identify variations in the data that may indicate degradation in channel stability or stream health. The results of this monitoring will be reviewed regularly and reported in the Annual Review as required.	6.2.1
16	The volume of water extracted under the Water Access Licences will be compared against the licence conditions on an annual basis.	6.3.2
16	Site water management data will be collected in accordance with RC procedures and will be used during the preparation of the Annual Site Water Balance to determine the volume of groundwater inflows / seepage from hard rock / coal and from alluvial aquifers. This data will also provide information on the groundwater extraction volumes associated with groundwater entitlements.	6.4.1
17	A regular review and assessment of water level and water quality monitoring data will be undertaken and include consideration of relevant meteorological and rainfall data.	6.4.2
18	If the inflow of groundwater from hard rock / coal or alluvial aquifers into the mine pits or former underground workings exceeds the respective licence limits (refer to **Table 6.5**), the event would trigger the measures outlined in **Section 7**.	6.5.1
19	A formal review of depressurisation of coal measures and comparison of responses with the aquifer model predictions will be undertaken biennially. Expert review will be undertaken by a suitably qualified hydro geologist if the measured depressurisation in the coal measures exceeds the predicted depressurisation for the designated period. Results will be reported in relevant Annual Review.	6.5.1
20	The RC ECC (or delegate) is responsible for the review of monitoring results and associated trends in groundwater quality. In the event that any successive groundwater quality measurement is found to deviate from background trends and/or is outside the adopted trigger values presented in **Tables 6.6** and **6.7.** The RC ECC will be responsible for initiating further site-specific investigations	6.5.2
21	The RC ECC (or delegate) is responsible for the monthly review of the monitoring results and associated trends in groundwater levels. In the event that two (or more) consecutive groundwater level measurements are found to deviate from background trends the RC ECC (or delegate) will be responsible for initiating further site-specific investigations in accordance with **Section 7.**	6.5.3
22	Trends in groundwater levels will be reported in the Annual Review.	6.5.3

Commitment No.	Management Plan Commitment	Location in Document
23	All major water storages, including prescribed water storages and tailings dams, will be inspected and maintained in accordance with the relevant RC and GCAA standard procedures.	8.1
24	Pipes and pumps will be inspected in accordance with procedures and GCAA standards.	8.2
25	Equipment used in the measurement of water quantities and quality such as flow meters, online instrumentation and hand held analytical meters shall be tested and calibrated by suitably qualified persons. Calibration certificates and records shall be kept on record.	8.3
26	The erosion and sediment controls will be inspected in accordance with the requirements of the RC Water Management System Inspection and Review Program.	8.4
27	The following reports will be prepared on a monthly basis and provided to GCAA and the RC management team: • Glencore Corporate Practice Database (GCP); • Monthly Environment and Community Status Report; and • Ravensworth Water Accounting Framework (WAF).	9.1
29	A summary of WMP monitoring results will be provided in the Annual Review. The Annual Review prepared each year for the RC will include the following information regarding water management on the site, in accordance with the Project Approval conditions (refer to **Appendix A**).	9.2
30	The report will also include an interpretation of the water monitoring results and the changes in water quality and groundwater levels over the period. In addition, any significant finding regarding the implementation of the WMP will be reported in the Annual Review.	9.2
31	Monitoring results will be reviewed and reported to the RC Community Consultative Committee.	9.2
32	A report on groundwater management will be provided in the Annual Review and to the NSW Department of Planning, Industry & Environment Water (DPIE Water)	9.2
33	A copy of the Annual Review including relevant water quality monitoring results will be made available on the RC website.	9.3
34	Site water management issues of interest to the community will be addressed in regular Community Consultative Committee meetings. Specific issues relating to individual landowners and residents will be addressed directly by the Ravensworth as required.	9.3
35	A copy of the Annual Review including relevant water quality monitoring results will be made available on the RC website.	9.3

Commitment No.	Management Plan Commitment	Location in Document
36	In the event that a complaint is received in relation to water management associated with the operation, an investigation will be undertaken in accordance with the relevant GCAA reporting guideline. Follow up correspondence with the complainant will be made to detail the outcome of the complaint investigation.	9.3
37	Records relating to community complaints will be managed in accordance with the requirements specified in EPL 2652	9.3
38	Monitoring records will be managed in accordance with the requirements specified in EPL 2652	9.4
39	Rehabilitation and revegetation is expected to commence once mining has ceased in the area known as Narama West or the relevant equipment is available.	16
40	Monitoring will be undertaken in order to: • Identify any possible degradation that occurs as mining progresses. This is suggested not to facilitate remediation of an area that will anyway be mined, but so downstream impacts prior to mining through can be mitigated and the possible impact of a reduced catchment area post mining characterised; and • Measurement of flood levels during flood events will facilitate calibration of the in stream roughness coefficients, which should then be applicable to the realigned section.	19.1
41	In order to survey the floristics composition of the rehabilitation plots will be sampled.	19.4.2
42	The monitoring results will be assessed and utilised in the continual improvement and refinement of rehabilitation/revegetation techniques and will be documented as part of the Annual Review.	19.4.2
43	Monitoring of aquatic habitats will begin when flows are returned to the reinstated Emu Creek.	19.4.3
44	The Annual Review prepared each year for the RC will include relevant information regarding the remediation of Bayswater Creek and Emu Creek in accordance with the Project Approval.	21.1
45	The Annual Review will also document complaints relating to the performance, maintenance and/or failure of the CDMP or ancillary plans, programs and/or procedures.	21.1
46	All Bayswater Creek and Emu Creek rehabilitation management issues of interest to the community will be addressed in regular community consultation meetings in accordance with the Social Involvement Plan (SIP).	21.2

3. Water Management

3.1 Clean Water Run off

Where possible, runoff from undisturbed areas of the complex is diverted around disturbed areas using diversion drains. The diversion drains prevent the contamination of clean water by mining activities and minimise the inflow of clean water runoff into the pits (refer to **Figure 3.1**).

3.2 Mine Water Management System

Components of the RC mine Water Management System (WMS) include:

- Dirty water runoff from disturbed areas and the mining areas;
- Groundwater inflow to the mining areas;
- Water transfer between different water storage facilities within the RC;
- Water transfer to the site from other mining operations in the Greater Ravensworth Water Sharing Scheme; and
- Water that has been imported to site to meet water deficits.

The development of the Ravensworth North Project included the construction of additional water storage dams including Booster Dam and associated infrastructure dams (refer to **Figure 3.1 – 3.3**). The major water storages for the mine WMS are provided in **Table 3.1**.

Monitoring of the mine WMS is undertaken through the Ravensworth Opencut and Ravensworth Central Coal Processing (RCCP) Citect control system and the RC site water balance.

3.3 Water Storages

Water at the RC is stored in surface dams, open cut pits, mining voids (on both the surface and underground), tailings dams and sediment dams. The major onsite dam storage capacities and surface areas are presented in **Table 3.1**

Table 3.1 Major Water Storages (2021)

Storage	Catchment Area (ha)	Approx. Max Volume (ML)
Former Cumnock underground mine workings	n/a	5480
Narama Inpit Storage Dam	80	709.5
Narama Void (Temporary storage)	-	3591
Highway Dam	0	173
Booster Dam	0	232
Ravensworth West Void	0	2432

Monitoring of onsite water storages is described in **Section 6.1.3**.

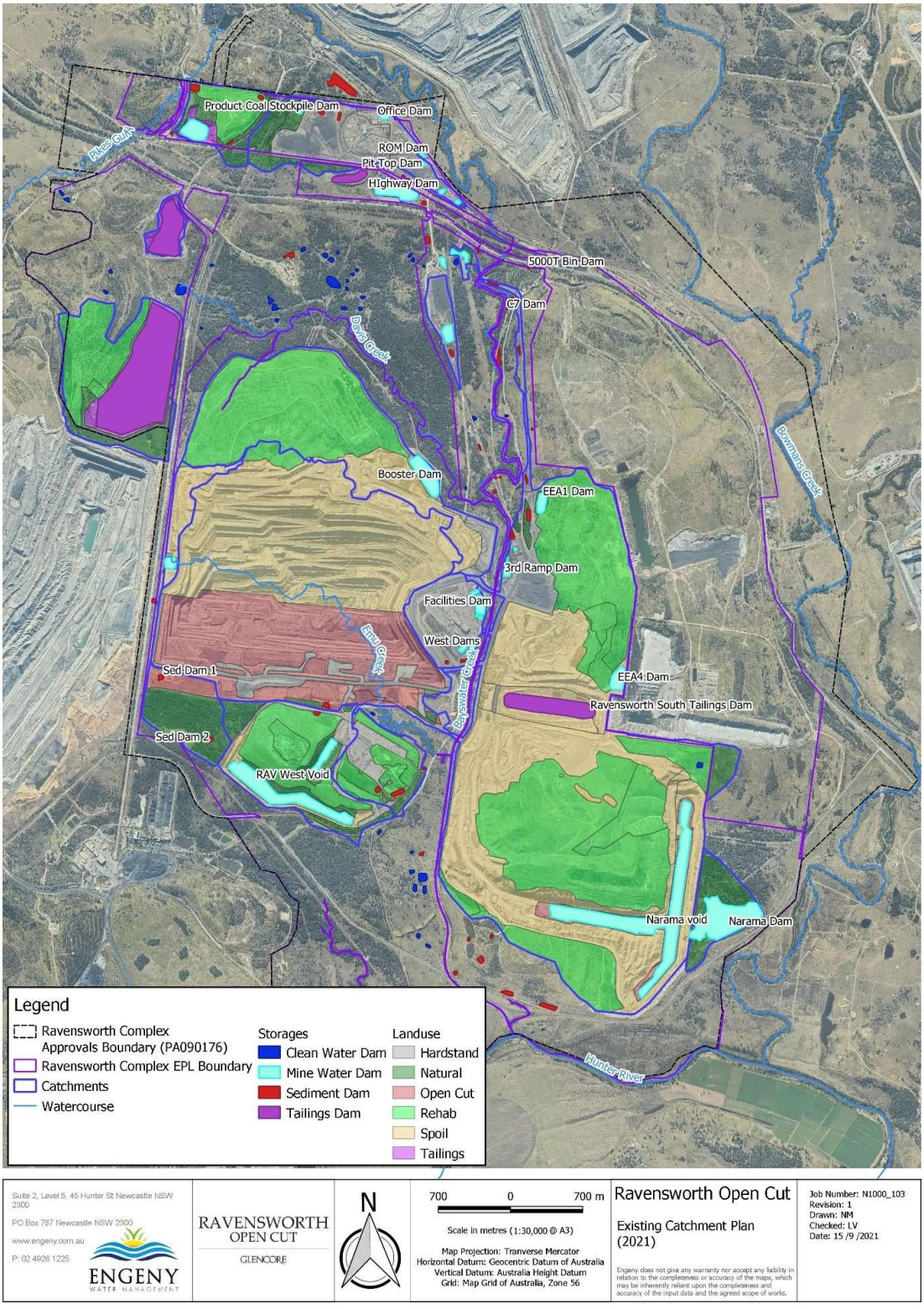


Figure 3.1 RC Existing Water Catchment Plan

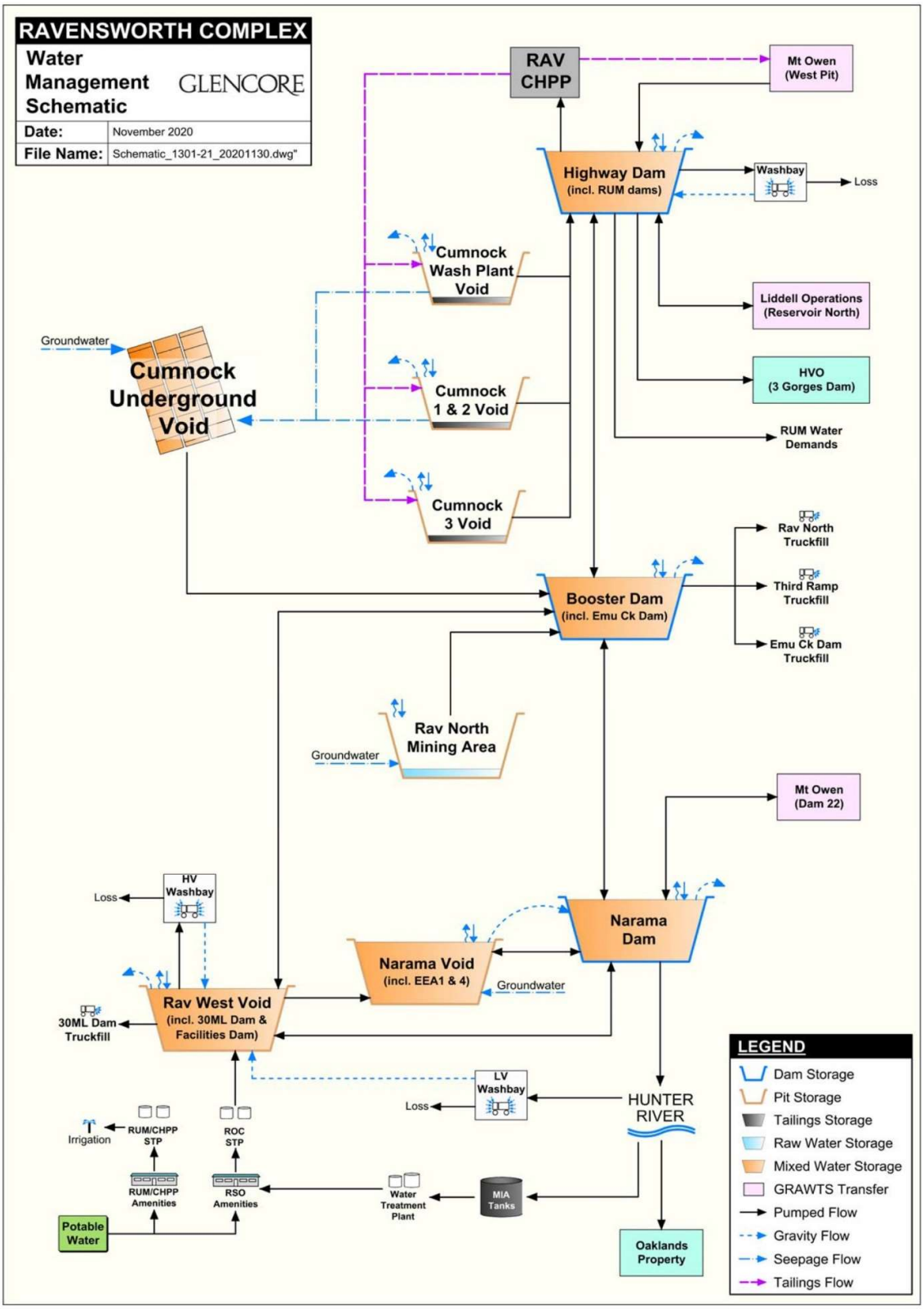


Figure 3.2 RC Water Transfer Schematic

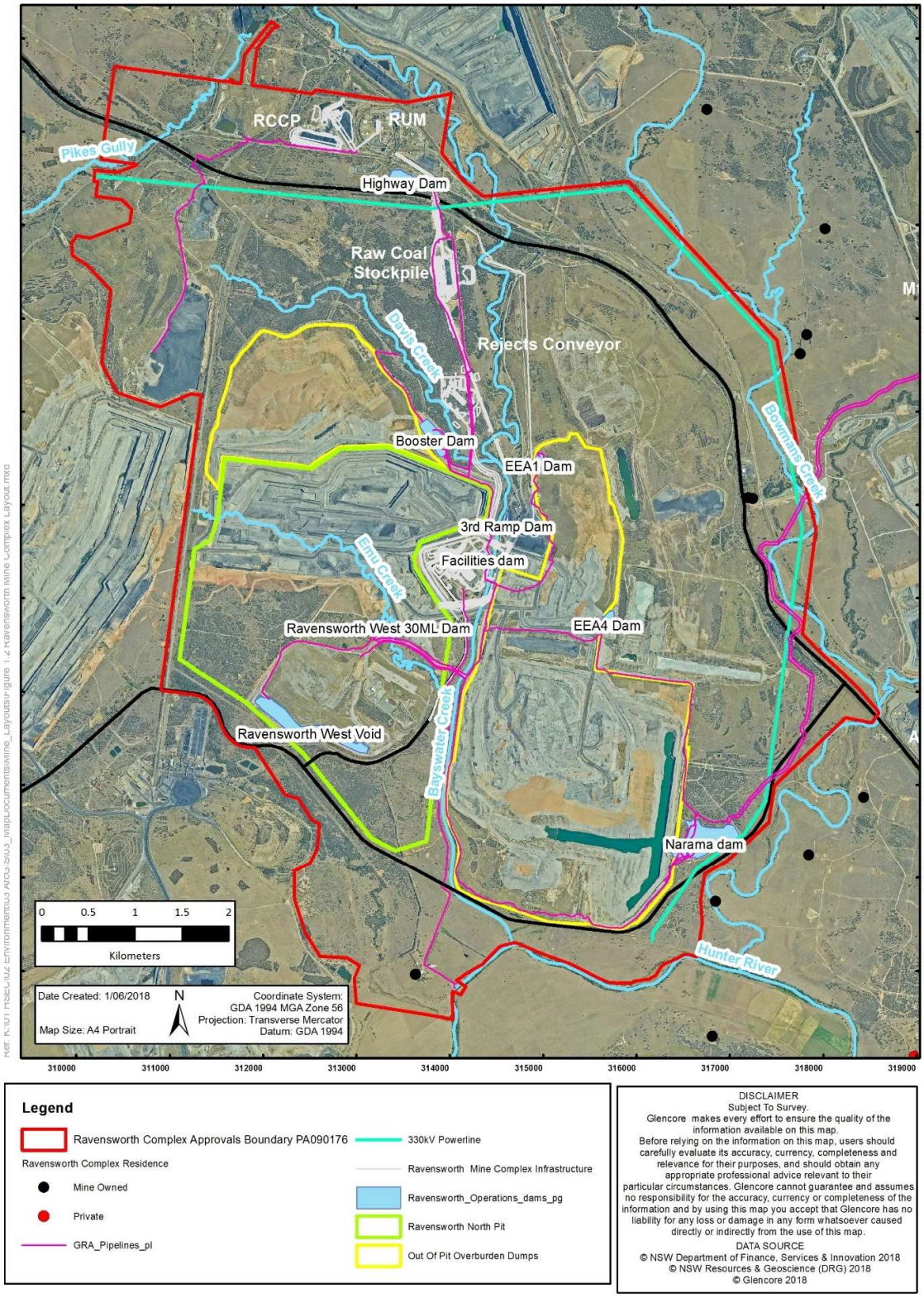


Figure 3.3 Booster Dam and associated infrastructure dams

3.4 Raw Water

The RC holds water access licences that allow water to be extracted from the Hunter River (WAL9050 and WAL10771). The pumping facility used to extract water from the Hunter River under WAL10771 is located upstream of the Bayswater Creek confluence point with the Hunter River. Raw water can also be pumped from the Hunter River via Lake Liddell under an agreement with AGL Macquarie .

Raw water will be stored in the Raw Water Dam (when constructed) or the storage tanks at the Mining Infrastructure Area (MIA) and is used within the Ravensworth Complex for the following purposes:

- Clean water supply to the MIA;
- Fire Water System;
- Vehicle washing; and
- Maintenance related cleaning of machines.

3.5 Potable Water

Potable water is purchased and transported to the site as needed. The potable water is used within the office complex and employee amenities.

3.6 Wastewater

Sewage treatment across the RC is provided by dedicated Sewage Treatment Plants (STPs). The STPs have both primary and secondary treatment systems. Effluent from the STPs is either disposed of offsite by a licenced waste contractor or after treatment is either irrigated on dedicated land or, returned to the mine water system in accordance with the project approval. Sewage treatment at the RC is managed and reported on in accordance with the requirements of EPL 2652.

3.7 Industrial Water System

Runoff from maintenance areas and hardstands in the MIA is collected in the industrial water system. Industrial water may contain traces of oil and grease associated with the maintenance and wash down of mobile equipment. Industrial water is treated in an oil and water separator. Oil and grease is collected and disposed of offsite by a licensed waste contractor. Treated water is sampled on a monthly basis for oil and grease and is reused in the mine WMS.

3.8 Participation of the Greater Ravensworth Area Water Tailings Strategy

RC participates in the Greater Ravensworth Area Water Tailings Strategy (GRAWTS), operated by GCAA across its mining operations, including Liddell Colliery, the Mt Owen Complex (including Mt Owen, Ravensworth East and Glendell mines) and Integra Underground.

The mining operations within the GRAWTS are linked through a range of water transfer and storage infrastructure, including pipelines, surface storages, mining voids and former underground mine workings.

The RC WMS plays an important role in the GRAWTS through its ability to discharge surplus water from the system through the existing Narama Inpit Storage Dam (refer to **Figure 3.2**) under the conditions of RC EPL and the Hunter River Salinity Trading Scheme (HRSTS).

The RC also has an agreement with Hunter Valley Operations (HVO) (Yancoal/Glencore Joint Venture) to transfer and receive water between the two operations.

3.9 Creek Diversion Management

Creek diversion management will be undertaken in accordance with the Creek Diversion Management Plan provided in **Appendix B**. The Creek Diversion Management Plan provides a framework for the management of Bayswater Creek, and more specifically details regarding the construction, remediation and rehabilitation phases. The Plan has been prepared to meet the requirements of Condition 31b, Schedule 3 of PA 09_0176.

The *Ravensworth Operations Project Environmental Assessment* (Umwelt, 2010) also proposed the temporary diversion of Emu Creek. The proposed diversion would have involved the construction of diversion dams upstream of the Ravensworth North mining area. Runoff captured in these dams would have been discharged into Davis Creek via a pump and pipeline system. The temporary diversion would then have been removed once operations were completed in the Ravensworth North mining area and Emu Creek has been reinstated as part of the proposed final landform.

Following discussions with DPIE Water and DPIE included in **Appendix F**, the RC no longer intends to undertake the temporary Emu Creek diversion. Instead of constructing the diversion dams, runoff from the residual catchment of Emu Creek will be allowed to flow into the mining area where it will be contained in a sump. This water will be used for operational activities onsite. This water will be taken in accordance with the RCs harvestable rights. Section 53 of the *Water Management Act 2000* states that the harvestable rights dam must be situated on a minor stream – the mining area (including the proposed sump) is situated on Emu Creek, which constitutes a minor stream; therefore, the capacity and location of the sump are consistent with the requirements of the *Water Management Act 2000*.

4. Site Water Balance

4.1 Water Sources

The main sources of water within the RC WMS are rainfall into the open cut mining areas and dirty water catchments, groundwater inflow to the Narama and Ravensworth North open cut pits, and water transferred in from other sites within the GRWATS. Potable water is = trucked to site. Water is also extracted from the Hunter River, Bayswater Creek under water access licences WAL9050, WAL10771 WAL1046, WAL8964 and WAL1325.

4.2 Water Demands and Losses

The main water demands at the RC include:

- Water used in the RCHPP, including water lost to product coal, coarse rejects and fine rejects (tailings);
- Dust suppression; and
- Potable water used within the staff facilities and bathhouse.

The main water losses are attributable to evaporation from the surface of water storage dams / pits and tailings dams.

4.2.1 Water Efficiency

To maintain water efficiency at the RC a number of key water reuse components will be implemented to effectively manage the water balance and maximise water reuse. The water reuse components include:

- Water recovery from the tailings emplacement areas through construction of features that will facilitate the management and drainage of tailings decant water for beneficial reuse as part of the RC, and more specifically for use at the RCHPP;
- Reuse of mine water to uses which are not limited in water quality criteria, such as dust suppression and coal washing; and
- Reuse of water from vehicle wash down areas and hardstand areas, to be collected and treated before use as process or dust suppression water.

Water recovered from the tailings emplacement areas has been considered as part of the project water balance. Further investigation of reasonable and feasible design alternatives to maximise the recovery of the tailings decant water will be considered as part of the detailed design for each of the tailings emplacement areas. Water usage, rainfall, dam volumes and discharges (including transfers) at the RC will continue to be monitored to assist in the management of the mine WMS.

4.3 Water Transfer and Disposal

Surplus water within the mine WMS is stored in the former Cumnock underground mine workings, the Narama Inpit Storage Dam, the Ravensworth West void and Narama Void.

As required, surplus water is either transferred to the RCHPP, the Mt Owen Complex under the GRAWTS, or discharged from the Narama Inpit Storage Dam to the Hunter River under the conditions of the RC EPL No. 2652 and the HRSTS.

When transferring water within the GRAWTS, site based procedures detail areas of responsibility, maintenance, inspections, communication and response to unplanned events.

EPL No. 2652 permits a maximum discharge of 400 ML/day from the Narama Inpit Storage Dam under the HRSTS regulations.

4.4 Future Water Balance

The RC WMS incorporates Ravensworth North, Narama, Ravensworth West, Cumnock Wash Plant Pit mining operations, the former Cumnock underground and open cut mines and tailings storage facilities; and the RCHPP area.

Under PA 09_0176, the RC water balance will incorporate all the mining operations that form part of the RC. A summary of the RC estimated water balance for Year 5 (approximately 2021) and Year 10 (approximately 2026) is shown in **Table 4.1**. The estimated future water balance is based on the water balance compiled for the *Ravensworth Operations Project Surface Water Assessment* (Umwelt, 2010) and updated by GHD (2017).

Table 4.1 The RC Estimated Water Balance Summary

Item	Year 5 (2021)	Year 10 (2026)
Inflows		
- Catchment runoff and direct rainfall	2570 ML	2624ML
- Groundwater inflows	2168 ML	2178 ML
- ROM Coal moisture	583 ML	586 ML
- From MOC	675 ML	601 ML
- From LCO	1447 ML	2454 ML
- From Hunter River	640 ML	802 ML
Total Inflows	**8083 ML**	**9244 ML**
Outflows		
- Evaporation	342 ML	364 ML
- Dust suppression usage	1021ML	1013 ML
- Product Coal moisture	588 ML	621 ML
- Coarse rejects moisture	426 ML	343 ML
- Tailings water	6305 ML	6334 ML
- To MOC	19 ML	0 ML
- To LOC	0 ML	0 ML
- Discharges to Hunter River	227 ML	437 ML
Total Outflows	**8928 ML**	**9111 ML**
Balance		
Change in Storage	**-837 ML**	**-141 ML**

The estimated water balance shows water deficits of 837 ML and 141 ML in Years 5 and 10. The results of the water balance will be reported in the Annual Review, which will include a comparison against the predictions in the EA (Umwelt, 2010).

4.5 Annual Water Balance

An annual site water balance will be compiled based on site water management data collected in accordance with the requirements of the RC procedures. The annual site water balance will be used to demonstrate compliance with the requirements of the EPLs, WALs and development consent conditions under which the RC operates.

5. Erosion and Sediment Control

Construction and maintenance activities, where required, will commence after the necessary approvals have been sought through the Ground Disturbance Permit (GDP) process. A GDP will be completed, where required, for construction or clearing activities to detail the erosion and sediment control measures to be implemented for that activity.

All erosion and sediment control activities will be undertaken in accordance with the GCAA Erosion and Sediment Control Protocol (GCAA-625378177-10323), guidelines from *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volumes 2A, 2C, 2D and 2E* (DECC, 2008) (the Blue Book), NSW Fisheries Guidelines *Fish Friendly Waterway Crossings* (undated) and *Guidelines for the planning, construction and maintenance of tracks* (Department of Land and Water Conservation, 1994).

5.1 Sources of Sediment

The mining operations and related activities that have the potential to generate sediment and impact on the surrounding catchment areas if not appropriately managed are:

- Construction works;
- Runoff from the construction and maintenance of internal access roads and haul roads;
- Clearing of land ahead of mining or for other mining related activities;
- Open cut mining and the placement of overburden and topsoil;
- Vehicle and equipment movements;
- Coal stockpiles and coal handling equipment including mobile equipment, coal crushing equipment and conveyors;
- Rehabilitation of disturbed areas;
- Management and rehabilitation of tailings and reject emplacement areas;
- Disturbed areas not yet rehabilitated; and
- Disturbed areas created by natural processes or by previous agricultural land uses.

5.2 Potential for Erosion

The mining operations at the RC will result in the alteration of existing surface water flow patterns and have the potential to create extensive areas of land disturbance. Erosion and sediment impacts that may result from the RCs mining operations and related activities or from activities within the surrounding natural environment include:

- Increased runoff volumes and velocities within existing drainage lines due to the removal of vegetation cover and increase of impervious areas;
- Runoff across disturbed areas outside existing drainage lines (e.g. overland flow); and
- Scouring of catch drains and diversion banks prior to the establishment of vegetation cover or as a result of the loss of vegetation cover.

5.3 Potential to Affect Flooding

The key features of the RC that have the potential to impact on flooding in the adjacent and downstream drainage systems both during mining operations and after decommissioning, were discussed in the Surface Water Assessment of the EA (Umwelt, 2010) and include:

- The construction of a flood levee on Emu Creek immediately upstream of the confluence of Emu Creek and Bayswater Creek;
- Localised catchment area changes due to the open cut pit and overburden emplacement areas; and
- The realignment of Lemington Road.

5.4 Erosion and Sediment Control Measures

Measures to manage potential erosion and sediment transport are implemented at the RC and include:

- Minimising all disturbed areas and stabilisation by progressive rehabilitation / stabilisation as soon as practicable;
- Clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas;
- Clearing as little vegetation as required, leaving mulch on cleared areas as late as possible and minimising machinery disturbance outside of these areas;
- Leaving topsoil on ground with mulch incorporated to protect underlying dispersive horizons;
- Constructing diversion banks upslope of areas to be disturbed to direct clean water runoff away from disturbed areas where practical. The diversion banks will be designed to provide effective segregation of sediment laden runoff and allow clean surface water to return to natural watercourses;
- Applying gypsum, where required, to reduce the dispensability of the subsoil's that will be disturbed and to minimise the potential for tunnel erosion and surface riling of disturbed or reshaped areas. The application rate is to be determined by soil analysis as required, which may include the completion of an Emerson Aggregate Test. Application rates are also to be determined in consideration of the requirements contained within the Blue Book; and
- In accordance with the requirements of the HRSTS, water discharged as part of the HRSTS is required to be less than 120 mg/L of TSS.

5.5 Topsoil Management

Topsoil stripping within areas proposed to be disturbed should be undertaken (where practicable) when the soil is in a slightly moist condition, thus reducing damage to soil structure and dust emissions. Topsoil management will be undertaken in accordance with site procedures and the RC Biodiversity Management Plan; including the following measures:

- Where possible, topsoil stockpiles are to be located away from mining, traffic areas and watercourses;
- Where possible, level or gently sloping areas are to be selected as stockpile sites to minimise erosion and potential soil loss;

- Appropriate sediment controls are to be installed upslope of stockpiles to divert water around the stockpiles and downslope of stockpiles to prevent soil loss;
- Stockpiles are to be generally less than three metres high and set out in windrows to maximise surface exposure and biological activity; and
- Vegetation of soil stockpiles if stored for longer than 12 months.

5.5.1 Works within Watercourses

When work is required within watercourses, the following will be implemented:

- Where possible maximise the preservation of any existing vegetation and minimise site disturbance during works within the riparian zone;
- Provide for the retention of natural functions and maintenance of fish passages with designs for works within or near water bodies, in accordance with NSW Fisheries Guidelines Fish Friendly Waterway Crossings (undated);
- Incorporate measures where works are to be undertaken within the two year flood level, to provide C-factors (i.e. factors relating to vegetation coverage as outlined in Appendix A of Volume 1 of the Blue Book (Landcom, 2004) are always below 0.05 during possible erosion events; and
- Schedule planned works for forecasted dry weather periods, where possible.

5.5.2 Temporary Waterway Crossings

Where temporary waterway crossings are required, construction of these will be in accordance with guidelines outlined in *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volumes 2A, 2C, 2D and 2E* (DECC, 2008a-d) the Blue Book, and NSW Fisheries Guidelines *Fish Friendly Waterway Crossings* (undated).

5.5.3 New Access Tracks

Where access tracks are required, construction of these will be in accordance with *Guidelines for the planning, construction and maintenance of tracks* published by Department of Land and Water Conservation (1994) and GCAA standards, including:

- Minimising disturbance of existing ground, e.g. where possible limiting works to slashing vegetation when constructing tracks;
- Limiting construction of access tracks across existing drainage lines;
- Maintaining vegetation buffers between access tracks and watercourses where possible;
- Ensuring tracks are free draining; and
- Including cross fall and outfall drainage, where required, to prevent concentration of runoff.

In addition, any tracks proposed to be constructed within the RC Offset Areas should be undertaken in accordance with the requirements of the RC Biodiversity Management Plan.

5.6 Erosion and Sediment Control Structures

The main erosion and sediment controls used by the RC include:

- **Clean water diversion drains and banks:** Clean water diversions will be constructed upslope of areas to be disturbed to divert clean water runoff away from disturbed areas and prevent water from entering active areas and the saline/dirty water systems. Clean water runoff will be diverted into nearby watercourses. Appropriate protection will be established where diverted waters enter creeks through the use of level spreaders or other protection measures.
- **Catch drains:** Catch drains will be established to divert runoff from the disturbed areas to sediment dams.
- **Sediment fences and other temporary controls:** Sediment fences, sediment traps, rock checks and other temporary erosion and sediment control measures from the Blue Book will be installed in advance of, or in conjunction with, earthworks to prevent sediment laden water leaving the site or entering clean water systems.
- **Sediment dams:** Sediment dams are to be constructed within dirty water catchments to capture and treat sediment laden water for treatment prior to discharge. Sediment dams will be installed where appropriate prior to any land disturbance activities occurring and maintained following completion.

Where new erosion and sediment controls are to be implemented at the RC or maintenance work is undertaken on existing structures, the design requirement for new or refurbished structures will be in accordance with **Appendix C** of this document.

5.6.1 Sediment Dams

Where a sediment dam is required the following should apply:

- Sediment dam design is to be generally in accordance with **Appendix C**;
- Sediment dams are to be maintained/managed in a drawn down state as far as practical to provide for the required settling zone (refer to Appendix C), this may be achieved through the use of the water in dust suppression;
- Sediment dams will be maintained with sediment zone not encroaching on settling zone; and
- Sediment dams are to be inspected and maintained as per **Section 7**.

5.7 Flood Management Structures

A flooding assessment of Bayswater Creek undertaken for the EA (Umwelt, 2010) indicates backwater from Bayswater Creek may flow up the Emu Creek channel under the 100-year ARI critical duration storm event and potentially enter the open cut pit. In order to prevent this backflow of water into the Emu Creek channel, construction of a flood levee commenced in 2022.

The Emu Creek flood levee (when construction is completed) will be located at the confluence of Emu Creek and Bayswater Creek. The proposed Emu Creek flood levee will be designed to contain the 100-year ARI storm event flood level in Bayswater Creek and include a one-metre freeboard. The proposed Emu Creek flood levee will be designed at a minimum height of 70 m AHD and will extend between the 70 m AHD contour line on the north bank and 70 m AHD contour line on the south bank of the Emu Creek channel.

6. Water Quality Monitoring

The section below details the water quality monitoring to be undertaken at the RC. Baseline data related to the Surface Water and Groundwater monitoring programs is included in **Appendix E**. Prior to Project Approval 09_0176, monitoring locations where designated to separate approvals these have been since combined with rationalisation in location and nomenclature.

6.1 Surface Water Monitoring Methodology

Surface water monitoring at the RC includes the following:

- Surface water quality and flows in upstream and downstream watercourses;
- Channel stability in upstream and downstream watercourses;
- Stream health conditions in upstream and downstream watercourses;
- Onsite water and wastewater management; and
- Discharges to Bowmans Creek under the HRSTS.

6.1.1 Surface Water Quality

Scheduled surface water monitoring is to be undertaken at the monitoring locations shown in **Figure 6.1** and **Tables 6.1, 6.2** to **6.4**. this includes monitoring of pH, EC, TSS, TDS. The watercourse locations are also monitored for flow.

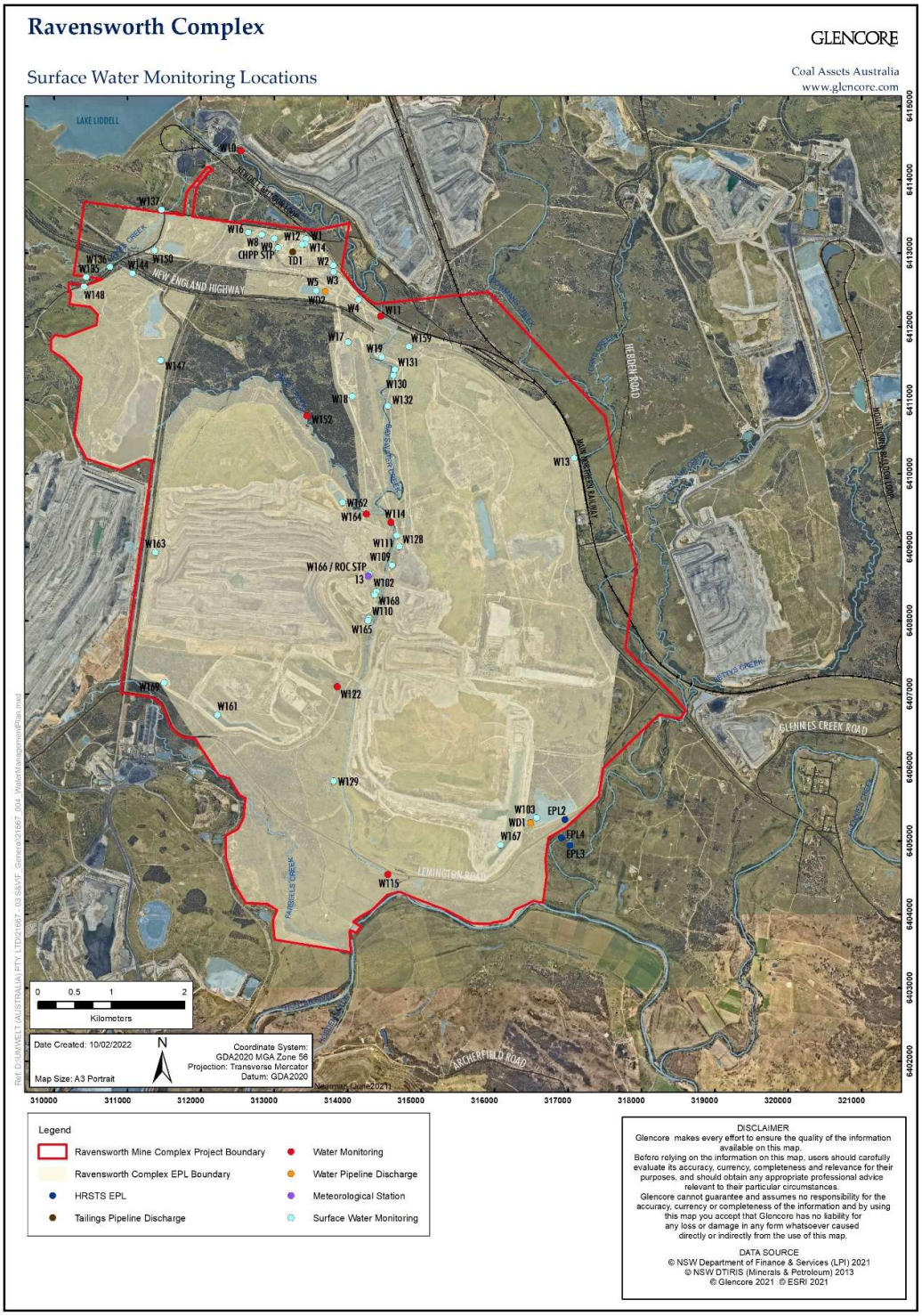


Figure 6.1 **Surface *Water Monitoring Locations***

Table 6.1 Monthly Water Quality and Flow Monitoring Program for Watercourses[1]

Monitoring Location	Site Description
ROC	
EPL 3	Bowmans Creek Upstream[2]
EPL 4	Bowmans Creek Downstream[2]
W114 (EPL 21)	Bayswater Creek Upstream
W115 (EPL 19)	Bayswater Creek Downstream
W122 (EPL 20)	Emu Creek Downstream
RUM	
W10 (EPL 25)	Bayswater Creek Upstream
W11 (EPL 24)	Bayswater Creek Downstream

Notes [1] Measured by way of observation, as streams listed may be ephemeral.
[2] During HRSTS discharge events pH, EC and TSS to be monitored twice per day.

Table 6.2 Bi-monthly Water Quality and Flow Monitoring Program for Watercourses

Monitoring Location	Site Description
W135	Pikes Gully Creek Upstream
W136	Pikes Gully Creek at New England Highway
W137	Pikes Gully Creek Road at CHPP Culvert
W152 (EPL 23)	Davis Creek 2
W164 (EPL 22)	Davis Creek Downstream

Table 6.3 Monthly Water Quality Monitoring Program for Onsite Dams

Monitoring Location	Site Description
Mine Water Storage Dams	
W1	Office Dam
W2	Pit Top Dam
W3	ROM Dam
W4	Eastern Dam
W5	Highway Dam
W9	Product Coal Construction Dam
W13	Vent Fan No.3 Dam
W16	Product Coal Main Dam
W17	Raw Coal North Dam
W18	Raw Coal South Dam

Monitoring Location	Site Description
W19	Reject Bin Dam
W102	Facilities Collection Dam
W103	Narama Dam
W109	3rd Ramp Dam
W110	West Dam
W111	Crushing Plant Dam
W161	Rav West Void
W162	Booster Dam
W165	West Emergency Dam
W167	Narama Void
Sedimentation Dams	
W8	Product Coal Sed Dam
W128	Crushing Plant Sed Dam
W129	Narama Dams
W130	C–7 Drive Head Collection Dam
W131	C-6 Drive Head Collection Dam
W132	Coal Conveyor Sedimentation Dam
W134	Park Dam
W147	Stage 2 Sed Dam
W159	5000T Bin Dam

Table 6.4 Bi-monthly Water Quality Monitoring Program for Dams

Monitoring Location	Site Description
W144	Stage 1 Sediment Basin C
W148	Carpark Sediment Basin
W150	Dispatch Sediment Dam

As the RC progresses, the surface water monitoring schedule will be updated to reflect changes to the onsite water storages (i.e. additions and decommissions).

Monitoring of water quality in onsite water management dams may also be undertaken at other times for site environmental management purposes.

6.1.2 Channel Stability and Stream Health

Monitoring of channel stability in Bowmans Creek, Bayswater Creek, Emu Creek, Pikes Gully and Davis Creek will involve annual inspections. The inspection program is limited to the sections of the respective creek lines within or adjoining the RC. This monitoring will include visual inspection of:

- Stream and riparian vegetation cover;
- Bed condition;
- Potential areas of instability;
- Creek diversion structures; and
- Drop structures, gabions and other engineered features.

This monitoring will be undertaken in accordance with the Ravensworth Complex EMS.

6.1.3 Onsite Water Monitoring

Monitoring of onsite water storages at RC, including water supply dams, mine voids, irrigation water storages and sediment dams is undertaken as required to identify any potential surface water impacts caused by the mining operation and assist in water balance calculations. The additional monitoring information is indicative only and will be refined as operations progress at the RC. Surface water monitoring that is undertaken at the RC to meet operational requirements includes the following:

- Daily rainfall, as recorded from a weather station;
- Daily water level monitoring of selected water storage dams;
- Water level monitoring of all other dams (to be conducted daily pre, during and post rainfall events of greater than 20 mm in 24 hours);
- Monthly volume of water imported onto the site from offsite in accordance with the relevant water access licence requirements. This information will be reported as part of the RC Annual Review;
- Monthly monitoring of dams from which offsite discharge can occur, for the following water quality parameters:
  - pH;
  - electrical conductivity (µS/cm);
  - TDS (mg/L); and
  - TSS (mg/L).
- 6 monthly speciation monitoring of the Narama Inpit Storage Dam for metals, nutrients and hydrocarbons;
- Dams in key locations including the infrastructure area are tested monthly for other analysts including:
  - BOD;
  - Oil and Grease; and
  - Phosphorous; and

- Regular inspections of all sediment and erosion controls (refer to Erosion and Sediment Control Plan) where possible during and after storm events (i.e. rainfall events of greater than 20 mm in 24 hours).

In the event that hydrocarbon contamination is suspected (i.e. visible sheen) of a dam or waterway, hydrocarbon monitoring will be undertaken. In the event that contamination is detected, suitable remediation actions will be undertaken.

As detailed within **Section 6**, in the event that a sediment dam onsite was to overtop, the relevant TARP response would be triggered.

Water to be discharged from the site will be discharged in accordance with the requirements of **Section 6.1.4,** with the water to be discharged in accordance with the relevant EPL for the site.

6.1.4 HRSTS Discharge

The procedure for the discharge of water under the HRSTS is documented in the RC EMS.

Under the HRSTS, discharges from mines and power stations are not permitted during periods when flow in the Hunter River is low. Discharge is permissible when flow in the Hunter River is high, providing sufficient salt credits and a discharge licence is held by the respective operation.

Ravensworth Complex discharges surplus water under the HRSTS into Bowmans Creek via the Narama Inpit Storage Dam. The maximum licensed discharge rate from the Narama Inpit Storage Dam (refer to **Figure 3.2**) during flood flow in the Hunter River is currently 400 ML/day. RC holds tradable credits in the HRSTS under EPL no. 2652. Additional credits can be obtained through a trading scheme with other license holders (if available) by accessing the online credit exchange facility.

6.2 Surface Water Impact and Assessment

6.2.1 Stream Health and Impacts

6.2.1.1 Water Quality and Flows

The RC ECC (or delegate) is responsible for the monthly review of the monitoring results and associated trends in water quality. In the event that any successive water quality measurement is found to deviate from background trends and/or is outside the adopted trigger values, the RC ECC (or delegate) will initiate further site-specific investigations when:

- In professional judgement, the deviation from background trends and adopted trigger values could result in environmental harm;
- Two (or more) consecutive values are outside the adopted Impact Assessment Criteria (IAC) values presented in **Appendix D**; or
- The measurement varies significantly from background water quality trends.

The IAC values adopted for surface water (shown as 80th percentile) management are presented in **Appendix D**.

When a water quality measurement has been investigated, the findings of the investigation will be reported in the Annual Review for the Ravensworth Complex.

All monitoring data will be retained in an appropriate format onsite and will be used to review the effectiveness of the RC WMS on an ongoing basis.

6.2.1.2 Channel stability and Stream Health Conditions

The RC ECC (or delegate) is responsible for the annual assessment of the channel stability and stream health in Bowmans Creek, Bayswater Creek, Emu Creek, Pikes Gully and Davis Creek in accordance with **Section 6.1.2**.

The channel stability and stream health monitoring program is outlined in **Section 6.1.2**. The monitoring results will be assessed against previous monitoring results to identify variations in the data that may indicate degradation in channel stability or stream health. The results of this monitoring will be reviewed regularly and reported in the Annual Review as required. If remedial actions are identified they will be input and tracked in the site action database.

6.3 Licence Condition

6.3.1 HRSTS Discharges

During discharge events under the HRSTS, the RC ECC (or delegate) is responsible for ensuring the discharge event occurs in accordance with the conditions in EPL No. 2652. All discharge events under the HRSTS will be reported in the annual HRSTS report in accordance with the HRSTS reporting requirements for EPL 2652 and in the Annual Review. Any exceedance of EPL No.2652 conditions in relation to HRSTS discharges will be reported to the EPA immediately.

In the event of an uncontrolled discharge offsite of water managed within the RC WMS, an investigation will be initiated.

6.3.2 Water Access Licences

The volume of water extracted under the Water Access Licences will be compared against the licence conditions on an annual basis.

6.4 Groundwater Monitoring Methodology

This program includes monitoring of the following elements of the alluvial and hardrock/coal aquifers underlying the RC:

- Groundwater inflows/seepage into open cut pits and former underground workings;
- Groundwater quality monitoring, including:
  - monitoring of pH, electrical conductivity (EC) and various trace elements (i.e. speciation) at 13 locations; and
- Groundwater levels/aquifer depressurisation; and
- Impacts on groundwater users and groundwater dependent ecosystems.

6.4.1 Groundwater Inflows and Seepage

Site water management data will be collected in accordance with the RC procedures and will be used during the preparation of the Annual Site Water Balance to determine the volume of groundwater inflows/seepage from hard rock/coal and from alluvial aquifers. This data will also provide information on the groundwater extraction volumes associated with groundwater entitlements.

6.4.2 Groundwater Quality and Levels

Details of the groundwater monitoring locations are presented in **Appendix E** and are shown on **Figure 6.2**.

A regular review and assessment of water level and water quality monitoring data will be undertaken and include consideration of relevant meteorological and rainfall data.

6.4.3 Existing Groundwater Users

There are no privately owned bores within the area of the RC WMS or within three kilometres of its boundary. The nearest known privately owned bores or wells that are not mining related, are located more than three kilometres to the southeast of the RC.

There are no predicted impacts on yields of privately owned boreholes associated with the Ravensworth Operations Project (Umwelt, 2010).

6.4.4 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems that have their species composition and natural ecological processes determined by groundwater (DLWC, 2002). GDEs potentially relevant to the RC could be associated with the pockets of alluvium within the RC WMS boundary.

If GDEs are found to be influenced by mining operations at the RC further investigations will be undertaken as outlined in **Section 7**.

6.5 Groundwater Impact and Assessment

6.5.1 Groundwater Extraction

If significant inflows from the alluvial groundwater into the mine pits are identified, the measures outlined in **Section 6** shall be implemented.

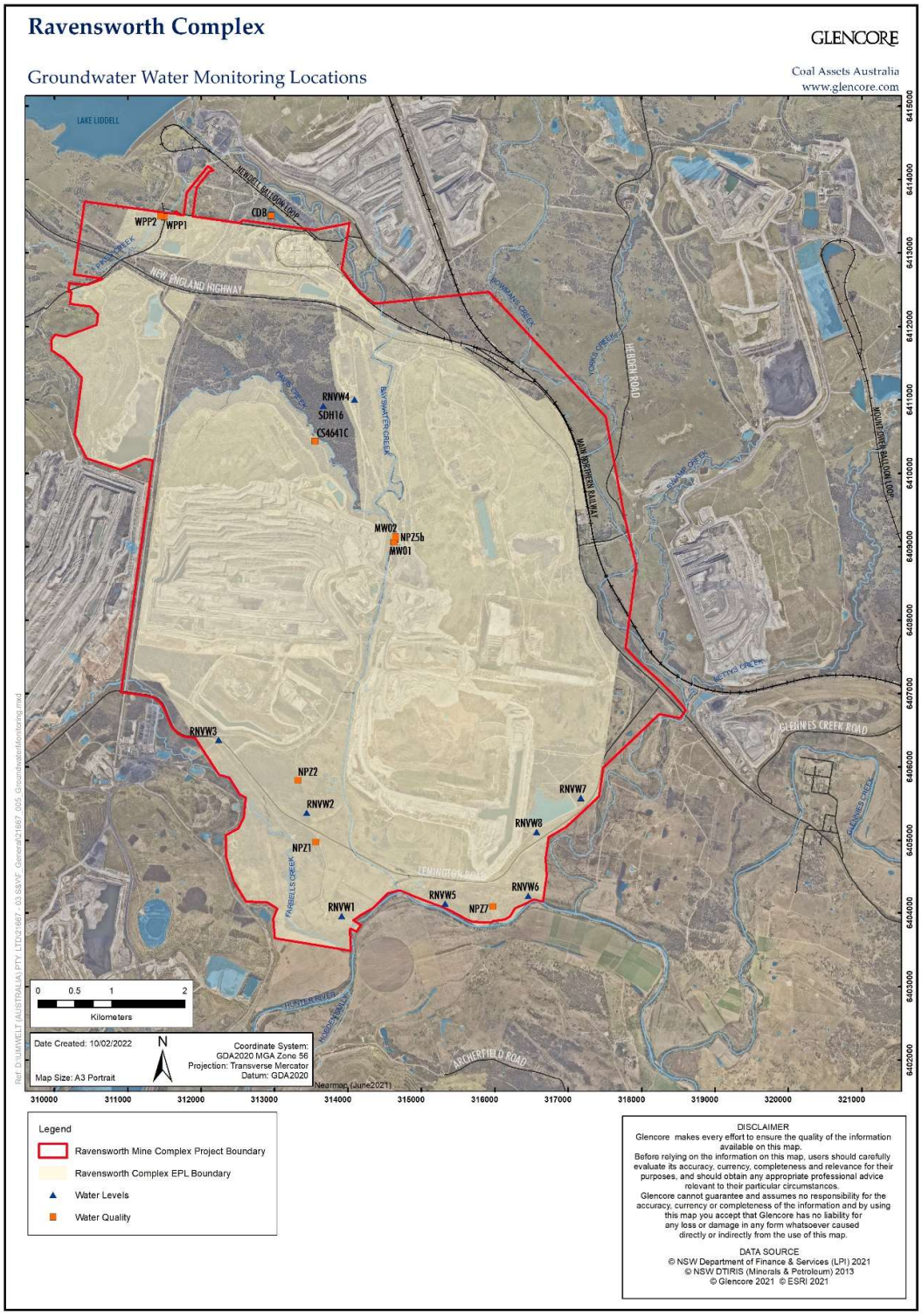


Figure 6.2 Groundwater Monitoring Locations

If the inflow of groundwater from hard rock / coal or alluvial aquifers into the mine pits or former underground workings exceeds the respective licence limits (refer to **Table 6.5**), the event would trigger the measures outlined in **Section 7**.

Table 6.5 Groundwater Extraction Limits

Mine	Licence No.	Extraction Limit
Cumnock South Open Cut Pit	20BL170776	50 ML/year
Cumnock No. 1 Underground Goaf	20BL168240	2520 ML/year
Ravensworth West Open Cut Pit	20BL170462	100 ML/year
Narama Open Cut Pit	20BL170749	150 ML/year

In accordance with the Project Approval Statement of Commitments Condition 6.8.4, a formal review of depressurisation of coal measures and comparison of responses with the aquifer model predictions will be undertaken biennially. Expert review will be undertaken by a suitably qualified hydro geologist if the measured depressurisation in the coal measures exceeds the predicted depressurisation for the designated period. Results will be reported in the relevant Annual Review

6.5.2 Groundwater Quality

The RC ECC (or delegate) is responsible for the review of monitoring results and associated trends in groundwater quality is undertaken. In the event that any groundwater quality measurement is found to deviate from background trends and/or is outside the adopted trigger values presented in **Tables 6.6** and **6.7** the RC ECC (or delegate) will be responsible for initiating further site-specific investigations when:

- In professional judgement, the deviation from background trends and adopted trigger values could result in environmental harm;
- Two (or more) consecutive values are outside the adopted trigger values presented in **Tables 6.6** and **6.7**; or
- The measurement varies significantly from background groundwater quality trends Site-specific impact assessment criteria values for EC and pH have been determined for each monitoring location and are presented in **Table 6.6**. Interim and site specific IAC values for speciation data are presented in **Table 6.7** and **6.8**

Note: monitoring locations CS4539Ca, CS4658, CS4539A, CS4545, CS4545B Tall, CS4545B Mid and CS4545B Small have been mined through.

Table 6.6 Adopted Impact Assessment Criteria Values for pH and EC

Monitoring Location	Target	Water Quality Parameter	IAC
Coffey Dam Borehole	Liddell	pH	9.2 – 10.0
		EC (µS/cm)	3160
CS4641C	Pikes Gully	pH	8.8 - 11.9
		EC (µS/cm)	8900
NPZ1 Mid	Bayswater	pH[1]	6.6 - 6.8
		EC (µS/cm)	15015
NPZ1 Tall	Lemington	pH	7.0 - 7.3
		EC (µS/cm)	9736
NPZ2 Tall	Lemington	pH	8.3 - 8.4
		EC (µS/cm)	9765
NPZ5B P1	Broonies	pH	7.2 - 7.4
		EC (µS/cm)	6340
NPZ5B P2	Bayswater Creek Alluvium	pH	7.1 - 7.3
		EC (µS/cm)	2193
NPZ6 Tall	Broonies	pH	7.5 - 7.7
		EC (µS/cm)	7120
NPZ7 Small	Hunter River Alluvium	pH	7.3 - 7.4
		EC (µS/cm)	5259
NPZ7 Tall	Bayswater	pH	7.4 - 7.5
		EC (µS/cm)	8678
NPZ7 Mid	Broonies	pH	7.3 - 7.7
		EC (µS/cm)	8446
WPP1	-	pH	7.0 – 7.1
		EC (µS/cm)	8604
WPP2	-	pH[1]	7.0 - 7.3
		EC (µS/cm)	9352

Table 6.7 Interim Impact Assessment Criteria Values for Speciation Data

Parameter	Unit of Measurement	IAC Value
Sodium	mg/L	300
Sulphate	mg/L	400
Chloride	mg/L	400
Iron	mg/L	0.3
Silver	mg/L	0.05
Aluminium	mg/L	0.2
Barium	mg/L	1
Cadmium	mg/L	0.005
Copper	mg/L	1
Manganese	mg/L	0.1
Nickel	mg/L	0.1
Lead	mg/L	0.05
Selenium	mg/L	0.01
Zinc	mg/L	5
Mercury	mg/L	0.001
Nitrite as N	mg/L	1
Nitrate as N	mg/L	10

Table 6.8 Impact Assessment Criteria Values for Speciation Data for select sites

Site	Parameter	Unit of Measurement	IAC Value 80th Percentile	IAC Value 20th Percentile
CS4641C	Sodium	mg/L	1980	1820
	Chloride	mg/L	2482	2310
NPZ1 Tall	Sodium	mg/L	2048	1820
	Chloride	mg/L	2744	2225
NPZ2 Tall	Sodium	mg/L	2178	2100
	Chloride	mg/L	2685	2430
NPZ5B P1	Sodium	mg/L	939	820
	Chloride	mg/L	1020	830
NPZ7 Small	Sodium	mg/L	1496	1300
	Chloride	mg/L	2492	1990

Site	Parameter	Unit of Measurement	IAC Value 80th Percentile	IAC Value 20th Percentile
NPZ7 Tall	Sodium	mg/L	1602	1320
	Chloride	mg/L	2542	2099

Section 3.3.2.3 of ANZECC (2000) suggests that if an adopted trigger value is exceeded, the aim of further site-specific investigations is to assess if a 'potential risk' or an actual problem exists. The site-specific investigation will be initiated in accordance with **Section 7**.

6.5.3 Groundwater Levels

The RC ECC (or delegate) is responsible for the monthly review of the monitoring results and associated trends in groundwater levels. In the event that two (or more) consecutive groundwater level measurements are found to deviate from background trends the RC ECC (or delegate) will be responsible for initiating further site-specific investigations in accordance with **Section 7**.

The impact assessment criteria (IAC) are determined as the 80th and 20th percentile levels of all available data. Trends in groundwater levels will be reported in the Annual Review.

7. Trigger Action Response Plan

The objective of the Trigger Action Response Plan (TARP) is to support the RC WMS by providing appropriate response protocols for events that may result in adverse impacts to the surrounding surface water and/or groundwater environment(s). These response protocols are a subset of the control measures that have been adopted by RC to manage/mitigate the risks associated with the management, storage and transfer of water to the successful operation of the mines within the RC and to the surrounding natural and built environment. **Table 7.1** outlines the response protocol for anticipated water management events. In addition to the protocols defined in **Table 7.1**, RC has developed a Pollution Incident Response Management Plan (PIRMP), in accordance with the requirements of the *Protection of the Environment Operations Act 1997*. The PIRMP details the incident reporting process to be utilised by RC in the event of an environmental incident.

Table 7.1 RC Water Management Response Actions

Event Trigger	Summary of Response Protocol	EMS
Breach Licensed Discharge Non-compliance with EPL and HRSTS discharge limits for: • pH; • total suspended solids (TSS); • flow rate; or • Electrical conductivity (EC).	• Investigate in accordance with the Section 8.1; • Consider any mitigating factors where applicable; • Determine if an incident has occurred; • Report results to senior management; and • Report non-compliance to the DPIE and EPA	HRSTS Discharge Surface Water and Stream Health Management
Water Quality Water monitoring results are outside: • the surface water and stream health impact assessment criteria; or • Above groundwater quality assessment criteria.	• Investigate results and trends, considering any mitigating factors where applicable; • Determine if an incident has occurred; • Initiate detailed investigation if trends indicate potential for harm; • Report results to senior management; and • Undertake mitigation actions as required.	Surface Water and Stream Health Management
Degradation of Channel Stability Visual inspection results indicate a reduction in watercourse stability.	• Investigate results and trends, considering any mitigating factors where applicable; • Determine if an incident has occurred; • Initiate detailed investigation if trends indicate potential for harm; and • Report results to senior management; and • Undertake mitigation actions as required.	Surface Water and Stream Health Management

Event Trigger	Summary of Response Protocol	EMS
Alluvial Groundwater Increased leakage from the alluvial aquifers into open cut pits.	• Confirm inflow rates exceed the Water Access Licence limits; • Investigate the cause of any increased seepage from the alluvial aquifers into open cut pits; • Report findings to senior management; • Report findings to the DPIE, EPA and DPIE Water. and • Undertake mitigation actions as required.	Groundwater Management
Unauthorised Discharge Overflow or failure of a dam, containment system, catch drain or diversion bank.	• Investigate in accordance with Section 8.1; • Consider any mitigating factors where applicable; • Determine if an incident has occurred; • Report discharge to the DPIE and EPA; and • Review adequacy of existing water management infrastructure and controls.	Surface Water and Stream Health Management
Failure of an Erosion and Sediment Control Structure Dirty water discharged to natural environment.	• Investigate in accordance with Section 8.1; • Consider any mitigating factors where applicable; • Determine if an incident has occurred; • Report discharge to the DPIE and EPA; • Review adequacy of Erosion and Sediment Control Structure and the maintenance and inspection regime; and • Undertake mitigation actions as required	Surface Water and Stream Health Management Construction and Maintenance of Erosion and Sediment Control Structures Design and Maintenance of the WMS

Event Trigger	Summary of Response Protocol	EMS
Overflow from Mine WMS Potentially leading to discharge of dirty water to natural environment.	• Investigate in accordance with Section 8.1; • Consider any mitigating factors where applicable; • Determine if an incident has occurred; • Report any unauthorised offsite discharges to the DPIE and EPA; • Review adequacy of erosion and sediment control structure and the maintenance and inspection regime; and • Undertake mitigation actions as required	Surface Water and Stream Health Management Construction and Maintenance of Erosion and Sediment Control Structures Design and Maintenance of the WMS
Surface Water Quality / Availability Loss of surface water availability for downstream water users (complaint based).	• Record complaint and report to senior management; • Investigate complaint, considering any mitigating factors and provide feedback to complainant; • Provide feedback to mine planning and production personnel, where relevant; • Initiate detailed investigation if complaint indicates potential for harm; • Report results to senior management; and • Undertake mitigation actions as required	General - Complaints Handling and Reporting Surface Water and Stream Health Management
Groundwater Availability Loss of groundwater availability at private licensed bore (complaint based).	• Record complaint and report to senior management; • Investigate complaint, considering any mitigating factors and provide feedback to complainant; • Provide feedback to mine planning and production personnel, where relevant; • Initiate detailed investigation if complaint indicates potential for harm; • Report results to senior management; and • Undertake mitigation actions as required.	General - Complaints Handling and Reporting Groundwater Management

Event Trigger	Summary of Response Protocol	EMS
Groundwater Groundwater inflow rate exceeds Part 5 Licence conditions.	• Confirm inflow rates exceed the licence limits; • Investigate the cause and source of any increased seepage from the aquifers into open cut pits; • Report findings to senior management; and • Report findings to the DPIE, EPA and DPIE Water	Groundwater Management
Groundwater Regional groundwater levels and/or inflow predictions vary from groundwater modelling predictions.	• Confirm results; • Investigate cause and potential source of discrepancies • Report findings to senior management; and • Report findings to DPIE, EPA and DPIE Water if required.	Groundwater Management

8. Inspection and Maintenance Requirements

8.1 Water Storages

All major water storages, including prescribed water storages and tailings dams, will be inspected and maintained in accordance with the relevant RC and GCAA standard procedures.

8.2 Pipes and Pumps

Pipes and pumps will be inspected in accordance with RC procedures and GCAA standards.

8.3 Equipment Testing

Equipment used in the measurement of water quantities and quality such as flow meters, online instrumentation and hand held analytical meters shall be tested and calibrated by suitably qualified persons. Calibration certificates and records shall be kept on record.

8.4 Erosion and Sediment Controls

The erosion and sediment controls will be inspected in accordance with the requirements of the RC Water Management System Inspection and Review Program. The objectives of the erosion and sediment controls section of this program include:

- Erosion and sediment structures are inspected at a frequency commensurate with the level of risk that each of the respective structures address;
- Maintenance works are conducted as required;
- Erosion and sediment control features are checked prior, where possible, during and after high rainfall events; and
- Erosion and sediment controls that are not performing adequately are repaired or redesigned.

The minimum requirements of the inspection and maintenance of the erosion and sediment controls structures are outlined as follows:

- Operational and Rehabilitation Phase Works:
  - During the operational and rehabilitation phases; and
  - After significant rainfall events.

Water quality in sediment dams that have the potential to discharge dirty water offsite will be monitored in accordance with **Section 6.1**.

9. Reporting Requirements

9.1 Internal Reporting

The following reports will be prepared on a monthly basis and provided to GCAA and the RC management team:

- Glencore Corporate Practice Database (GCP);
- Monthly Environment and Community Status Report; and
- Ravensworth Water Accounting Framework (WAF).

9.2 External Reporting

A summary of WMP monitoring results will be provided in the Annual Review. The Annual Review prepared each year for the RC will include the following information regarding water management on the site; in accordance with the Project Approval conditions (refer to **Appendix A**):

- A review of the effectiveness of environmental management of the subject area in terms of EPA and DRE requirements, which enables ready comparison with the Environmental Assessment predictions, diagrams and tables;
- A review of performance in terms of the conditions of Project Approval, against baseline conditions and identification of trends and likely causes;
- Results of environmental monitoring;
- A listing of any variations obtained to approvals applicable to the subject area during the previous year;
- A review of the WMP (refer to **Section 10**);
- The outcome of the water budget for the year, the quantity of clean water used from water storages, and details of the waste disposal of any contaminated water onsite or into water courses; and
- Environmental management targets for the next year.

The report will also include an interpretation of the water monitoring results and the changes in water quality and groundwater levels over the period. In addition, any significant finding regarding the implementation of the WMP will be reported in the Annual Review, including:

- The effectiveness of the erosion and sediment controls; and
- Any identified issues or exceedances of impact criteria.

The Annual Review will also document complaints relating to the performance, maintenance and/or failure of the RC WMS. The program of work to be undertaken in preparation for the compilation of the Annual Review is outlined in the RC Monitoring and Review Program.

Monitoring results will be reviewed annually and reported to the RC Community Consultative Committee.

A report on groundwater management will be provided in the Annual Review and to DPIE Water.

The RC has attempted to develop a data sharing agreement that would allow all sites within the agreement to gain access to monitoring data received from monitoring equipment operated by the

RC, HVO and Ashton Coal Operations Limited (ACOL). This will include sharing of relevant piezometric data. To date, formal data sharing agreements are yet to be established, however neighbouring mines where relevant coordinate and cooperate with data sharing in the interests of minimising cumulative impacts.

9.3 Community Consultation

Site water management issues of interest to the community will be addressed in regular Community Consultative Committee community consultation meetings. Specific issues relating to individual landowners and residents will be addressed directly by the RC as required.

A copy of the Annual Review including relevant water quality monitoring results will be made available on the RC website.

In accordance with the Environmental Management Strategy, RC will maintain a centralised location to record communication details of relevant external stakeholders and procedures for stakeholder contact including a Complaints Procedure.

The Complaints Procedure will utilise the Community Contact Line; a free call telephone number that will be regularly advertised in a local newspaper. The Contact Line will be in operation 24 hours per day, seven days a week. Complaints will be recorded and investigated, all other complaints, via letter, email in person or by fax, will also be recorded and investigated. Initial response to the complainant will be made as soon as practicable.

In the event that a complaint is received in relation to water management associated with the operation, an investigation will be undertaken in accordance with the relevant GCAA reporting guideline. Follow up correspondence with the complainant will be made to detail the outcome of the complaint investigations.

Records relating to community complaints will be managed in accordance with the requirements specified in EPL 2652.

9.4 Monitoring Records

Monitoring records will be managed in accordance with the requirements specified in EPL 2652.

10. Implementation and Review

Ongoing monitoring and review on the performance and implementation of this WMP will be undertaken in accordance with the RC EMS.

In accordance with Condition 4, Schedule 5 of Project Approval (09_0176), the RC shall review, and if necessary revise, the strategies, plans and programs required under Project Approval to the satisfaction of the Secretary, within three months of:

(a) *the submission of an annual review under Condition 3 of Schedule 5;*

(b) *the submission of an incident report under Condition 6 of Schedule 5;*

(c) *the submission of an audit report under Condition 8 of Schedule 5; and*

(d) *Any modification to the conditions of this approval.*

The Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Secretary.

Any changes made to the program as a result of the review will be made in consultation with EPA, DPIE and DPIE Water. A copy of the revised program will be supplied to the Secretary of DPIE for approval.

11. References

ANZECC/ARMCANZ, 2000. *National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality*.

Department of Environment and Climate Change (DECC), 2008a. *Managing Urban Stormwater – Soils and Construction*, *Volume 2A Installation of services*.

Department of Environment and Climate Change (DECC), 2008b. *Managing Urban Stormwater – Soils and Construction*, *Volume 2C Unsealed Roads*.

Department of Environment and Climate Change (DECC), 2008c. *Managing Urban Stormwater – Soils and Construction*, *Volume 2D Main Road Construction*.

Department of Environment and Climate Change (DECC), 2008d. *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries*.

Department of Land and Water Conservation, 1994. *Guidelines for the planning, construction and maintenance of tracks.*

DIPNR, 2005. *Draft Guidelines for Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region*.

DPIE Water, 2007. *River Hydrology and Energy Relationships – Design Notes for the Mining Industry*.

NSW Fisheries Guidelines, undated. *Fish Friendly Waterway Crossings*.

Landcom, 2004. *Managing Urban Stormwater – Soils and Construction*, Volume 1.

Umwelt, 2010. *Ravensworth Operations Project Environmental Assessment.*

12. Glossary, Abbreviations and Acronyms

Term	Meaning/Description
µS/cm	Micro Siemens per centimetre is the standard measure of electrical conductivity and is used to indicate the salinity level of water.
Alluvium	Sediment deposited by a flowing stream, e.g. clay, silt, sand, etc.
Annual Review	Annual Environmental Management Report
ANZECC	Australia and New Zealand Environment and Conservation Council
Aquifer	A water-bearing rock formation.
ARI	Average Recurrence Interval. Expresses the rarity of a rainfall event and is used to indicate intensity e.g. a rainfall total of 159 millimetres in 3 hours may occur in a given location, on average, once in 100 years and is described as a 100 year ARI rainfall event.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Blue Book	Common name for the following publications: • *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom, 2004); • *Managing Urban Stormwater – Soils and Construction, Volume 2A Installation of services*; • *Managing Urban Stormwater – Soils and Construction, Volume 2C Unsealed Roads*; • *Managing Urban Stormwater – Soils and Construction, Volume 2D Main Road Construction*; and • *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries*.
BOD_5	5 day Biological Oxygen Demand
Bore	A hole formed by boring or auguring
Ca	Calcium
Cfu	A measure of viable colony-forming units
CHPP	Coal Handling and Preparation Plant
CPP	Coal Preparation Plant
Cl	Chlorine
COD	Chemical Oxygen Demand
Cumnock	Cumnock Joint Venture
DA	Development Application
DEC	Department of Environment and Conservation now the EPA
DECC	Department of Environment and Climate Change now the EPA

Term	Meaning/Description
DECCW	Department of Environment, Climate Change and Water now the EPA
DNR	Department of Natural Resources
DMR	Department of Mineral Resources
DPIE	Department of Planning, Industry and Environment
DPIE Water	Department of Planning, Industry & Environment Water
DPI	Department of Primary Industries
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services
EA	Environmental Assessment
EC	Electrical Conductivity
ECD	Environmental Control Dam
EIS	Environmental Impact Statement
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979* NSW Government Act to provide for the orderly development of land in NSW.
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
EPL	Environment Protection Licence
FC	Faecal Coliform
GDA	Geocentric Datum Australia
Groundwater	Sub-surface water, which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.
GRAWTS	Greater Ravensworth Area Water And Tailings Strategy
HRSTS	Hunter River Salinity Trading Scheme
HSEC	Health, Safety, Environment and Community
kL	kilo litres or thousands of litres, e.g. 3 kL is the same as 3000 litres
LGA	Local Government Area
LWC	Land and Water Council
mAHD	metres Australian Height Datum used to indicate elevation
MIA	Mine Infrastructure Area
ML	megalitres or millions of litres, e.g. 5 ML is the same as 5 million litres
Mtpa	million tonnes per annum

Term	Meaning/Description
N	Nitrogen
O&G	Oil and Grease
pH	A measure of acidity
Piezometer	A small diameter bore lined with a slotted tube used for determining the standing water level of groundwaters.
Potable water	Water that is free from impurities, which may cause disease or harmful physiological effects and is considered safe for human consumption.
PoEO Act	*Protection of the Environment Operations Act 1997* NSW legislation administered by DECCW that regulates discharges to land, air and water.
Ravensworth Operations	Ravensworth Operations Pty Limited
Ravensworth Complex	Ravensworth Operations and Cumnock
Raw water	Water taken from the environment that may be subsequently treated or purified to produce potable water.
RCHPP	Ravensworth Coal Handling and Preparation Plant
RCT	Ravensworth Coal Terminal
RUM	Ravensworth Underground Mine
Run of mine (ROM)	Bulk material extracted from a mine, before it is processed in any way.
RUSLE	Revised Universal Soil Loss Equation used to compute soil loss from sheet and rill erosion caused by rainfall and the associated runoff.
SO_4	Sulphate
SSC	Singleton Shire Council
Surface Infrastructure	Any man-made object, facility or structure on the surface of the land.
Tailings	Fine residual waste material separated in the coal preparation process.
TC	Total Coliform
TDS	Total Dissolved Solids
Tot P	Total Phosphorus
TSS	Total Suspended Solids
WMP	Water Management Plan
MO	Mt Owen

13. Document Information

13.1 Change Information

Full details of the document history are recorded in the document control register, by version. A summary of the current change is provided below.

Table 13.1 – Change information

Version	Date	Reviewers	Change Summary
1	24/04/2013	E&C Dept.	Plan updated following discussions with N.O.W regarding Bayswater & Emu Creeks
2	23/10/2014	E&C Dept.	Updated to reflect DoPE comments
3	17/11/2014	E&C Dept.	Updated following review Final version comments
3.1	24/11/2014	E&C Dept.	Template adjustment – not mapping correctly. No content changed
4	01/05/2016	E&C Dept.	Updated as part of Annual Review Submission
5	04/06/2018	E&C Dept.	Updated as part of Annual Review Submission
6	24/05/2019	E&C Dept.	Updated as part of Annual Review Submission
6.1	30/08/2021	E&C Dept.	Minor update of front title block to “approved” following Independent Environment Audit 2021. No content changed.
7	12/02/2022	E&C Dept.	Template update and minor administrative updates.

Appendix A - Project Approvals and Other Conditions

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 26	Schedule 3, Condition 20	**Water Supply** The Proponent shall maintain sufficient water for all stages of the project, and if necessary, adjust the scale of mining operations to match its available water supply, to the satisfaction of the Secretary. *Note: The Proponent is required to obtain all necessary water licences and approvals for the project under the Water Act 1912 and/or Water Management Act 2000.*	Sections 3 & 4
Schedule 3, Condition 27	-	**Baseflow Offsets** The Proponent shall offset the loss of any baseflow to the surrounding watercourses and/or associated creeks caused by the Ravensworth mine complex to the satisfaction of the Secretary. *Notes:* • *This condition does not apply in the case of losses of baseflow, which are negligible.* • *Offsets should be provided via the retirement of adequate water entitlements to account for the loss attributable to the project.* • *The Proponent is not required to provide additional baseflow offsets where such offsets have already been provided under previous consents or approvals for the mine complex. These existing offsets are to be described and evaluated in the Surface and Ground Water Response Plan (see below).*	Section 6.3

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 28	Schedule 3, Condition 21	**Compensatory Water Supply** The Proponent shall provide compensatory water supply to any landowner of privately owned land whose water entitlements are adversely and directly impacted (other than an impact that is negligible) as a result of the project, in consultation with DPI Water, and to the satisfaction of the Secretary. The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributed to the project. Equivalent water supply must be provided (at least on an interim basis) within 24 hours of the loss being identified. If the Proponent and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution. If the Proponent is unable to provide an alternative long-term supply of water, then the Proponent shall provide alternative compensation to the satisfaction of the Secretary.	Sections 6.3 & 7
Schedule 3, Condition 29	Schedule 3, Condition 22	**Surface Water Discharges** The Proponent shall ensure all surface water discharges from the site comply with the: (a) discharge limits (both volume and quality) set for the project in any EPL; or (b) Relevant provisions of the POEO Act or *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.	Section 6.1.4

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 30	-	**Emu Creek and Bayswater Creek Diversions** The Proponent shall: (a) carry out the diversion of Emu Creek to the satisfaction of the Secretary; (b) submit an as-executed report to the Secretary and DPI- Water, certified by a practising engineer, confirming that the Emu Creek diversion is sufficiently hydraulically and geomorphologically stable, prior to commissioning the diversion; (c) reinstate Emu Creek generally in accordance with the concept design outlined in the EA (as depicted in the figure in Appendix 7) and minimising net loss of stream length, as soon as practicable following mining and rehabilitation in the applicable area, to the satisfaction of the Secretary; (d) rehabilitate and revegetate the Bayswater Creek diversion to provide a hydraulically and geomorphically stable stream as soon as practicable following mining and rehabilitation in the applicable area, to the satisfaction of the Secretary; and (e) Submit as-executed reports to the Secretary and DPI- Water, certified by a practising engineer, confirming that the reinstated/rehabilitated Emu Creek and Bayswater Creek are sufficiently hydraulically and geomorphologically stable, prior to commissioning the reinstated/rehabilitated creeks.	Appendix B
Schedule 3, Condition 31	Schedule 3, Condition 23	**Water Management Plan** The Proponent shall prepare and implement a Water Management Plan for the Ravensworth mine to the satisfaction of the Secretary. This plan must be prepared in consultation with EPA, DPI- Water and DRE, and be submitted to the Secretary for approval by the end of June 2011. The plan must include:	Entire document

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 31 (a)	Schedule 3, Condition 23 (a)	a Site Water Balance, which must: • include details of: ▪ sources and security of water supply; ▪ water use onsite; ▪ water management onsite; ▪ any offsite water transfers; and • investigate and implement all reasonable and feasible measures to minimise water use by the Ravensworth mine complex;	Sections 4 & 4.2.1
Schedule 3, Condition 31 (b)	-	a Creek Diversion Management Plan, which must include: • a vision statement for the Emu Creek and Bayswater Creek diversions; • an assessment of the water quality, ecological, hydrological and geomorphic baseline conditions within each creek; • the detailed design specifications for the creek relocations/rehabilitation; • a construction program for the creek relocations/rehabilitation, describing how the work would be staged, and integrated with mining operations; • a revegetation program for the relocated/rehabilitated creeks using a range of suitable native species; • water quality, ecological, hydrological and geomorphic performance and completion criteria for the creek relocations/rehabilitation based on the assessment of baseline conditions; and • a program to monitor and maintain the water quality, ecological, hydrological and geomorphic integrity of the creek relocations/rehabilitation;	Appendix B

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 31 (c)	Schedule 3, Condition 23 (b)	an Erosion and Sediment Control Plan, which must: • identify activities that could cause soil erosion, generate sediment or affect flooding; • describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and manage flood risk; • describe the location, function, and capacity of erosion and sediment control structures and flood management structures; and • describe what measures would be implemented to maintain the structures over time;	Section 5
Schedule 3, Condition 31 (d)	Schedule 3, Condition 23 (c)	a Surface Water Management Plan, which must include: • detailed baseline data on surface water flows and quality in creeks and other water bodies that could potentially be affected by the project; • surface water and stream health impact assessment criteria including trigger levels for investigating any potentially adverse surface water impacts; • a program to monitor and assess: ▪ surface water flows and quality; ▪ impacts on water users; ▪ stream health; and ▪ channel stability;	Section 6.1 and Appendix D

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 3, Condition 31 (e)	Schedule 3, Condition 23 (d)	a Groundwater Management Plan, which must include: • detailed baseline data of groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the project; • groundwater impact assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts; • a program to monitor and assess: ▪ groundwater inflows to the mining operations; ▪ impacts on regional aquifers; ▪ impacts on the groundwater supply of potentially affected landowners; ▪ impacts on the Hunter River, Bayswater Creek and Bowmans Creek alluvial aquifers; and ▪ impacts on any groundwater dependent ecosystems and riparian vegetation;	Section 6.3 and Appendix E
Schedule 3, Condition 31 (f)	Schedule 3, Condition 23 (e)	a Surface and Ground Water Response Plan, which must include: • a response protocol for any exceedances of the surface water and groundwater assessment criteria; • measures to offset the loss of any baseflow to watercourses caused by the project; • measures to prevent, minimise or offset groundwater leakage from alluvial aquifers caused by the project, particularly when mining within 150 metres of any such alluvials (see Appendix 6); • measures to compensate landowners of privately-owned land whose water supply is adversely affected by the project; and • Measures to mitigate and/or offset any adverse impacts on groundwater dependent ecosystems or riparian vegetation. The Proponent shall implement the approved management plan as approved from time to time by the Secretary.	Section 7

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 5, Condition 2	-	**Management Plan Requirements** The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include: (a) detailed baseline data;	Appendix D and Appendix E
Schedule 5, Condition 2	-	(b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	Section 1.1.1 and Appendix A
Schedule 5, Condition 2	-	(c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Section 3
Schedule 5, Condition 2	-	(d) a program to monitor and report on the: • impacts and environmental performance of the project; • effectiveness of any management measures (see (c) above);	Sections 6 & 8
Schedule 5, Condition 2	-	(e) a contingency plan to manage any unpredicted impacts and their consequences;	Section 7
Schedule 5, Condition 2	-	(f) a program to investigate and implement ways to improve the environmental performance of the project over time;	Section 10
Schedule 5, Condition 2	-	(g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with the conditions of this approval and statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and	Section 9

Ravensworth Operations (PA 09_0176)	Ravensworth Underground Mine (DA 104/96)	Condition	Relevant Section of Document
Schedule 5, Condition 2	-	(h) a protocol for periodic review of the plan. Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.	Section 10
Schedule 5, Condition 4	Schedule 4, Condition 3	**Revision of Strategies, Plans and Programs** Within 3 months of: (a) the submission of an annual review under condition 3 above; (b) the submission of an incident report under condition 6 below; (c) the submission of an audit under condition 8 below; and (d) any modification to the conditions of this approval, the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Secretary. Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the project.	Section 10
Schedule 5, Condition 6	Schedule 4, Condition 5	**REPORTING** **Incident Reporting** The Proponent shall notify the Secretary and any other relevant agencies of any incident associated with the project as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of becoming aware of the incident, the Proponent shall provide the Secretary and any relevant agencies with a detailed report on the incident.	Section 9
Schedule 5, Condition 7	Schedule 4, Condition 6	The Proponent shall provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any approved plans of the conditions of this approval.	Section 9

Condition	Ravensworth Operations (PA 09_0176) Statement of Commitments.	Relevant Section of Document
6.8.1	**Surface Water** The Proponent will continue to undertake surface water quality monitoring in accordance with its existing program, with additional monitoring points to be established at Davis Creek for the life of the Project except where otherwise agreed with the Department and following consultation with EPA. All surface water monitoring results will be reported in the Annual Review.	Section 6.1
6.8.2	At least 12 months prior to the diversion of Emu Creek, the Proponent in conjunction with Coal & Allied will review the need to undertake any further studies to inform the detailed design of the diversion to ensure the appropriate integration of the diversion with future mining operations associated with the Project and the adjacent Coal & Allied operations. As part of the detailed design of the proposed Emu Creek diversion, the Proponent will obtain all relevant approvals in consultation with Coal & Allied and to the satisfaction of the Department.	Section 6.1
6.8.3	**Groundwater** The Proponent will undertake two-monthly assessments of any departures from identified monitoring or predicted data trends. Departures from identified monitoring trends are taken to be consecutive data over a period of 6 months (minimum of three consecutive readings) exhibiting an increasing divergence in a negative impact sense from the previous data or from established or predicted trends. Any identified issues will be the subject of further investigation, in accordance with the relevant response procedures developed under the Groundwater Monitoring Program for the Project	Section 6.5 Section 7
6.8.4	A formal review of the depressurisation of coal measures and comparison of responses with the aquifer model predictions will be undertaken biennially. Expert review will be undertaken by a suitably qualified hydrogeologist if the measured depressurisation in the coal measures exceeds the predicted depressurisation for the designated period.	Section 6.5.1
6.8.5	The Proponent will develop appropriate remedial and recovery plans for identified stands of Eucalyptus camaldulensis along the Hunter River in the southern extent of the Project area on land controlled by the Proponent. The plans will be developed in consultation with DPI – Water and EPA, to the satisfaction of the Secretary.	Ravensworth Biodiversity Offest Management Plan
6.8.6	The Proponent will seek to enter into a co-operative, transparent, data sharing agreement with surrounding operations, including Coal and Allied Hunter Valley Operations and Ashton, for the sharing of relevant piezometric data	Section 9.2

<table>
<tr><th>Condition</th><th>Environment Protection Licence 2652</th><th>Relevant Section of Document</th></tr>
<tr><td>P1.3</td><td>The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.
Water and land
<table>
<tr><th>EPA Identi-fication no.</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Location Description</th></tr>
<tr><td>2</td><td>Hunter River Salinity Trading Scheme (HRSTS) discharge water volume monitoring and water quality monitoring</td><td>Hunter River Salinity Trading Scheme (HRSTS) discharge water volume monitoring and water quality monitoring</td><td>Outlet works from water management dam at co-ordinates 316956, 6405290 (Easting, Northing) identified as EPL2 on Figure 1.</td></tr>
<tr><td>3</td><td>Tributary monitoring point under Hunter River Salinity Trading Scheme</td><td></td><td>Bowmans Creek - within 100 metres upstream of the confluence of the flow from discharge Point No. 2 at co-ordinates 317024, 6404941 (Easting, Northing) identified as EPL3 on Figure 1.</td></tr>
<tr><td>4</td><td>Tributary monitoring point under Hunter River Salinity Trading Scheme</td><td></td><td>Bowmans Creek - within 100 metres downstream of the confluence of the flow from discharge Point No. 2 at co-ordinates 316911, 6405049 (Easting, Northing) identified as EPL4 on Figure 1.</td></tr>
<tr><td>12</td><td></td><td>Effluent quality monitoring Discharge to Utilisation Area</td><td>MIA STP monitoring and discharge to Facilities Dam at co-ordinates 314312 6408455 (Easting, Northing) identified as STP Discharge Point on Figure 1.</td></tr>
</table></td><td>Section 6.1</td></tr>
</table>

Condition	Environment Protection Licence 2652				Relevant Section of Document
	19	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 314545 6404538 (Easting, Northing) identified as W115 on Figure 1.	
	20	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 313854 6407096 (Easting, Northing) identified as W122 on Figure 1.	
	21	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 314588 6409336(Easting, Northing) identified as W114 on Figure 1.	
	22	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 314251 6109450 (Easting, Northing) identified as W164 on Figure 1.	
	23	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 313444 6410788 (Easting, Northing) identified as W152 on Figure 1.	
	24	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 314450 6412144 (Easting, Northing) identified as W11 on Figure 1.	
	25	Ambient water quality monitoring		Monitoring (insert name) at co-ordinates 312540 6414393 (Easting, Northing) identified as W10 on Figure 1.	
	26		Discharge to pipeline	Coal tailings transfer to Mt Owen Complex Mines at co-ordinates 313249 6413016 (Easting, Northing) identified as TD1 on Figure 1.	

<table>
<tr><th>Condition</th><th>Environment Protection Licence 2652</th><th>Relevant Section of Document</th></tr>
<tr><td>P1.5</td><td>For the purpose of Condition P1.1, P1.3 and P1.4 Figure 1 refers to the plan titled “Ravensworth Complex EPL 2652 Environmental Monitoring Locations” dated 21/3/2021 EPA Reference DOC21/233801.</td><td>Section 6.1</td></tr>
<tr><td>L1.1</td><td>Pollution of waters
Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.</td><td>This WMP</td></tr>
<tr><td>L2.1</td><td>Concentration limits
For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.</td><td>Section 6.1.4
Section 6.3.1</td></tr>
<tr><td>L2.2</td><td>Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges</td><td>Section 6.2</td></tr>
<tr><td>L2.3</td><td>To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.</td><td>This WMP</td></tr>
<tr><td>L2.4</td><td>Water and/or Land Concentration Limits
POINT 2
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>-</th><th>-</th><th>-</th><th>100 percentile concentration limit</th></tr>
<tr><td>pH</td><td>pH</td><td></td><td></td><td></td><td>6.5-9.5</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td></td><td></td><td></td><td>120</td></tr>
</table></td><td>Section 6.2</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Environment Protection Licence 2652</th><th>Relevant Section of Document</th></tr>
<tr><td>L3.1</td><td>Volume and mass limits
For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) Liquids discharged to water: or;
b) Solids or liquids applied to the area;
must not exceed the volume/mass limit specified for that discharge point or area.
<table><tr><th>Point</th><th>Unit of Measure</th><th>Volume/Mass Limit</th></tr><tr><td>2</td><td>megalitres per day</td><td>400</td></tr></table></td><td>Section 6.1.4
Section 6.3.1</td></tr>
<tr><td>L4.3</td><td>The Licensee is authorised to receive saline mine water from Liddell Coal Mine and the Mt Owen Complex for storage and use in activities authorised by this licence.</td><td>Section 3.8</td></tr>
<tr><td>O2.2</td><td>The Licensee is responsible for the correct operation of the sewage treatment system on the premises.</td><td>Section 3.6</td></tr>
<tr><td>O2.3</td><td>Correct operation involves regular supervision and system maintenance. The licensee must be aware of the system management requirements and must ensure that the necessary service contracts are in place.</td><td>Section 3.6</td></tr>
<tr><td>O2.4</td><td>The sewage treatment system must be services by a suitably qualified and experienced wastewater technician at least once in each quarterly period and a minimum of four times per year.</td><td>Section 3.6</td></tr>
<tr><td>O2.5</td><td>The licensee must record each inspection and any actions required or recommended by the technician including all results of tests performed on the sewage treatment system by the technician as required in Condition O2.4.</td><td>Section 3.6</td></tr>
<tr><td>O2.6</td><td>The licensee must prepare a sewage treatment maintenance program. The program must include:
a) Certification from the system provider that the sewage treatment system is operating within its capacity;
b) Date, time and results of all routine maintenance procedures undertaken to the sewage treatment system; and
c) Provide written records of each quarterly inspection.</td><td>Section 3.6</td></tr>
</table>

Condition	Environment Protection Licence 2652	Relevant Section of Document
M1.1	**Monitoring Records** The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.	Section 9.4
M1.2	All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form; b) kept for at least 4 years after the monitoring or event to which they relate took place; and c) produced in a legible form to any authorised officer of the EPA who asks to see them.	Section 9.4
M1.3	The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.	Section 9.4
M2.1	For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:	Section 6.1
M2.3	Water and/or Land Monitoring Requirements:	

<table>
<tr><th>Condition</th><th>Environment Protection Licence 2652</th><th>Relevant Section of Document</th></tr>
<tr><td></td><td>
POINT 2
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Continuous during discharge</td><td>A probe designed to measure the range 0 to 10,000 uS/cm</td></tr>
<tr><td>pH</td><td>pH</td><td>Daily during any discharge</td><td>Grab sample</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Daily during any discharge</td><td>Grab sample</td></tr>
<tr><td>Turbidity</td><td>nephelometric turbidity units</td><td>Continuous during discharge</td><td>In line instrumentation</td></tr>
</table>
POINT 3
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Special Frequency 1</td><td>Grab sample</td></tr>
</table>
POINT 4
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Special Frequency 1</td><td>Grab sample</td></tr>
</table>
</td><td></td></tr>
<tr><td>M2.4</td><td>Note: Special Frequency 1 means the licensee must measure and record conductivity twice (2) per day (with at least 6 hours between the two daily measurements) on each day that wastes are discharges from Point No.2 and on each of the following five (5) days.</td><td>Section 6.1</td></tr>
</table>

Condition	Environment Protection Licence 2652	Relevant Section of Document
M3.2	**Testing methods – concentration limits** Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharges to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.	
M4.1	**Testing methods – load limits** Division 3 of the Protection of the Environment Operations (General) regulation 2009 requires that monitoring of actual loads of assessable pollutants listed in L2.2 must be carries out in accordance with the testing method set out in the relevant load calculation protocol for the fee-based activity classification listed in condition A1.1.	-
M6.1	**Recording of pollution complaints** The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.	Section 9.3
M6.2	The record must include details of the following: a) the date and time of the complaint; b) the method by which the complaint was made; c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect; d) the nature of the complaint; e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and f) if no action was taken by the licensee, the reasons why no action was taken.	Section 9.3
M6.3	The record of a complaint must be kept for at least 4 years after the complaint was made.	Section 9.3

<table>
<tr><th>Condition</th><th>Environment Protection Licence 2652</th><th>Relevant Section of Document</th></tr>
<tr><td>M6.4</td><td>The record must be produced to any authorised officer of the EPA who asks to see them.</td><td>Section 9.3</td></tr>
<tr><td>M7.1</td><td>The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.</td><td>Section 9.3</td></tr>
<tr><td>M7.2</td><td>The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.</td><td>Section 9.3</td></tr>
<tr><td>M7.3</td><td>The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.</td><td>-</td></tr>
<tr><td>M8.1</td><td>Requirements to monitor volume or mass
For each discharge point or utilisation area specified below, the licensee must monitor;
a) the volume of liquids discharged to water or applied to the area;
at the frequency and using the method an units of measure, specified below.
POINT 2<table><tr><th>Frequency</th><th>Unit of Measure</th><th>Sampling Method</th></tr><tr><td>Continuous during discharge</td><td>megalitres per day</td><td>Ultrasonic flow meter</td></tr></table></td><td>Section 6.1.4</td></tr>
<tr><td>M10.1</td><td>Other Monitoring and recording conditions
Hunter River Salinity Trading Scheme (HRSTS) Monitoring
The licensee must continuously operate and maintain communication equipment which makes the conductivity and flow measurements, taken at Point 2 available to the “Service Coordinator” within one hour of those measurements being taken and makes them available in the format specified in the “Hunter River Salinity Trading Scheme Discharge Point Telemetry Specification – Rev V1.0 released 4 October 2018” as published by Water NSW.</td><td>Section 6.1.4</td></tr>
</table>

Condition	Environment Protection Licence 2652	Relevant Section of Document
M10.2	The licensee must ensure that the results of the measurements it takes at the tributary monitoring points are available to the regional water quality monitoring network operated by the NSW Office of Water (or other service provider as advised by the EPA) within 1 hour of its recording.	Section 6.1.4
M10.3	The licensee must ensure that all monitoring data is within a margin of error of 5% for conductivity measurements and 10% for discharge flow measurement.	Section 6.1.4
M10.4	The licensee must mark monitoring point(s) 2,3 & 4, with a sign which clearly indicates the name of the licensee, whether the monitoring point is up or down stream of the discharge point(s) and that it is a monitoring point for the Hunter River Salinity Trading Scheme.	Section 6.1.4
R2.1	**Notification of Environmental harm** Notifications must be made by telephoning the Environment Line service on 131 555.	Section 9
R2.2	The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred. Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.	Section 9
R4.1	**Other Notifications** **Notification of Pollution of Waters** The Licensee must notify the EPA by Telephoning the Environment Line service on 131 555 immediately after the Licensee becomes aware of any contravention or potential contravention of Condition L1 of the Licence.	Section 9
R4.2	The licensee must provide written details of the notification to the EPA with 7 days of the date of the notification. This may be by email.	Section 9

Condition	Environment Protection Licence 2652	Relevant Section of Document
R5.1	**Other Reporting Conditions** **Hunter River Salinity Trading Scheme (HRSTS) Reporting** The licensee must compile a written report of the activities under the HRSTS for each HRSTS year. The HRSTS year is the period from 1 July to 30 June each year. The written report must be submitted to the EPA's Hunter regional office within 60 days after the end of each HRSTS year and be in a form and manner approved by the EPA. The information will be used by the EPA to compile and annual HRSTS report.	Section 6.3.1
R5.2	The Licensee must include graphical analysis of turbidity measured at EPA Point 2 for the duration of any discharges from EPA Point 2 within the HRSTS Report.	Section 6.3.1
R5.5	The sewage treatment system maintenance program required by Condition O2.6 must be submitted annually to the EPA with the Annual Return.	Section 3.6
R5.6	The licensee must retain a copy of each report required by condition O2.5 for 3 years from the date each record is made.	Section 3.6
E1.1	**Hunter River Salinity Trading Scheme** This licence authorises the discharge of saline water into the Hunter River Catchment from an authorised discharge point (or points), in accordance with the Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.	Section 6.3.1
E1.2	Duplicate of E1.1.	-
E1.3	The licensee must not exceed the hourly volume discharge limit calculated using the following formula, at Point 2 of this licence. H=V / RRT	Section 6.3.1

Condition	Environment Protection Licence 2652	Relevant Section of Document
	Where: H is the hourly volume discharge limit (in megalitres per hour); V is the licence holder's volume discharge limit for the block (in megalitres) calculated in accordance with clause 23 of the Protection of the Environment Operations (hunter River Salinity Trading Scheme) Regulation (2002); and RRT is the difference between the discharge stop and start times shown in the river register for that block (in hours). Note 1 : The intent of this condition is to prevent spikes of saline water in the Hunter River as a result of discharges of less than the duration permitted by the river register. Note 2: A river register is issued by the Service Co-ordinator and allows participants of the Hunter River Salinity Trading Scheme (HRSTS) to discharge saline to the Hunter River during the discharge period.	
E2.1	**Acceptance of wastewater from Bayswater Power Station Void 4 Trial** The licensee may accept up to 500 mega litres of wastewater from the Bayswater Power Station Void 4 for beneficial reuse purposes on the premises.	Not Triggered
E2.2	The licensee must prior to accepting any wastewater from the Bayswater Power Station Void 4, operate and maintain continuous flow volume monitoring equipment on the wastewater transfer line.	Not Triggered
E2.3	The licensee must continuously record the wastewater flow by use of a data logger or other monitoring equipment.	Not Triggered
E2.4	The licensee must notify the EPA within the 7 days of when the maximum volume of 500 mega litres of wastewater has been received on the premises.	Not Triggered
E2.5	The licensee must maintain a record of the flow recordings required by this condition for a period of 12 months after any measurement as made or recorded.	Not Triggered
E2.6	After acceptance of the wastewater the licensee may only discharge the wastewater in accordance with the current conditions of this licence.	Not Triggered

Appendix B - Creek Diversion Management Plan – Bayswater and Emu Creek

B1 Introduction

This Creek Diversion Management Plan (CDMP) has been prepared to satisfy Condition 31(b), Schedule 3 of 09_0176, RC is required to prepare the CDMP for the Bayswater Creek and Emu Creek diversions. This Plan has been developed in accordance with the conditions of consent and the statement of commitments (refer to **Appendix A**).

This CDMP has been prepared as a component of the Water Management Plan (WMP), and should be read in conjunction with the overarching WMP.

B1.1 Background

The creek diversions detailed in this document include rehabilitation of an existing diversion of Bayswater Creek and the proposed diversion of Emu Creek. These two creek diversions represent different challenges, which are outlined in **Sections 2.1** and **2.2**. The objectives and desired outcomes for both the existing and future diversions are reflected in this management plan. An overview of the creek diversions is shown on **Figure 1.2** and the conceptual final landform on **Figure 1.3**.

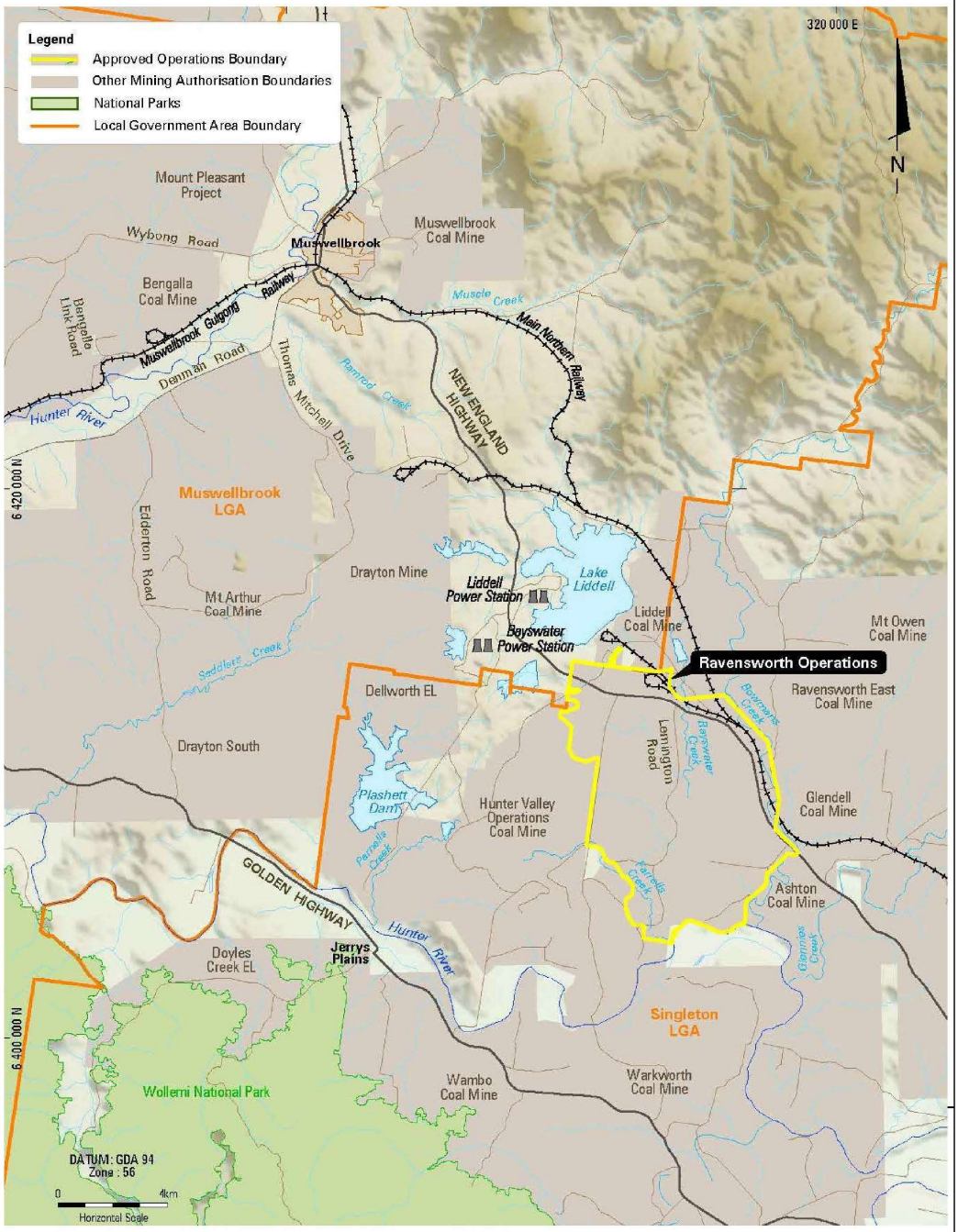
B1.1.1 Bayswater Creek

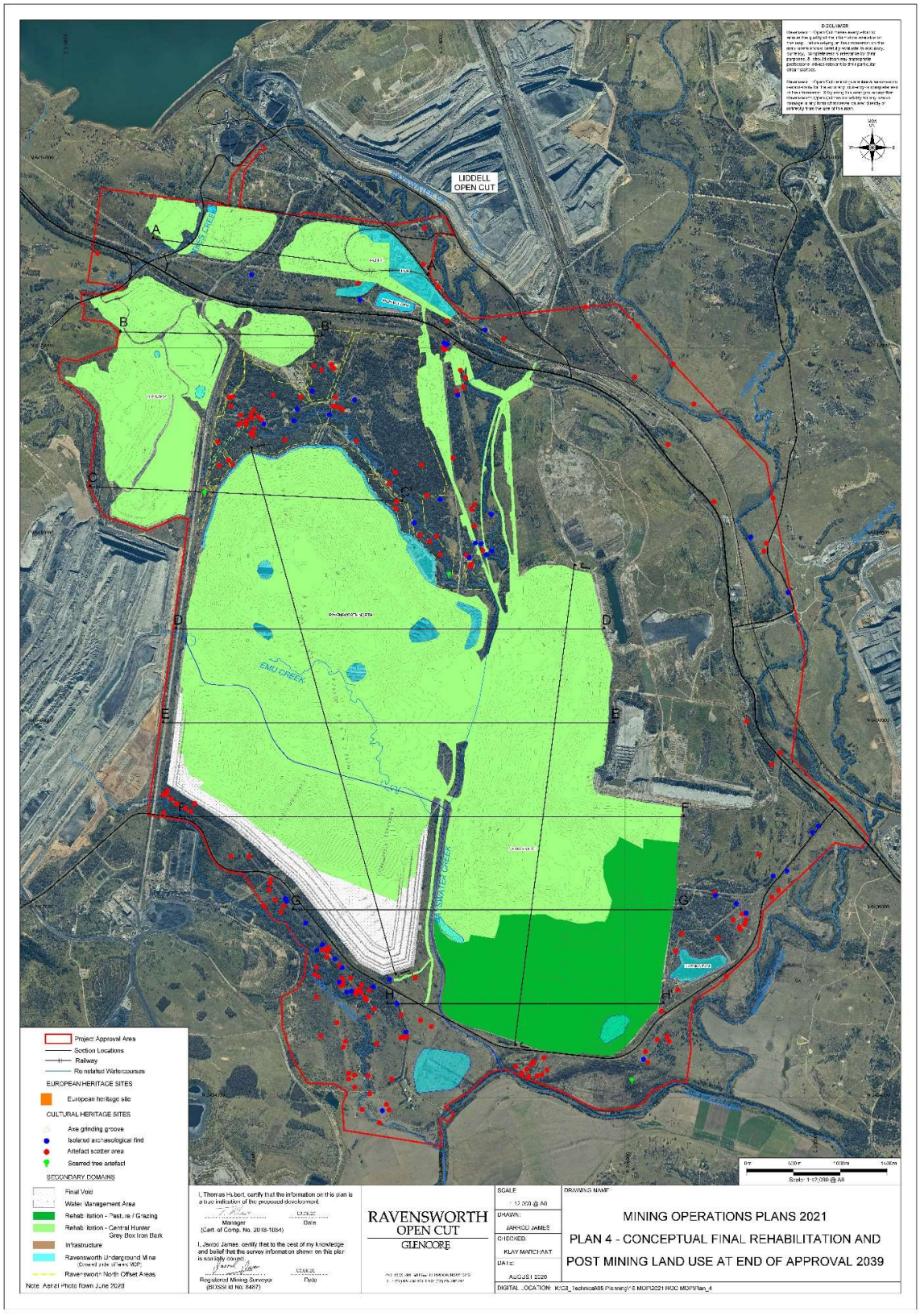
A reach of Bayswater Creek was diverted historically, with no particular attention to the environmental processes of the original creek. The resulting legacy is a linear channel and drop structure within a relatively narrow available space that has some constraints in terms of meeting the objectives of preserving the creek integrity.

Ravensworth Complex Creek Diversion Management Plan GLENCORE

Figure 1.1 - Locality Plan

Coal Assets Australia
www.glencore.com





B1.1.3 Emu Creek

Following discussions with DPIE Water and DPIE included in **Appendix F**, the RC no longer intends to undertake the temporary Emu Creek diversion. Instead of constructing the diversion dams, runoff from the residual catchment of Emu Creek will be allowed to flow into the mining area where it will be contained in a sump. This water will be used for operational activities onsite. This water will be taken in accordance with the RC harvestable rights. Section 53 of the *Water Management Act 2000* states that the harvestable rights dam must be situated on a minor stream – the mining area (including the proposed sump) is situated on Emu Creek, which constitutes a minor stream; therefore, the capacity and location of the sump are consistent with the requirements of the *Water Management Act 2000*.

Once the mining area has been rehabilitated, a creek line will be re-established along a similar alignment to the existing Emu Creek (refer to **Figure 1.3**). Planning for the reinstatement has commenced with a focus to implement a final alignment that meets objectives in terms of preserving creek integrity for Emu Creek and Davis Creek, limiting impacts in terms of stream flows and water quality, and results in an integrated final landform.

- If the existing materials in Emu Creek are to be used for the final creek, they will need to be excavated separately ahead of mining and stockpiled, and subsequently placed into the final alignment. All materials deemed feasible will be utilised as part of rehabilitation processes. Alternatively, if similar materials from elsewhere can be identified, these materials could be utilised to avoid double handling. Stockpiling of materials may have implications in terms of the seed bank and loss of structure.
- The post-mining catchment shape, form and extent will influence the post mining hydrograph during flood events. This could have implications on the long-term stability of the creek and likely yield, and the post mining landform draining to Emu Creek is integral to the diversion.
- The diversion will be designed and constructed consistent with requirements set out in the Ravensworth Operations Project Environmental Assessment, more detailed planning and consultation will take place closer to the construction date.

B1.1.4 Related Documents

Documents within the RC EMS that relate to, or provide support to this CDMP include:

- WMP;
- Erosion and Sediment Control Plan;
- Surface Water Management Plan ;
- Groundwater Management Plan;
- Biodiversity Management Plan; and
- Water Management Trigger Action Response Plan.

B1.2 Statutory Conditions

B1.2.1 Legislation and Guidelines

The RC will undertake the construction and rehabilitation works associated the Bayswater Creek diversion and Emu Creek reinstatement in accordance with the policies, principles, regulations and guidelines contained within:

- *Protection of the Environment Operations Act 1997* (POEO Act) administered by the Biodiversity and Conservation Division (BCD) and the Environmental Protection Authority (EPA);

- *Water Management Act 2000*, administered by Department of Planning, Industry and Environment Water (DPIE Water);
- *Management of stream/aquifer systems in coal mining developments - Hunter Region* (DIPNR, 2005);
- *River Hydrology and Energy Relationships – Design Notes for the Mining Industry* (NSW Office of Water (DPIE Water) 2007);
- *Environmental Planning and Assessment Act 1979* (EP&A Act), administered by the Department of Planning, Industry and Environment (DPIE);
- *Managing Urban Stormwater – Soils and Construction, Volume 1 (the Blue Book)* (Landcom, 2004);
- *Managing Urban Stormwater – Soils and Construction, Volume 2A Installation of services* (Department of Environment and Climate Change (DECC) 2008a)*;*
- *Managing Urban Stormwater – Soils and Construction, Volume 2C Unsealed Roads* (DECC, 2008b);
- *Managing Urban Stormwater – Soils and Construction, Volume 2D Main Road Construction* (DECC, 2008c);
- *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries* (DECC, 2008d); and
- *National Water Quality Management Strategy: Australian Freshwater Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council (ANZECC) 2000).

In addition, the regional natural resource management context of the creek realignment and rehabilitation work is set by the Hunter and Central Rivers Catchment Management Authority (HCRCMA) Catchment Action Plan (CAP), which feeds into the NSW Statewide Natural Resource Management (NRM) targets.

Although the CAP and Statewide NRM targets have been set for outcomes to be achieved by 2015, well before project completion, these targets provide a good indication of the priorities for enhancing the condition of aquatic systems in the region.

In order to maintain and improve the condition and functioning of freshwater and riparian ecosystems, the HCRCMA CAP targets include:

- Protect an additional 1100 km of native riparian vegetation;
- Regenerate 550 km of degraded native riparian vegetation;
- Restore native fish passage to 60 instream barriers;
- Improve habitat of 200 km of stream channels; and
- Stabilise 125 km of unstable or degraded stream channels (or estuarine shorelines).

The broad targets set in the CAP are reinforced by the objectives of the Department of Infrastructure Planning and Natural Resources (DIPNR) Guidelines (2005). The objectives of the guidelines are that, in the context of sustainable recovery of coal resources, the following should be achieved:

- Protection of riverine integrity, through retention of environmental and use values, maintenance of the river system within its geomorphic boundaries and of its geomorphic character and protection of dependent ecosystem values;
- Minimising adverse impacts on stream flows and groundwater availability; and
- Maintaining surface water and groundwater quality within acceptable limits.

This CDMP aims to incorporate the objectives outlined in the above mentioned targets and guidelines.

B1.2.2 Project Approval

The Project Approval for the RC was assessed under the EP&A Act. It was granted by the then Minister for Planning and Infrastructure on 11 February 2011 and subsequently modified August 2013, December 2014 and February 2016. The requirement for this CDMP arises from Condition 30 and 31b, Schedule 3 of the Project Approval.

A detailed list of the Project Approval conditions and the relevant Statement of Commitments and where they are addressed in this document is included in **Appendix A** of the WMP.

B1.2.3 Mining Lease Approval

The RC currently holds a number of mining leases for its operations. These mining leases contain specific conditions, which relate to the management of erosion and sediment within the site. The CDMP has been developed in accordance with these requirements.

B1.3 Purpose and Scope

This CDMP has been prepared so that the desired outcomes for both creeks are managed, including:

- Avoiding degradation of existing creek systems; and
- Should be hydraulically and geomorphically stable and healthy creek systems are in place post mining, including creek channels and floodplains (where possible).

The CDMP has been developed to provide the framework for the rehabilitation of the existing Bayswater Creek Diversion and the reinstatement of Emu Creek after mining.

B1.4 Consultation

Extensive consultation with government authorities was undertaken during the preparation of the *Ravensworth Operations Project Environmental Assessment* (EA) (Umwelt, 2010), including project briefings, a Planning Focus Meeting and separate meetings with relevant government authorities to discuss specific issues. The consultation undertaken during the preparation of the EA is described in Section 4 of the EA (Umwelt, 2010).

In accordance with Condition 34(a), Schedule 3, of Project Approval 09_0176, this CDMP has been submitted to DPIE, DPIE Water, BCD and the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) concurrently for review and comment. (**Appendix F**)

RC held a meeting with DPIE Water on 14 February 2014 to discuss an alternative to the temporary diversion of Emu Creek (as required by the Project Approval). DPIE Water endorsed the use of harvestable rights to authorise the taking of water from the Emu Creek catchment, see **Appendix F.** Subsequently the Emu Creek diversion will now no longer take place and therefore consultation in accordance with Statement of Commitment 6.8.2 with Yancoal is no longer required. Consultation with Yancoal will still occur in regards to managing the Emu Creek water via harvestable rights on an as needs basis.

B1.5 Vision

The forming of a vision statement in creek / river remediation and diversion is considered a key step in attaining a common suite of objectives for what could and should be achieved in the realigned creek. The vision statement also forms a basis for review on completion of the work to establish whether the desired outcomes and objectives have been attained.

Based on the broad regional targets and guidelines as context the vision for Bayswater Creek and Emu Creek is that the realigned channels and riparian zones will be healthy, functioning aquatic and riparian systems, with creek condition equivalent to or better than the existing aquatic and riparian systems.

The specific vision statements for each creek are outlined in **Section 5.1** and **5.2**.

B1.5.1 Bayswater Creek Vision

To rehabilitate and revegetate the diverted section of the creek to be a hydraulically and geomorphically stable stream. The final creek will incorporate sustainable systems emulating other stable landforms in the general area.

B1.5.2 Emu Creek Vision

The final alignment should be hydraulically and geomorphically stable, generally in accordance with the design concept outlined in the Environmental Assessment. In addition, the restored creek will minimise net loss of stream length and the planning around the final landform will be so as to restore in terms of quantity and quality the flows in the creek, albeit with a modified final catchment compared to pre-diversion.

B1.6 Baseline Conditions

It is apparent in creek restoration literature that the restoration process is not simply a matter of emulating pre-diversion baseline conditions, simply because many creeks are not inherently stable and because the future scenario may be very different to the pre-diversion conditions. This is particularly applicable for Emu Creek where the entire catchment form and drainage pattern post mining will potentially differ significantly from the pre mining landform.

The pre-diversion baseline provides a key indicator of potentially acceptable post-diversion geomorphic, hydraulic and ecological conditions, particular once the context of each reach of the creek is characterised and understood in terms of stability, erosion and deposition, fluvial processes and riparian and aquatic habitat.

Detailed mapping of all of the reaches of Emu Creek and the pre-diversion conditions of Bayswater Creek has not been undertaken, and in the case of Bayswater Creek, is no longer possible. The section below, however, discusses key aspects of each of the creeks that will need to be considered during the detailed design stages.

B1.7 Catchment Characteristics

The Ravensworth Complex area is typical of the Central Lowlands of the Hunter Valley, which are characterised by undulating to low rolling hills formed on weak sedimentary rocks with low local relief (Kovac and Lawrie, 1991). Elevations range between 65 m Australian Height Datum (AHD) in the southeast and 100 m AHD in the north-west.

The Central Lowlands area is centred on the Hunter River, its floodplain and terraces. Several sub catchments join the Hunter River within its Central Lowlands reaches. These include Bowmans Creek, Bayswater Creek, Glennies Creek and Wollombi Brook. Emu Creek is a tributary of Bayswater Creek.

All of the major fluvial features of the Central Lowlands landscape are strongly meandering, partly confined to unconfined channels.

The valley side slopes of the Central Lowlands have been logged and/or cleared for grazing for 150 to 200 years. The valley floor area, initially cleared for grazing and cropping (on floodplain and terrace landforms) has been heavily modified by mining, transport and power infrastructure over the last 50 years.

B1.7.1 Bayswater Creek

The key catchment characteristics of Bayswater Creek are described in **Table B1.1**.

Table B1.1 Catchment Characteristics of Bayswater Creek

Characteristic	Description
Catchment Area	Current Bayswater Creek catchment (including the sub catchments of Pikes Gully, Emu Creek and Davis Creek) has a total area of approximately 3,330 ha with approximately 2,315 ha (70 %) located within the Ravensworth Complex. The natural catchment area has previously been reduced by the mining operations.
Shape	Dendritic, but with some evidence of jointing and faulting controlling drainage lines in the general area.
Vegetation Cover	Natural catchment a mixture of grasslands and forested areas, but highly impacted due to historical clearing.

B1.7.2 Emu Creek

The key catchment characteristics of Emu Creek are described in **Table B1.2**.

Table B1.2 Catchment Characteristics of Emu Creek

Characteristic	Description
Catchment Area	Emu Creek catchment is approximately 665 ha with approximately 520 ha (78 %) located within the Ravensworth Complex. The size of the natural catchment has been reduced by the Yancoal Hunter Valley Operations (HVO) mining operations and associated water management system and the existing Ravensworth West mining operations and associated water management system. The catchment on Yancoal land is approximately 160Ha and is continually to be effected by mining operations.
Shape	Highly disturbed but largely dendritic.
Vegetation Cover	Largely transformed mixture of grassland, forest and mining areas.

B1.8 Water Quality

Baseline water quality data for Bayswater Creek and Emu Creek is included in the WMP.

In summary, the ephemeral creeks within the Ravensworth Complex (i.e. Bayswater Creek, Emu Creek, Davis Creek and Pikes Gully) typically exhibit high salinity levels due to intermittent flows. The electrical conductivities recorded in the ephemeral creeks vary considerably from 43 µS/cm to 21,150 µS/cm. pH levels recorded in the ephemeral creeks generally ranges from 6.4 to 9.6.

The total suspended solids (TSS) levels recorded in the ephemeral creeks generally ranged up to 1,350 mg/L with total dissolved solids (TDS) levels recorded in the ephemeral creeks ranging up to 16,800 mg/L. The variability of the results is considered primarily attributable to the change in flow conditions associated with rainfall.

B1.9 Geomorphology

The RC area includes part of the lower reaches of the Bayswater Creek catchment, commencing approximately 6.5 km upstream of its junction with the Hunter River. This includes a section of the terrace and floodplain of Bayswater Creek. Davis Creek and Emu Creek are sub-parallel right bank tributaries of Bayswater Creek. These sub catchments are separated by low north-north-west to south-south-east trending ridges. The channel alignment and bed levels of Davis Creek and Emu Creek are strongly structurally controlled. The channel of Davis Creek in particular is confined to a narrow valley between bedrock spurs, with limited development of alluvial fill. Sandstone outcrops in the creek bed of Davis Creek control bed incision and channel gradient.

B1.9.1 Bayswater Creek

Bayswater Creek is a fourth order (Schedule 2) stream by the Strahler stream ordering system (DIPNR, 2005).

The geomorphology of Bayswater Creek upstream of the existing diversion is discussed below based on field inspection of the creek during a period of high flow on the 16 June 2011 and work undertaken prior to the Narama diversion of Bayswater Creek (Resource Planning Limited, 1992).

The key geomorphic characteristics of Bayswater Creek are described in **Table B1.3**.

Table B1.3 Geomorphic Characteristics of Bayswater Creek

Characteristic	Description
Valley setting	Laterally unconfined, although now confined through man-made structures (e.g. roads, mining infrastructure).
General soils and bed material texture	The soil landscape within the catchment is predominately the Liddell (ld) soil landscape with very low relief, gentle slopes, low fertility and slightly acidic topsoils. Soils in these areas are imperfectly drained and have a moderate erosion potential. The Hunter (hu) soil landscape also occurs within the catchment around the lower reaches of Bayswater Creek. Soils in this area of the catchment are moderately to rapidly draining with moderate to low fertility levels (Kovac and Lawrie, 1991). Soils in the riverbed are fine – typically a sandy silt, with gravel lenses within the valley fill stratigraphy.
Channel geometry	In the reach of Bayswater creek approximately 500 m upstream of the Hunter River confluence, the active channel (prior to diversion) was incised up to eight metres below the main terrace unit, with a narrow recent floodplain inset within the older alluvium (Resource Planning Limited, 1992). Abandoned channels of Bayswater Creek indicated that prior to the recent period of incision; the channel form had been much shallower. The recent site inspection during high flow indicated an upstream channel form that is largely a single channel, highly sinuous, typically 10 m to 15 m wide. Flow depths were noted during the site inspection to be generally shallow, probably less than one metre on average. Upstream of the intersection of Davis Creek with Bayswater Creek, the current channel of Bayswater Creek is incised below a high terrace on the right bank. The terrace surface is divided into units by low angle bedrock spurs that extend almost to the creek bank. The terrace surface is dominated by hard setting, pale grey fine sandy loam. The bed of the channel in this region is approximately six metres below the terrace level. An in channel bench – at modern floodplain level - is set below the terrace surface at approximately three metres above the bed.

Characteristic	Description
Geomorphic units	The bank stratigraphy includes basal sandstone outcrop, overlain by coarse gravel, which was then overlain by stratified upwards fining sequence. The terrace surface is dominated by hard setting, massive and pale fine sandy loam. In some sections, a dark grey clay-to-clay loam is exposed in the upper part of the bank. This material is symptomatic of the former chain of ponds morphology. Although the banks are higher, the overall sequence is similar to that exposed in the alluvial units of Emu Creek.
Vegetation associations	Some parts of the Bayswater Creek alluvium retain good habitat quality. Several even age stands of casuarinas occur on the various floodplain terraces, probably indicating significant flood damage to the trees during large flood events. There are some large specimens. There are also stands of rough barked apple in places across the terrace surface. In some areas the channel is treed (Casuarinas).

B1.9.2 Bayswater Creek Diversion

The Bayswater Creek diversion diverts a five-kilometre length of Bayswater Creek around the Narama mine, from downstream of the confluence of Bayswater Creek with Davis Creek to approximately 100 m upstream of the confluence of Bayswater Creek and the Hunter River. The diversion realigned Bayswater Creek along the western edge of the Narama mining lease, shortening the length of the creek and requiring the construction of a drop structure approximately 100 m upstream of the confluence with the Hunter River.

Bayswater Creek was diverted for the lower 3,050m as part of the Narama Coal mine development application and subsequent approval (DA135/90). The Environmental Impact Study (1990) detailed the 1 in 100 year recurring flood studies done, the levees to be constructed and the hydraulics and hydrology studies completed.

Since the construction of the diversion channel, a number of issues have been raised, including flow velocities along the channel, the condition of the drop structure and erosion downstream of the drop structure. During late 2007, RC carried out works to repair the drop structure and the scoured channel banks after formal approval was received from the former Department of Primary Industries - Mineral Resources (DPI-MR) and the former Department of Water and Energy (DWE).

B1.9.3 Emu Creek Geomorphology

Emu Creek is a fourth order (Schedule 2) stream by the Strahler stream ordering system (DIPNR, 2005). Emu Creek flows in a south easterly direction before joining Bayswater Creek approximately three kilometres upstream of the confluence of Bayswater Creek and the Hunter River. Emu Creek is an ephemeral creek system with flows only occurring in the creek during storm events or after prolonged rainfall.

The catchment and channel of Emu Creek provide clear evidence of moderate to severe changes to channel form over the last 200 years. However, the stratigraphy of the alluvial creek banks also indicates previous cycles of infilling and incision within the bedrock controlled maximum channel dimensions. Active channel incision and widening continues in the upstream reaches within the Ravensworth Mine area. The channel form of the lower reaches within the Mine area appears, from visual inspection, to be more stable.

Consequently, Emu Creek exhibits very different morphology in the upstream reaches compared to the downstream reach. As such the upstream and downstream reaches are discussed separately.

The key geomorphic characteristics of the upper reaches of Emu Creek are described in **Table B1.4** and the downstream reaches of Emu Creek in **Table B1.5**

Table B1.4 Geomorphic Characteristics of Emu Creek - Upstream Reaches

Characteristic	Description
Valley setting	Laterally unconfined, although partly confined in areas where bedrock limits the extent of erosion. Lower valley side slopes in the upper Emu Creek and Davis Creek catchments are very low gradient and the break of slope between foot slope colluvial deposits and alluvial valley fill may be slight. Drainage of the lower slopes is poor, with shallow A2 horizons overlying heavy clay B-horizons and shallow bedrock. Dispersible remnant A2 soils tend to be waterlogged in wet weather, encouraging overland sheet flow.
General soils and bed material texture	The soils of the lower foot slopes include remnants of very hard setting A2 horizon material. The A2 horizon depth is frequently less than five centimetres deep, with heavy clay B-horizon material intermittently exposed at the surface. It is likely that 10 cm or more of surface lowering has occurred within the last 100 years. Where lower slope regrowth is bull oak and ground cover is inhibited, rafts of casuarina needles and entrained soil materials in transit are widespread. This sheet wash 'float' is one centimetre to 20 cm thick, with an uneven surface, reflecting intermittent waves of sheet scour and deposition. Where organic debris from casuarinas is absent, the surface may be covered by algae/lichen, with uneven micro topography consistent with erosive sheet flows. The creek bank of the upper reaches of Emu Creek and of Davis Creek may be formed by alluvial deposits or in low angle foot slope colluvium. In both cases channel widening by head cut undercutting occurs where sheet flows pass over the break of slope. The stratigraphy of the valley fill, exposed in eroded banks, includes coarse basal gravels, mottled concretionary sandy clay, reddish brown sandy clay loam with gravel lenses, dark grey brown organic clay with abundant root channels (this material occasionally occurs at two levels in the banks), reddish brown pedal light clay, hard setting pale fine sandy loam and poorly consolidated grey brown fine sandy loam.
Channel geometry	In the upper reaches, the full alluvial section of Emu Creek is approximately four metres deep, overlying sandstone bedrock outcrop. The channel form tends to be sinuous and trapezoidal in nature, with limited flow depths of typically <1 metre, only being exceeded during large flood events.
Geomorphic units	Emu Creek may originally have been chain of ponds, but is now a meandering fine-grained continuous incised channel. Evidence of primarily erosion in the upstream section with this section likely being a sediment provider.
Vegetation associations	Emu Creek vegetation is typically even age stands of casuarinas similar to Bayswater Creek, although less diversity was noted in the areas inspected.

B1.10 Hydraulic

B1.10.1 Bayswater Creek

As part of the EA, a flood assessment was undertaken for Bayswater Creek using XP-Storm, a one dimensional (1D) hydrodynamic flood model. Catchment and runoff characteristics incorporated into the models were based onsite inspections, aerial photograph interpretation and recommendations from *Australian Rainfall and Runoff* (AR&R) (IEAust, 1987).

Based on the outcomes of the modelling and the site inspections the hydraulic characteristics of Bayswater Creek are outlined in **Table B1.5**.

Table B1.5 Hydraulic Characteristics of Bayswater Creek

Characteristic	Description
Hydraulic characteristics (modelled)	Peak flows for 100-year Average Recurrence Interval (ARI) storm event downstream of confluence with the Davis Creek are approximately 120 m^3/s, increasing to approximately 150 m^3/s just upstream of confluence with the Hunter River. Velocity (average) for peak flow equal to approximately 2.2 m/s.
Observed flow	Flow observed during a high flow period onsite inspection indicated rippled flow with some sections of unbroken standing waves. Velocities were estimated to be typically 1.5 m/s to 2 m/s.
Characteristics/controls	The sinuosity of the channel and width to depth ratio suggest that the sediment transport is mixed load.

B1.10.2 Emu Creek

As part of the EA, a flood assessment was undertaken for Emu Creek using XP-Storm, a one dimensional (1D) hydrodynamic flood model. Catchment and runoff characteristics incorporated into the models were based on site inspections, aerial photograph interpretation and recommendations from AR&R (IEAust, 1987).

Based on the outcomes of the modelling and the site inspections the hydraulic characteristics of Emu Creek are outlined in **Table B1.6**.

Table B1.6 Hydraulic Characteristics of Emu Creek

Characteristic	Description
Hydraulic characteristics (modelled)	Peak flows for 100-year storm event are approximately 28 m^3/s just upstream of confluence with the Bayswater Creek. With peak velocities in the order of 2 m/s.
Observed flow	Flow observed during a high flow period indicated rippled flow. Velocities were estimated to be typically around 0.3 m/s to 0.6 m/s and fairly uniform.
Characteristics/controls	The sinuosity of the channel and width to depth ratio suggest that the sediment transport is mixed load.

B1.11 Ecology

Ecology is a key driver in creek system recreations, although the ecology is largely driven by the geomorphology and hydraulics, particularly within recreated creek lines. Largely, the baseline ecology and the establishment of similar species will determine the success of the rehabilitation and diversion construction.

B1.11.1 Regional Ecological Context

The Upper Hunter Valley has been largely cleared of native vegetation, primarily for agricultural and other land uses including urban development and mining. The valley floodplain areas have been subject to intensive agricultural use. Due to these land use patterns, conserved areas of native vegetation are generally located on the edge of the valley. Connectivity to and from these conservation reserves is patchy due to the variety of land tenures and long history of land modification.

The key regional ecological characteristics are summarised in **Table B1.7**.

Table B1.7 Regional Ecological Characteristics

Characteristic	Description
General ecosystem	The areas surrounding the RCare predominantly composed of valley floor woodlands, forests and native and exotic pastures derived from the clearing of the woodlands. The broad fauna habitat types of grassland, riparian, woodland/forest and aquatic habitat found within the Ravensworth Complex area are representative of the broad habitat types within the surrounding region. All habitats in the region have been extensively cleared or modified for agriculture, largely for cattle grazing. Because of the widespread clearing of habitats in the region, those remaining contain important refuges for a number of flora and fauna species, many of which are now threatened due to habitat loss and fragmentation.
Key issue	Connectivity to the east and west of the RC is limited due to extensive areas of cleared land and adjoining open cut mining operations. Thus, vegetated areas, including riparian areas, are considered important corridors for the movement of mobile fauna species in an east-west direction.
Characteristics/controls	The existing slopes, stream powers in stable areas, and roughness coefficient have been mapped at certain key areas, but a more detailed reach evaluation will be undertaken prior to submission of the final CDMP. The sinuosity of the channel and width to depth ratio suggest that the sediment transport is mixed load.

B1.11.2 Ravensworth Complex Area

The RC occurs within part of a relatively large area of regenerating native vegetation of approximately 1200 ha. Due to historical clearing, the native vegetation communities within the Ravensworth Complex are characterised by extensive areas of regrowth (20 to 30 years old) with few tree hollows. As indicated above, the clearing has resulted in limited treed connectivity between the RC and other valley floor remnants, and substantial areas of derived grasslands in and around the RC.

The key flora and fauna relative to the creeks are outlined in **Tables B1.8** and **B1.9**.

Table B1.8 Key Flora

Characteristic	Description
General ecosystem	The dominant communities identified in the Ravensworth Complex are Central Hunter Box-Ironbark Woodland and Derived Grassland with Central Hunter Bulloak Forest Regeneration. A number of small patches of planted native vegetation occur within the Ravensworth Complex associated with mine rehabilitation comprising endemic and non-endemic eucalypt species. Two variants of Derived Grassland are present: high to moderate quality native grassland located between remnants of Central Hunter Box-Ironbark Woodland and low quality derived grassland occurring on the floodplains of the Hunter River, Bowmans Creek and Bayswater Creek. Hunter Floodplain Red Gum Woodland was recorded on the floodplains of the Hunter River and Bayswater Creek, in the south and central portion of the Ravensworth Complex.
Threatened and endangered species	One threatened flora species, *Bothriochloa biloba,*and two endangered flora populations, *Acacia pendula* and *Eucalyptus camaldulensis* were recorded at the Ravensworth Complex during field surveys. Due to the extensive level of flora survey effort undertaken within the Ravensworth Complex as part of development assessments and ongoing ecological monitoring, *Bothriochloa biloba* is considered to be rare within the Ravensworth Complex. Weeping Myall (*Acacia pendula*) has been recorded at four locations within the Ravensworth Complex. A planted area adjacent to Old Lemington Road contains a large number of planted Weeping Myall, and the remaining three locations of Weeping Myall refer to one individual tree each. Three single river red gum trees (*Eucalyptus camaldulensis*) were recorded within the Ravensworth Complex along the Hunter River.

A total of 180 fauna species have been recorded during surveys of the RC. Thirteen threatened species (as listed under the *Threatened Species Conservation Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*) were recorded either as part of environmental assessments or from other sources such as previous surveys, database searches or literature reviews. The listed threatened species are all relevant to the riparian habitat and include those identified in **Table B1.9**.

Table B1.9 Key Fauna

Characteristic	Description
Threatened species	Green and golden bell frog (*Litoria aurea*); masked owl (*Tyto novaehollandiae*); brown treecreeper (eastern subspecies) (*Climacteris picumnus victorae*); speckled warbler (*Chthonicola saggitatus*); scarlet robin (*Petroica boodang*) (PD); hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*); grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*); grey-headed flying-fox (*Pteropus poliocephalus*); eastern freetail-bat (*Mormopterus norfolkensis*); little bentwing-bat (*Miniopterus australis*); eastern bentwing-bat (*Miniopterus schreibersii oceanensis*); eastern false pipistrelle (*Falsistrellis tasmaniensis*); and large-footed myotis (*Myotis adversus*).

The green and golden bell frog (*Litoria aurea*) has been recorded in the RC Project area on three occasions over an 11-year period. All confirmed records of the species since 1994 have identified low numbers of adult individuals and only one record identified tadpoles of the species. Consequently, the Upper Hunter Green and Golden Bell Frog Key Population is recognised as one of high conservation significance and a priority for conservation efforts (DECC 2007). The provision of suitable habitat for the green and golden bell frog (*Litoria aurea*) will be a priority for the re-creation efforts to use best endeavours to prevent any net loss of habitat for the species in the long term.

Five vulnerable woodland bird species and five vulnerable species of microbat were recorded widely across the RC and the vulnerable grey-headed flying fox (*Pteropus poliocephalus*) was recorded at one location (Umwelt, 2010). The re-creation of habitat for threatened woodland birds and microbats will be an objective of the rehabilitation of Bayswater Creek and the re-creation of Emu Creek.

The Hunter River catchment, including Bayswater Creek, does not provide habitat for any of the threatened aquatic species, populations and Endangered Ecological Communities (EECs) listed under the *Fisheries Management Act 1994*. No threatened aquatic species were recorded during the EA and none are expected to occur within the Ravensworth Complex (Umwelt, 2010).

B2 Design Specifications

B2.1 Bayswater Creek

The remediation of Bayswater Creek diversion will be undertaken in accordance with NOW approved design report, *Remediation of Bayswater Creek Diversion Design Report, 27 February 2014,* included as **Appendix G.** Interim measures to be commenced prior to full remediation where discussed and approved with DPIE Water. Details of consultation are included in **Appendix F** and a general designs is included in **Appendix H.**

B2.2 Emu Creek

Reinstatement of Emu Creek will be done general in accordance with the concept design outlined in the Environmental Assessment (February 2010). Key characteristics of the Emu Creek reinstatement will addressed in the final design through discussions with key stakeholders at a date consistent with current Life of Mine (currently approximately 2020).

B2.3 Detailed Design Requirements

The detailed design of the Bayswater Creek remediation will need to:

- Address the long term hydraulic and geomorphic stability;
- Improve the ecosystem compared to existing diversion ecosystems; and
- Use geomorphic structures where appropriate.

The detailed design of the Emu Creek reinstatement / rehabilitation will need to address the following:

- Management of materials to be placed back into the final creek alignment;
- Post mining landform that provides the future catchment to Emu Creek, including HVO land upslope;
- Final creek alignment, including construction details. This work will include details of the final landform associated with the overburden emplacement area and will use best endeavours to confirm minimal net loss of stream length;
- Monitoring of settlement of the overburden emplacement area so as to determine the risk and implications of future settlement;
- Assessment as to how any leakage of water from the creek to the overburden emplacement area will be monitored or measured so as to best endeavours to check problems can be identified in a timely manner, or, if this is not practical, identify the consequences and management options;
- Determine possible issues around the Bayswater alluvial aquifer interaction;
- Interim use of sediment dam adjacent to Bayswater Creek during establishment of final creek alignment and use of sediment dam in final design of the Emu Creek diversion; and
- In addition, the detailed design stage will incorporate submission of an as-executed report to the Secretary and DPIE Water, certified by a practising engineer, confirming that the reinstated/rehabilitated Emu Creek and Bayswater Creek are sufficiently hydraulically and geomorphologically stable prior to commissioning (approximately 2020) the reinstated/rehabilitated creeks.

B2.3 Working Plan

The working plan addresses a range of issues, and is included in **Appendix G** as part of the detailed design report.

The requirements for Emu Creek will be similar, but include aspects of the mining rehabilitation planning that are not relevant to Bayswater Creek.

Table B2.1 Emu Creek Working Plan

Characteristic	Description
Baseline maps	Studies conducted as part of the Ecology, Groundwater and Surface water assessments for the Environmental Assessment will be utilised as baseline conditions to document the creek in the best condition possible prior to mining impacting the area too significantly.
Mine rehabilitation plan around Emu Creek	The proposed mining schedule will need to detail the likely timing of excavation through sections of the creek, materials management options, and the final realigned creek (which need not follow the exact pre-mining layout, except that the gradient should not be flattened or changed significantly due to settlement and sedimentation risks). A final landform will need to be developed for the mining planning team, and the timing of placing the creek back over the overburden emplacement area identified – probably late in the life of the mine, but still to be determined.
Detailed designs and drawings	Layouts of engineering and ecological systems to be installed. This will include excavation, construction, and materials requirements, including the desired outcomes.
Erosion and sediment control plans	Methods for controlling erosion during the construction and operational phase. Soil and Water Management Plans will be included here, detailing aspects such as preventing hydrocarbon spillage, design of sediment basins, and other relevant information.
Construction/Safe Works Method statements	Typically, there would be site-specific safety documents relevant to the Ravensworth Complex and a requirement for a GDP that the contractor will need to meet prior to construction commencing.

B3 Construction Program

The Bayswater Creek, designs for rehabilitation and revegetation was approved in early 2014 (**Appendix F**). Rehabilitation and revegetation is expected to commence once mining has ceased in the area known as Narama West and when relevant equipment is available (approximately 2020).

Mining through Emu Creek will take a period of several years and the bulk of Emu Creek will be mined through in approximately 10 years' time.

The relocation of Emu Creek is highly dependent on an integrated strategy in terms of the mine spoils final landform which will give the final catchment to the creek, the final shape of the low lying areas and the risk of the channel migrating off the backfilled sandy / silty material, the final slope of the realigned creek and integration of the materials movement.

Mapping and detailed design work of the Emu Creek alignment will be undertaken in approximately 2019 when the diversion will be designed in accordance with Mining Operations Plan and consultation with appropriate regulators.

In accordance with *Project Approval Statement of Commitments Condition 6.8.2*:

> *At least 12 months prior to the diversion of Emu Creek, Ravensworth Operations, in conjunction with Coal and Allied will review the need to undertake any further studies to inform the detailed design of the diversion with future mining operations associated with Ravensworth Mine Complex and the adjacent Coal and Allied operations.*

The proposed temporary diversion of Emu Creek to Davis Creek will no longer be undertaken. GCAA will allow runoff from the upper catchment to be captured in a sump within the mining area, relying on harvestable rights to authorise the taking of water. Work on the final design will be completed in so far as is necessary to confirm that the final design back over the overburden emplacement area is workable and sustainable.

Integration with the mining operation will probably limit the level of detailed design around the final long section to conceptual details until the final landform surface is able to be surveyed.

B4 Revegetation Program

The proposed revegetation program is outlined in **Table B4.1**.

Table B4.1 Proposed Revegetation Program

Characteristic	Description
Seed collection and propagation	A detailed seed collection program will be implemented by the RC, in order to maximise the amount of viable seed of local provenance for use in the ongoing rehabilitation and revegetation activities. This program continually incorporates any recent innovations to industry best practice techniques, where relevant. The selection of appropriate self-sustaining native vegetation communities characteristic of the creek reaches will thus involve collection of appropriate seed ahead of time. For Emu Creek, the seed will probably have to be collected from elsewhere due to the timeframes associated with reinstating the creek.
Substrate preparation	The sandy silty profile is particularly erodible when not vegetated. The final process of rehabilitation has still to be finalised but may involve the use of soils with a seed bank, topsoil in some areas (where it will not be washed away), temporary armouring where required, and the need for soil ameliorants such as organic matter to bind the soils, or gypsum for sodic soils. Some reworking of the upper surface with equipment is likely where this will not result in additional erosion. For Emu Creek, consideration of clay lining of channel and substrate preparation will need to be considered.
Revegetation	As discussed, the revegetation program will be based on the targeted ecosystem and geomorphology. The process will require time and the use of interim vegetation such as cover crops to stabilise the area initially is not excluded. Monitoring, care and maintenance will be undertaken, although the timing and extent has still to be determined.

B5 Performance and Completion Criteria

B5.1 Objectives and Criteria

The primary objectives (refer to **Section 2**) specifically relate to long-term geomorphic and hydraulic stability of the creeks as well as establishing a suitable and sustainable ecosystem throughout the channel reaches. It should be noted that the objectives are given for both Emu Creek and Bayswater Creek, although some issues will not be relevant to Bayswater Creek. The completion criterion for biodiversity is also considered as part of the Biodiversity Management Plan.

Table B5.1 Performance Objectives and Associated Criteria

Objective	Criteria
Protect riverine integrity including the retention of environmental and use values, maintenance of the river system within its geomorphic boundaries and geomorphic character, and protection of dependent ecosystems.	Propose single channel stream similar to natural system that may include pools and riffles and also with sinuosity, slopes and stream powers similar to the pre-mining stable reaches for Emu Creek. Minimise net loss of stream length for Emu Creek. Geomorphology of existing streams to be emulated to the extent desirable, specifically around compound nature of the stream, stream bed materials, diversity of habitat. Vegetation and fauna habitat recreation to confirm no net loss of riparian habitat. Flora species assemblages and orders to be characteristic of species found within the original alignment. Sediment transport upstream and downstream to be largely unimpeached by the diversion in the longer term, with measures to address increased loads. Aesthetic appearance to be such as to provide use value. Impact on aquatic species to be negligible.
Ensuring minimal adverse impact on stream flows and groundwater availability due to mining activities.	Flow off diversions to be similar to that of unmined creek but adjusted for the new catchment. Where ingress may result due to settlement or other issues (Emu Creek), a strategy to address the loss of flow is required either related to monitoring and repair, augmentation of flow or some other means.
Maintaining water quality within acceptable limits. This includes maintaining groundwater quality within its current beneficial use class and surface water quality within the background limits of variability.	Materials used to be non-polluting in terms of chemistry, as well as other issues such as suspended solids / turbidity. The current source of water quality impacts to be understood so that a reasonable target quality can be set. Groundwater impacts related to the alluvial aquifer to be understood and mitigated where practical.

Objective	Criteria
Ensuring the integrity of the landform and barrier land to alluvial floodplains and river systems remains into the post-mining period.	Sustainability of the creek so there is no excessive erosion or erosion that affects the long-term integrity of the diversion and reinstatement. Impact of the diversion and reinstatement on large floods to be negligible, taking into account the loss of storage on floodplains over the diverted length. Overall integrity of the system in terms of possible flooding onto previously mined ground to be prevented or mitigated due to the risk of increased loss of clean water into a dirty water system.

B5.1 Risks to the Proposed Strategy

A range of issues and risks that may impact upon the ability of RC to successfully implement the CDMP have been discussed in the document. A risk analysis, however, will be undertaken early in the design process.

The major risks identified to date include:

- Excessive erosion on the diverted sections of Bayswater Creek due to concentration of flows. Emu Creek could also be unstable if not properly designed and constructed, with additional erosion risks immediately post construction;
- Possible instability of Emu Creek post mining affecting safety and yield;
- Possibility of a poor ecosystem along the diverted stream, reducing the ecological and use value of the creek;
- Increased sedimentation downstream, with the possibility of increased suspended solids, affecting downstream users and ecosystems; and
- Possible impacts on downstream flood peaks associated with the loss of floodplain storage.

B6 Monitoring

It is clear in the CDMP that there are a range of issues and aspects to be monitored. Some of these will add value if undertaken prior to the diversion and others will apply post diversion.

The key monitoring requirements for the diversion are discussed in **Sections 2.1**, **2.2** and **2.3**.

B6.1 Prior to Mining Through Emu Creek

Monitoring will be undertaken in order to:

- Identify any possible degradation that occurs as mining progresses. This is suggested not to facilitate remediation of an area that will anyway be mined, but so downstream impacts prior to mining through can be mitigated and the possible impact of a reduced catchment area post mining characterised; and
- Measurement of flood levels during flood events will facilitate calibration of the in stream roughness coefficients, which should then be applicable to the realigned section.

B6.2 During Restoration and Diversion

The RC will undertake the normal water quality and rehabilitation monitoring to determine the possible impacts of the work on downstream users and ecosystems.

The construction will also be documented in terms of materials used; soil preparation techniques and revegetation methodologies so relevant follow up can be made to address any problem areas.

During the remediation phase, all works and their erosion and sediment controls will be inspected regularly to confirm that all required controls are in place and operating effectively.

Approval and input from key stakeholders on detailed monitoring will be sought prior to commissioning of the Bayswater or Emu Creek diversions.

B6.3 On Completion

In addition to the above, as well as the normal water quality monitoring activities, additional inspections will be made of the diversions as follows:

- As a minimum, Bayswater Creek and Emu Creek will be inspected within one month of the completion of rehabilitation works to assess the extent to which the geomorphologic objectives have been achieved;
- Following storm events, the realigned creek channels will be inspected for evidence of erosion, until such time as they are shown to be stable for such events;
- Following the initial establishment period, rehabilitation inspections will be continued on a quarterly basis to assess soil conditions and erosion, drainage and sediment control structures, runoff water quality, germination rates, plant health and weed infestation; and
- As the ecosystem and vegetation establishes, additional inspections will be arranged as and where necessary to confirm timely interventions can be made if progress is not in line with the targeted plans.

Typical aspects to be monitored will include:

- Plant health;
- Feral animals and the need for control;
- Weed infestation and the need for control;
- Requirements for additional planting to be undertaken;
- Need for further fertilisation;
- Requirement for application of lime or gypsum to control pH and improve soil structure;
- Erosion and the need for repair of eroded areas;
- Fire management;
- Quality and effectiveness of erosion and sediment controls; and
- Signs of disturbance, either by animals or humans.

Outcomes of the rehabilitation inspection process will be recorded and any required management actions that are identified as part of the inspection process implemented as soon as practical. Where necessary, rehabilitation and revegetation procedures will be amended accordingly with the aim of continually improving standards.

Following demonstration that vegetation communities and fauna habitat have been established within a remediated reach of the diversion, the inspection frequency may be reduced for the respective reach where it can also be demonstrated that the channel is geomorphically and hydraulically stable.

B6.4 Long Term Monitoring

The objective of this monitoring is to evaluate the progress of restoration and rehabilitation works towards fulfilling the objectives and criteria as outlined.

The period for long term monitoring will be dependent on several factors including:

- The extent to which objectives have been met; and
- Predictions around future settlement and the implications of settlement.

It is envisaged the long-term monitoring program will commence when revegetation has reached a level of maturity (i.e. between Years 5 to 10) where a range of success-based/floristic aspects can be accurately measured. A suitably qualified and experienced specialist will be required to complete the long term monitoring.

Initially it is envisaged that the long term monitoring will be undertaken annually (after commencement), however, where results are showing rehabilitation is progressing along the required trajectory, the frequency of monitoring may be reduced (i.e. biennial) in consultation with DPIE and EPA.

B6.4.1 Success-Based Rehabilitation/Regeneration Monitoring

The success-based monitoring of rehabilitation will be based on best practice and include (but are not necessarily limited to), the following:

- Replicate monitoring sites in representative rehabilitation/regeneration areas of different ages; and
- Smaller subplots allow an estimate of statistical variance, so that if required, statistical analyses can be undertaken to objectively compare different rehabilitation/re-vegetation treatments, changes over time, and others:

- 10 x 10 m subplots: the number of individual plants of each species between one metre and five metres in height occurring within the plot will be recorded; and
- 2 x 2 m subplots: the number of individual plants of each species less than one metre in height occurring within the plot will be recorded and / or estimated where they are numerous.

B6.4.2 Floristic Monitoring

In order to survey the floristics composition of the rehabilitation plots will be sampled, as follows:

- All vascular flora species present will be recorded. Flora species will be identified onsite or samples taken for identification at a later date. All species will be assigned cover abundance values as a reflection of their relative cover and abundance in the plot. A modified Braun-Blanquet 6-point scale (Braun-Blanquet, 1927, with selected modifications sourced from Poore, 1955 and Austin *et al.*, 2000) will be used to estimate cover abundances of the plant species identified within each plot. Additionally, the number of individual plants of each species over five metres in height occurring within the plot will be recorded; and
- the flora contained within each plot will be assessed for:
  - Floristic composition and structure;
  - Progress of re-vegetation/regeneration towards target native vegetation community;
  - General health of vegetation;
  - Evidence of natural regeneration;
  - Requirements for species-specific planting or thinning;
  - Success of management actions implemented following previous monitoring inspections; and
  - The occurrence and abundance of weeds, evidence of animal disturbance, and observable impacts from mining associated activities.

The monitoring results will be assessed and utilised in the continual improvement and refinement of rehabilitation / revegetation techniques and will be documented as part of the Annual Review. Whilst the program will be designed to be comparable between monitoring periods, the program will also be flexible to enable the incorporation of a range of industry-accepted techniques that will enable sites to be tracked against meeting the closure criteria. Further revisions of this document may identify the need for further monitoring.

B6.4.3 Monitoring of Emu Creek Habitats

Monitoring of aquatic habitats will begin when flows are returned to the reinstated Emu Creek. Monitoring may typically include assessment of the following characteristics:

- General health of the aquatic vegetation;
- Occurrence and abundance of weed species;
- Signs of disturbance;
- Any observable impacts of mining such as the effectiveness of sediment and erosion control structures;
- Habitat attributes of the aquatic vegetation;
- Presence of fauna species utilising the habitat, particularly amphibians; and
- Presence and type of macro invertebrates utilising the recreated habitats.

Monitoring will be continued until it can be demonstrated that the reinstated habitats are characteristic of original conditions or the agreed target conditions.

B6.5 Corrective Actions

Where a failure of erosion and sediment control structures or remediation works has occurred, or an inspection identifies a noncompliance with this plan, the incident / noncompliance will be handled in accordance with the Surface Water and Groundwater Response Plan. All actions may be captured and documented to monitor completion and the effectiveness of the action.

B7 Care and Maintenance

Care and maintenance planning will need to be revisited once the detailed design work has been completed. Typical actions that may be used to assist in the rehabilitation of post-diversion areas and the management of habitat within these areas will include:

- Monitoring of flows along the creeks;
- Visual inspections for possible areas of ingress of clean water into the overburden emplacement areas or new areas of ponding;
- Maintenance of silt pond areas;
- Fencing (where necessary) to prevent access by stock, vehicles or humans;
- Signage to identify significant ecological features and protect rehabilitation, regeneration and re-vegetation areas;
- Weed management;
- Bushfire management;
- Control of feral animals; and
- Specific works as identified from the monitoring program to confirm remediation works continue along a trajectory to achieve the appropriate objectives and criteria. Such works may involve maintenance to erosion and sediment control structures, further earthmoving or re-vegetation works to address areas that may have failed.

B8 Reporting and Review

B8.1 External Reporting

The Annual Review prepared each year for the RC will include relevant information regarding the remediation of Bayswater Creek and Emu Creek in accordance with the Project Approval (refer to **Table 1.1**).

In addition, any significant finding regarding the implementation of the CDMP will be reported, including:

- The effectiveness of the erosion and sediment controls;
- The effectiveness of engineered structures; and
- Any identified issues.

The Annual Review will also document complaints relating to the performance, maintenance and/or failure of the CDMP or ancillary plans, programs and/or procedures.

B8.2 Community Consultation

All Bayswater Creek and Emu Creek rehabilitation management issues of interest to the community will be addressed in regular community consultation meetings (CCC) in accordance with the Social Involvement Plan (SIP). Specific issues relating to individual landowners and residents will be addressed directly by the ECM as required.

B8.3 Review

The CDMP will be reviewed in accordance with Project Approval 09_0176 Schedule 5 Condition 4 or whenever directed by DPI&E. The CDMP will reflect changes in environmental requirements, technology and operational procedures.

A copy of the revised program will be supplied to the Secretary of the DPIE.

B9 Roles and Responsibilities

B9.1 Responsibilities

The Ravensworth Complex ECM is responsible for managing the CDMP. This duty includes assessing the compliance of the Ravensworth Complex with the conditions listed in the relevant development consents and EPLs. The RC Operations Manager is responsible for providing adequate resources to undertake the activities required by this program.

Some of the responsibilities for work required will become part of the construction contractor's requirements associated with construction activities and potentially some of the monitoring requirements. All monitoring undertaken by the contractor must be in accordance with this CDMP and all relevant monitoring standards.

The responsibilities of the relevant personnel at the Ravensworth Complex and under this program are summarised in **Table B9.1**.

Table B9.1 CDMP Responsibilities at the Ravensworth Complex

Position	Accountability
Operations Manager	• Utilising best endeavours to confirm the mining components required by the CDMP are addressed; • Approving revisions of this plan; and • Completing required external reporting regarding the contents of this plan.
Environment and Community Manager	• Utilising best endeavours to confirm adequate resources are available to implement the requirements of the CDMP; • Utilising best endeavours to confirm key aspects are undertaken by suitably qualified personnel including aspects such as: ▪ additional baseline survey of Emu Creek and Davis Creek in terms of geomorphology, hydraulics and ecosystem; ▪ collection of suitable background information such as surveying actual flood levels, and spoils settlements; ▪ detailed design of proposed diversion and proposed restoration of Bayswater Creek; ▪ integration with mine rehabilitation plan, including materials handling, final landform; ▪ construction in line with the CDMP; ▪ monitoring prior to, during and post construction; and ▪ corrective action to address deficiencies; • Consultation with relevant parties on the CDMP prior to implementation, and completion of reporting as required in terms of Condition 30 of the approval; and • Providing information to Operations Manager regarding reporting requirements for external agencies.

Position	Accountability
Environment and Community Coordinator	• Coordinating community consultation and concerns relating to the CDMP; • Investigating non-compliances or near non-compliances in terms of the monitoring program, including corrective action; and • Completing reporting requirements as per this plan.
All employees and contractors	• Undertaking all activities in accordance with this plan; and • Reporting all non-compliances with this plan as per the Ravensworth Complex reporting procedures.

B10 References

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Appendix C - Erosion and Sediment Control Design Construction Matrix and Drawings of Typical Erosion and Sediment control Structures

C1 Design Construction Matrix for Erosion and Sediment Control Structures

The following matrix provides detail for the construction of erosion and sediment control structures outlined in the Ravensworth Complex Erosion and Sediment Control Plan

Table C1.1 Drain design Criteria

Drain Type	Location	ARI Storm Event	Storm Duration	Freeboard	Typical Grade	Side Batters	Comments
Diversion	Entire site	20 year	Time of concentration[1]	Minimum of 0.5 metre	0.5% to 1.0%	No steeper than 1:2 (v:h)	Where velocity >1.5m/s in 20 year ARI storm event place rock bars every 100 metres to reduce scour potential All drains to be vegetated and/or rock lined Level spreaders to be located at ends of all drains
Catch	Entire site	20 year	Time of concentration[1]	Minimum of 0.5 metre	0.5% to 1.0%	No steeper than 1:2 (v:h)	Where velocity >1.5m/s place rock bars every 100 metres to reduce scour potential All drains to be vegetated and/or rock lined Level spreaders to be located at ends of all drains

[1] To be determined based on methods outlined in Australian Rainfall and Runoff (AR&R) (Institution of Engineers, 1987) – Time of concentration for storm event and Mannings Equation for flow

Table 2 – Sediment Dam Design Criteria

Location	Soil Type	Method	Sediment Zone[1]	Runoff Coefficient	Freeboard	Treatment and Pump Out	
						Overflow Pathway	Requirement[2]
Overburden emplacement area above active pit	Overburden	100 year ARI 24 hour storm event[3]	Sediment zone = 50% of settling zone	As per AR&R[3]	Design for minimum of 1 metre	Mine Water Management System	Ability to pump out in 10 days and sufficient downstream volume to contain spills
						Downstream creek systems	Ability to treat and pump out full dam volume in 5 days
Overburden emplacement area not above active pit	Overburden	Blue Book[4] Type D (dispersive) for 5 day Blue Book rainfall event	Sediment zone = 50% of settling zone	Runoff coefficient (C_v) = 0.9 (hardstand) Runoff coefficient (other areas) = 0.79	Design for minimum of 1 metre	Mine Water Management System	Ability to pump out in 10 days and sufficient downstream volume to contain spills
						Downstream creek systems	Ability to treat and pump out full dam volume in 5 days
Other disturbed areas	Dispersive	Blue Book[4] Type D (dispersive) for 5 day Blue Book rainfall event	Sediment zone = 50% of settling zone	Runoff coefficient (C_v) = 0.9 (hardstand) Runoff coefficient (other areas) = 0.79	Design for minimum of 1 metre	Mine Water Management System	Ability to pump out in 10 days and sufficient downstream volume to contain spills
						Downstream creek systems	Ability to treat and pump out full dam volume in 5 days
	Non-dispersive	Blue Book[4] Type F (fine) for 5 day Blue Book rainfall event	Sediment zone = 50% of settling zone	Runoff coefficient (C_v) = 0.9 (hardstand) Runoff coefficient (other areas) = 0.79	Design for minimum of 1 metre	Mine Water Management System	Ability to pump out in 10 days and sufficient downstream volume to contain spills
						Downstream creek systems	Ability to treat and pump out full dam volume in 5 days

Note 1: Total dam volume = Settling Zone + Sediment Zone (Blue Book – Landcom, 2004)

Note 2: Treat suitable for discharge or pump out to mine water management system dams – refer to Site Water Management Plan

Note 3: To be determined based on methods outlined in Australian Rainfall & Runoff (AR&R) (Institution of Engineers, 1987) – Time of concentration for storm event

Note 4: Managing Urban Stormwater: Soils and Construction (the Blue Book) - Volume 1 (Landcom, 2004) and Volume 2E (DECC, 2004)

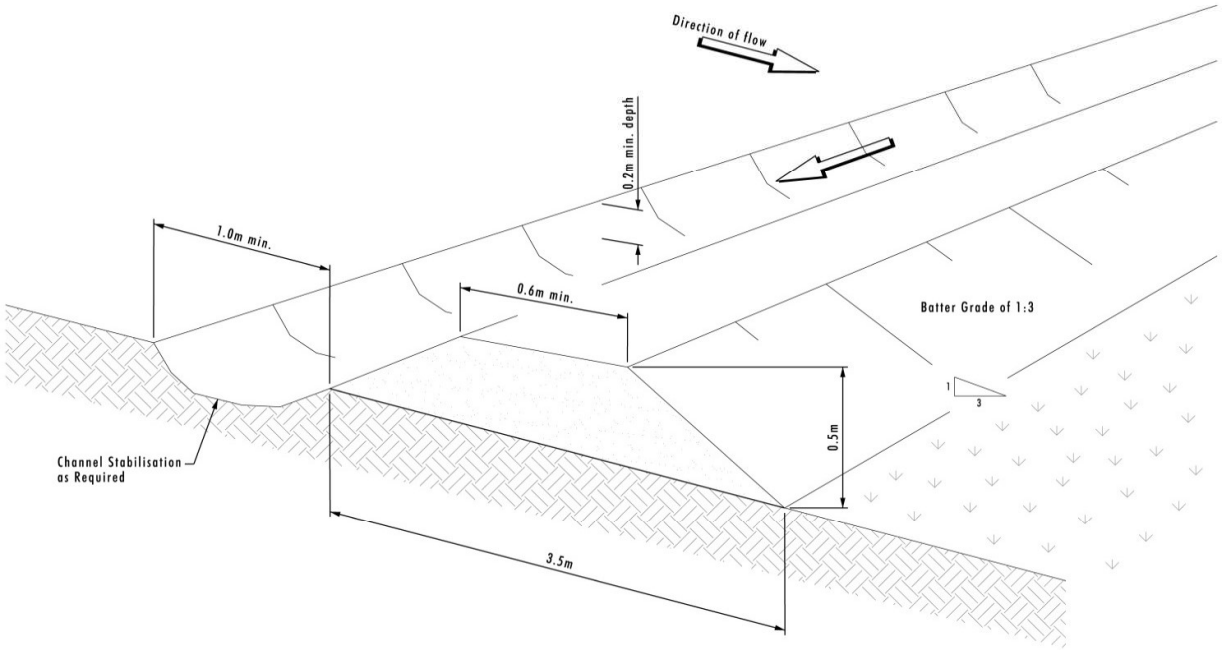


FIGURE 1

Typical Catch / Diversion Drain

Source: Landcom (2004)
File Name (A4): R05_V2/WMP/2795_184.dgn

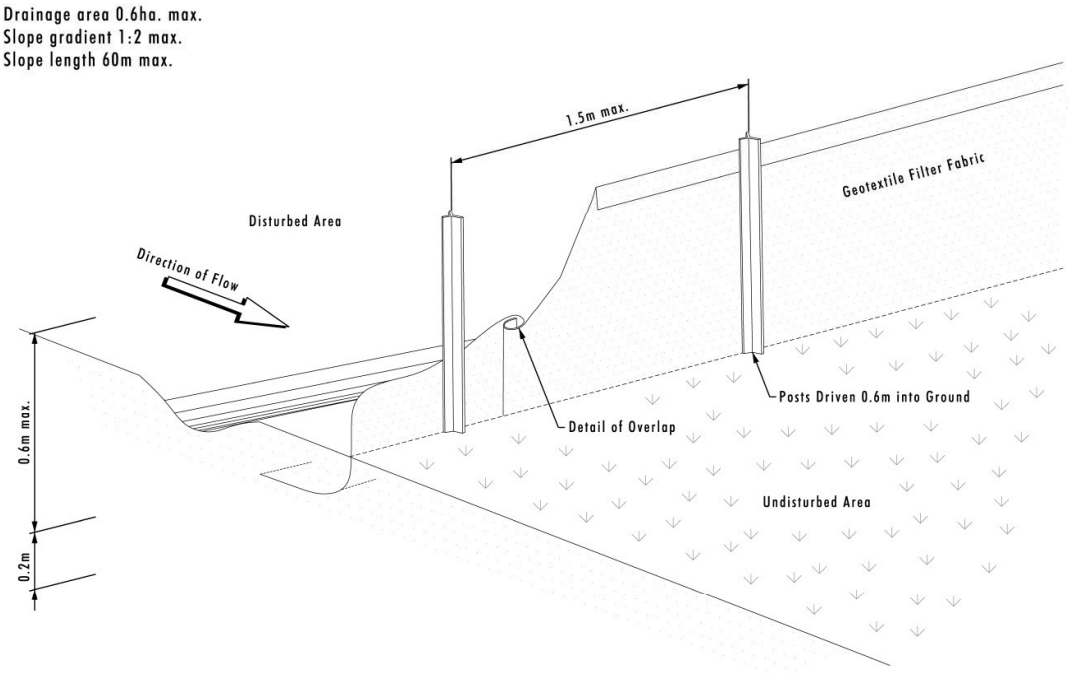
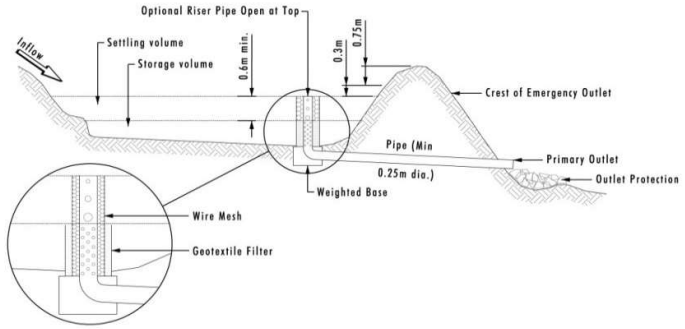


FIGURE 2

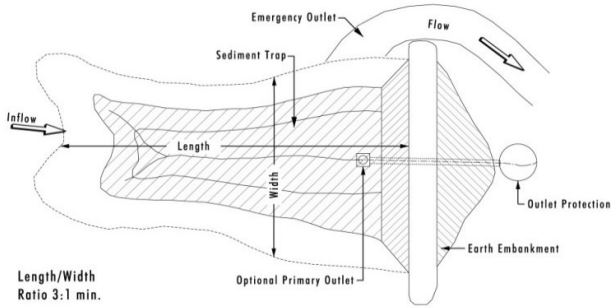
Silt Fence

Source: Landcom (2004)

File Name (A4): R05_V2/WMP/2795_185.dgn



Cross Section



Plan

FIGURE 3
Sediment Dam

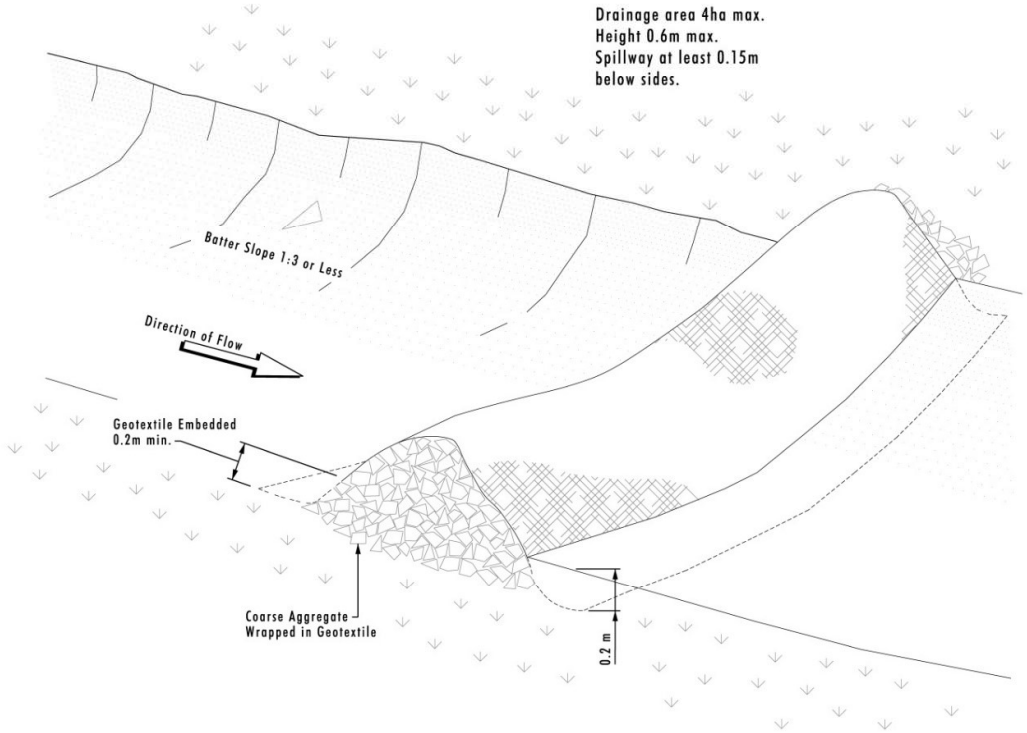


FIGURE 4

Rock Check Dam

Source: Landcom (2004)

File Name (A4): R05_V2/WMP/2795_187.dgn

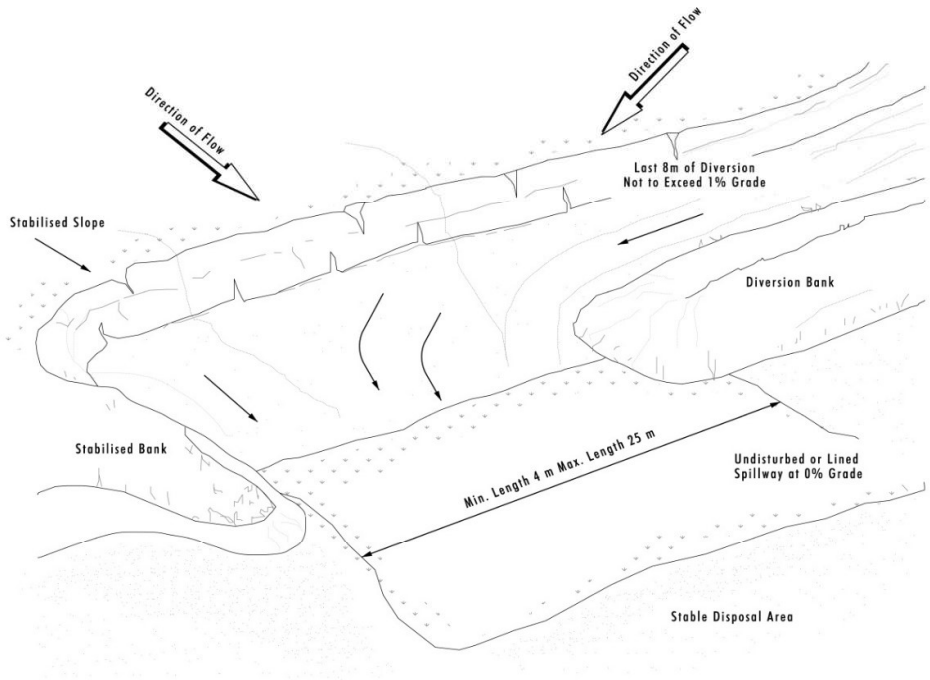


FIGURE 5
Level Spreader

File Name (A4): R05_V2/WMP/2795_188.dgn

Appendix D - Surface Water Impact Assessment Criteria and Baseline Data

D1 Impact Assessment Criteria Determination

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000), published by the Australian and New Zealand Environment Conservation Council (ANZECC), provides a framework for the assessment of water quality in fresh water environments. These guidelines form the central technical reference of the National Water Quality Management Strategy, which the federal government and all state and territory governments have adopted for managing water quality. These guidelines apply to both surface waters and groundwaters.

The ANZECC (2000) guidelines recommend that trigger values be used as a yardstick against which to compare the results of water quality monitoring and suggest that when monitoring results fall outside the trigger range there is a possible risk to environmental value and further action should be taken to investigate or address the cause.

ANZECC (2000) recommends that wherever possible site specific data is used to define Impact Assessment Criteria (IAC) values for physical and chemical factors which can adversely impact the environment. The guidelines, however, provide default trigger values that can be used where there is insufficient site specific data available.

The approach recommended by ANZECC (2000) for developing site specific IAC values for highly disturbed ecosystems is to formulate trigger values based on the 80th percentile of the site specific baseline monitoring data.

This approach to defining site specific IAC values, however, does not allow for water quality variability caused by climatic conditions and the ephemeral nature of the creek systems present at the sites that form the Ravensworth Complex. It is therefore considered that an 80th percentile trigger value may not adequately reflect the water quality dynamics for highly disturbed ecosystems with ephemeral creek systems.

A summary of the baseline monitoring data is presented in **Section 2**.

In the event that a suitable site specific trigger value cannot be determined for a given water quality parameter at the Ravensworth Complex, the default value defined by ANZECC (2000) is used (refer to **Table D1.1**).

Table D1.1 - ANZECC (2000) Default IAC Values for Key Water Quality Parameters1

Water Quality Variable	Trigger Value
pH range	6.5 – 8.0
Electrical Conductivity (EC) (µS/cm)	125 – 2200

Source: ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Note [1:] for lowland rivers in slightly disturbed ecosystems in south-east Australia

D2 Baseline Data

D2.1 Watercourses

Surface water quality monitoring has been undertaken by the Ravensworth Complex in the surrounding catchments at locations upstream and downstream of the Ravensworth Complex. **Table D2.1** summarises the existing locations and periods of monitoring for the surrounding watercourses.

Table D2.1 Period of Record of Surface Water Quality Monitoring in Watercourses

Watercourse	Monitoring Location	Location Code	Period of Record
Bowmans Creek	Bowmans Creek Upstream	EPL3	July 2007 to present
	Bowmans Creek Downstream	EPL4	January 2007 to present
Bayswater Creek	Bayswater Creek Upstream	W114	January 2007 to present
	Bayswater Creek Downstream	W115	January 2007 to present
Emu Creek	Emu Creek Upstream	W163	April 2013 to 2018
	Emu Creek Midstream	W121	January 2007 to January 2015
	Emu Creek Downstream	W122	January 2007 to present
Davis Creek	Davis Creek 1	W151	July 2007 to February 2015
	Davis Creek 2	W152	July 2007 to present
	Davis Creek 3	W153	July 2007 to February 2015
	Davis Creek 4	W154	July 2007 to February 2015
	Davis Creek 6	W155	July 2007 to February 2015
	Davis Creek 7	W156	July 2007 to February 2015
	Davis Creek 8	W164	July 2007 to February 2015
	Davis Creek Down	W164	April 2013 to present
Pikes Gully	Pikes Creek Upstream	W135	2007 to present
	Pikes Creek at New England Highway	W136	2007 to present
	Pikes Creek Road at CHPP Culvert	W137	2007 to present
	Pikes Creek Downstream	W138	2007 April 2015

D2.2 Bowmans Creek

The Ravensworth Complex surface water monitoring program for Bowmans Creek comprises monthly monitoring at locations EPL3 and EPL4 (refer to **Figure 6.1** in the WMP). The range in water quality of Bowmans Creek is outlined in **Table D2.2**.

Table D2.2 Monthly Water Quality Monitoring at Bowmans Creek January 2007 to December 2018

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	7.0	7.7 - 8.1	8.4
Electrical Conductivity (EC) (µS/cm)	337	1,331	5,840
Total Suspended Solids (TSS) (mg/L)	0	18	176
Total Dissolved Solids (TDS) (mg/L)	226	817	2,476

D2.3 Bayswater Creek

The Ravensworth Complex surface water monitoring program for Bayswater Creek comprises monthly monitoring, at locations W114 and W115 (refer to **Figure 6.1** in the WMP). The range in water quality of Bayswater Creek is outlined in **Table D2.3**.

Table D2.3 Monthly Water Quality Monitoring at Bayswater CreekJanuary 2007 to December 2018

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	7.1	7.7 - 8.5	9.4
EC (µS/cm)	424	4,882	13,320
TSS (mg/L)	0	23.2	400
TDS (mg/L)	277	3,216	8,850

D2.4 Emu Creek

The Ravensworth Complex surface water monitoring program for Emu Creek comprises monthly monitoring, when the creek is flowing, at location W122 (refer to **Figure 6.1** in the WMP). The range in water quality of Emu Creek is outlined in **Table D2.4**.

Table D2.4 Monthly Water Quality Monitoring at Emu CreekJanuary 2007 to December 2018

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	7	7.4 - 8.2	9.4
EC (µS/cm)	149	3,336	14,425
TSS (mg/L)	1	47	1,349
TDS (mg/L)	140	2,014	7,530

D2.5 Davis Creek

The Ravensworth Complex surface water monitoring program for Davis Creek comprises bi-monthly monitoring, at locations W152 and W164 (refer to **Figure 6.1** in the WMP). Following a rainfall event (>30mm in 24hrs) Davis Creek monitoring locations W152 & W164 will be included in the following round of surface water sampling. The range in water quality of Davis Creek is outlined in **Table D2.5**.

Table D2.5 Monthly Water Quality Monitoring at Davis Creek July 2007 to December 2018

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	6.6	7.5 - 8.3	9.00
EC (µS/cm)	111	7,378	16,390
TSS (mg/L)	1	31	350
TDS (mg/L)	90	4,630	10,600

D2.6 Pikes Gully

The Ravensworth Complex surface water monitoring program for Pikes Gully comprises bi-monthly monitoring, at locations W135 through to W137 (refer to **Figure 6.1** in the WMP). Following a rainfall event (>30mm in 24hrs) Pikes Gully, monitoring locations W135 - W137 will be included in the following round of surface water sampling. The range in water quality of Pikes Creek is outlined in **Table D2.6**.

Table D2.6 Monthly Water Quality Monitoring at Pikes Creek July 2007 to December 2018

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	6.9	7.8 - 8.3	8.8
EC (µS/cm)	536	13,832	27,100
TSS (mg/L)	1	32	417
TDS (mg/L)	415	10,818	21,600

Appendix E - Groundwater Impact Assessment Criteria, Baseline Data and Monitoring Schedule

E1 Impact Assessment Criteria Determination

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000), published by the Australian and New Zealand Environment Conservation Council (ANZECC), provides a framework for the assessment of water quality in fresh water environments. These guidelines form the central technical reference of the National Water Quality Management Strategy, which the federal government and all state and territory governments have adopted for managing water quality. These guidelines apply to both surface waters and groundwaters. The objective of the guidelines with respect to groundwater is to maintain groundwater quality so that in the event it reaches the surface it will not detrimentally impact the environmental values or water quality objectives of the surrounding ecosystem.

The ANZECC (2000) guidelines recommend that trigger values be used as a yardstick against which to compare the results of water quality monitoring and suggest that when monitoring results fall outside the trigger range there is a possible risk to environmental value and further action should be taken to investigate or address the cause.

The ANZECC guidelines (ANZECC, 2000) recommend that wherever possible site specific data is used to define Impact Assessment Criteria (IAC) values based on the 80th percentile value for physical and chemical factors that can adversely impact the environment. This approach to the defining of site specific IAC values, however, does not account for the variation in water quality due to the properties of the aquifers present in the region surrounding the Ravensworth Complex or the historical level of development in the area. It is considered that applying an 80th percentile IAC value may not adequately reflect the water quality dynamics of the region and may initiate investigations into groundwater quality, which can be associated with natural water quality variations.

Site specific IAC values for the RC have been defined using three statistical values. This approach assumes that the monitoring data has a normal data distribution and is representative of the water quality at each location. Three statistical values are calculated and used to assess the monitoring results, as follows:

- Mean;
- Upper Allowable Limit (UAL) is defined as the 90th percentile value (i.e. mean + 1.28 x standard deviation); and
- Upper Cut-off Limit (UCL) is defined as the 99th percentile value (i.e. mean + 2.33 x standard deviation).

Where there is insufficient data available to determine site specific IAC values, appropriate interim values will be adopted. Ongoing monitoring results will subsequently be used to refine the interim UAL value and to determine appropriate values for the mean and UCL.

E2 Baseline Data

Baseline data for the Groundwater Management Plan consists of various datasets. These include:

- Historical groundwater quality monitoring data (refer to **Section 2.5.1**); and
- Historical groundwater level data (refer to **Section 2.5.2**).

Baseline data on groundwater quality and levels for the Ravensworth Complex suitable for use in determining impact assessment criteria (also known as trigger values) were selected and analysed in the RC Groundwater Management Plan This data and associated analysis has been used in the subsequent revision as it is considered suitably representative of the baseline data.

E2.1 Historical Groundwater Quality

A graphical summary of the historical groundwater monitoring results are presented in **Section 2.2**. The results for pH and EC are summarised in **Table E2.1** for each target seam. For the purpose of groundwater quality and level analysis, Borehole P and SDH17/SDH18 are considered to provide continuous monitoring data based on their close proximity to each other, similar relative levels and termination within the former Cumnock underground mine workings.

Table E2.1 - Ravensworth Complex Historical Water Quality Results July 2008 – January 2018

Seam	Monitoring Bore	pH			Conductivity (µS/cm)		
		Min	Max	Mean	Min	Max	Mean
Pikes Gully	CS4641C	8.0	12.	9.8	6,620	9,060	7,812
	CS4539A	6.9	7.3	7.0	6,670	7,550	7,200
Liddell	Coffey Dam Borehole	8.8	10.0	9.5	2,840	3,790	3,065
	CS4545	7.2	11.0	10.7	7,700	11,340	8,444
	CS4545B Tall	7.0	7.6	7.1	10,980	12,830	12,006
Lemington	NPZ1 Tall	6.9	7.4	7.1	1,010	10,010	9,205
	NPZ2 Tall	8.1	8.5	8.3	8,820	9,840	9,510
Bayswater	NPZ7 Tall	7.2	7.6	7.4	4,400	9,140	7,086
Barrett	NPZ5B - P1	7.0	7.6	7.3	2,320	7,160	5,232
	NPZ6 Tall	7.3	7.9	7.6	1,740	7,350	6,322
Broonies	CS4545B	6.9	8.3	7.5	1,228	7,810	2,368
Alluvial	NPZ7 Small (Hunter)	7.2	7.6	7.5	1,154	8,540	6,577

E2.2 Groundwater Levels

Groundwater levels have been monitored around the Ravensworth mining operation since December 1999. The historical monitoring results from 2010 until 2021 are summarised in **Charts 2A** and **2B**.

Details of the monitoring locations, including target seams and depths to seams are provided in **Table E3.1**.

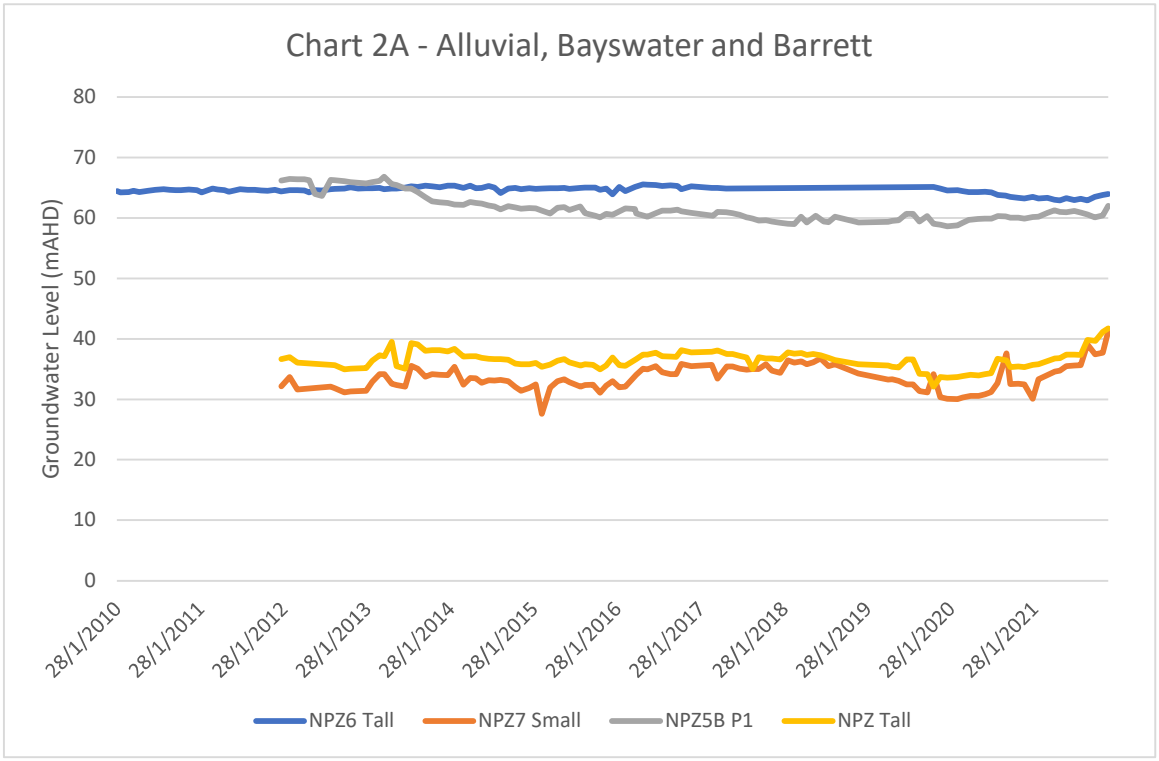


Chart 2A - Alluvial, Bayswater and Barrett
Groundwater Level (mAHD)
80
70
60
50
40
30
20
10
0
28/1/2010
28/1/2011
28/1/2012
28/1/2013
28/1/2014
28/1/2015
28/1/2016
28/1/2017
28/1/2018
28/1/2019
28/1/2020
28/1/2021
NPZ6 Tall
NPZ7 Small
NPZ5B P1
NPZ Tall

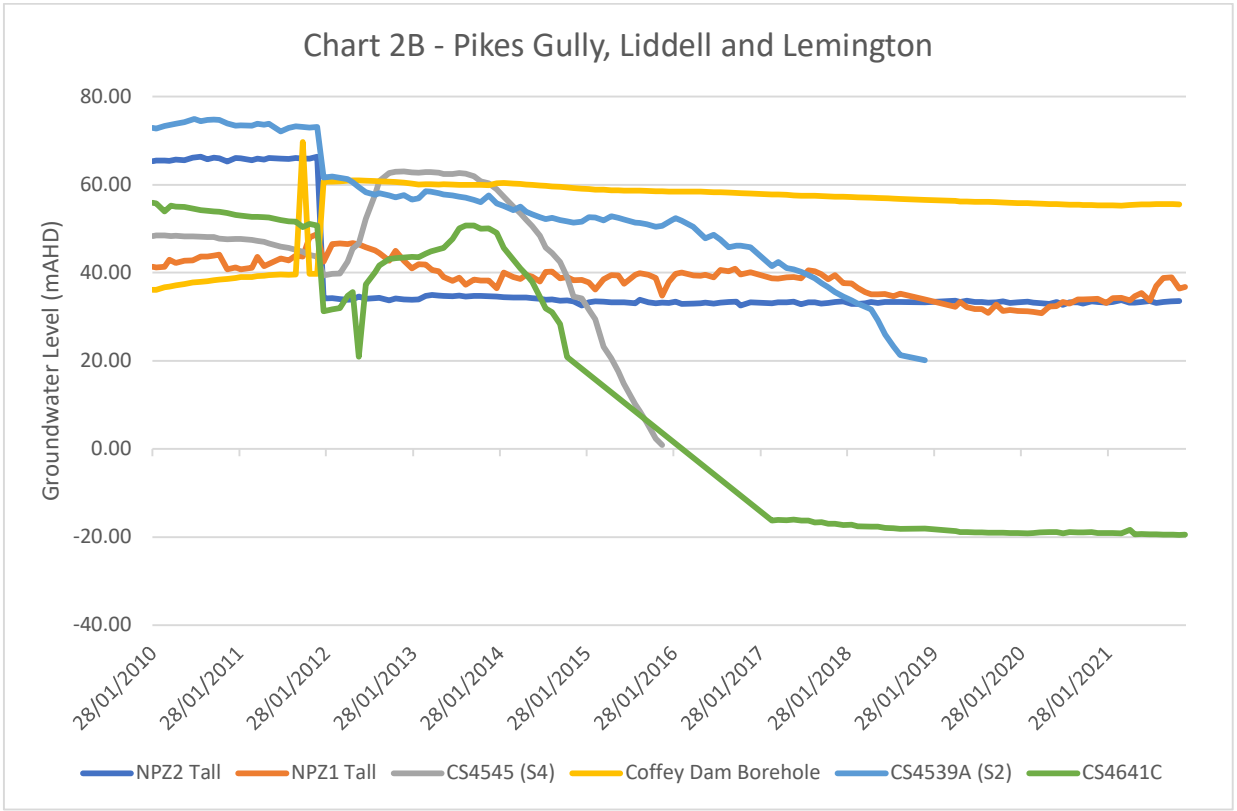


Chart 2B - Pikes Gully, Liddell and Lemington
Groundwater Level (mAHD)
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
28/01/2010
28/01/2011
28/01/2012
28/01/2013
28/01/2014
28/01/2015
28/01/2016
28/01/2017
28/01/2018
28/01/2019
28/01/2020
28/01/2021
NPZ2 Tall
NPZ1 Tall
CS4545 (S4)
Coffey Dam Borehole
CS4539A (S2)
CS4641C

E3 Monitoring Locations and Schedule

Details of the groundwater monitoring locations are presented in **Table E3.1**. **Table E3.2** outlines the monitoring frequency and the parameters measured at each location.

Table E3.1 Ravensworth Complex Groundwater Monitoring Locations

Piezometer ID	Measuring Device	Easting (MGA)	Northing (MGA)	Collar RL (mAHD)	Aquifer	Depth (m)	Stick Up (m)
Coffey Dam Borehole	Single standpipe	312953	6413510	100.4	Liddell	-	1.3
CS4641C	Single standpipe	313549	6410436	81.6	Lower Pikes Gully	154.5	0.6
CS4658	Vibrating wire	311860	6407655	123.9*	Bayswater Lemington LMH Lemington LMA Upper Pikes Gully Upper Arties Upper Liddell Lower Liddell Barrett	54.2 91.9 134.2 153.5 175.7 197.0 219.5 239.3	-
NPZ1	Multi standpipe	313562	6404972	91.4	Broonies Lemington	49.7 130	0.9 1.1
NPZ2	Multi standpipe	313315	6405816	100.9	Lemington	120	0.9
NPZ5B	Multi standpipe	314429	6410407	76	Alluvium Broonies	12 27	0.9 1.1
NPZ6	Single standpipe	314646	6409098	76.3	Broonies	70.0	0.2
NPZ7	Multi standpipe	315973	6404086	61.91	Alluvium Broonies Bayswater	22 53 80	-
RNVW1	Vibrating wire	313911	6403955	79.8*	Bayswater Lemington LMH Lemington LMA	48.0 68.0 109.0	-

Piezometer ID	Measuring Device	Easting (MGA)	Northing (MGA)	Collar RL (mAHD)	Aquifer	Depth (m)	Stick Up (m)
					Upper Pikes Gully	150.0	
					Upper Arties	190.0	
					Upper Liddell	240.0	
					Lower Liddell	270.0	
					Barrett	326.0	
RNVW2	Vibrating wire	313433	6405371	101.5*	Bayswater	-	-
					Lemington LMH	43.0	
					Lemington LMA	85.0	
					Upper Pikes Gully	140.0	
					Upper Arties	180.0	
					Upper Liddell	239.0	
					Lower Liddell	258.0	
					Barrett	305.0	
RNVW3	Vibrating wire	313433	6405371	89.9*	Bayswater	-	-
					Lemington LMH	-	
					Lemington LMA	61.0	
					Upper Pikes Gully	103.0	
					Upper Arties	143.0	
					Upper Liddell	180.0	
					Lower Liddell	210.0	
					Barrett	254.0	
RNVW4	Vibrating wire	314086	6411001	81.1*	Bayswater	-	-
					Lemington LMH	-	
					Lemington LMA	-	
					Upper Pikes Gully	101.5	

Piezometer ID	Measuring Device	Easting (MGA)	Northing (MGA)	Collar RL (mAHD)	Aquifer	Depth (m)	Stick Up (m)
					Upper Arties Upper Liddell Lower Liddell Barrett	114.0 163.0 200.5 225.0	
RNVW5	Vibrating wire	315322.500	6404122.500	62.310	Alluvium Unnamed Bayswater Lemington H Lemington A Upper Liddell Barrett	19 50 87 139 215 279 350	-
RNVW6	Vibrating wire	316452.900	6404230.700	60.120	Alluvium Unnamed Bayswater Lemington H Lemington A Upper Liddell Barrett	19 43 66 116 195 265 330	-
RNVW7	Vibrating wire	316569	6405112	70	Barrett	-	-
RNVW8	Vibrating wire	317171	6405576	63	Barrett	-	-
Borehole P	Single standpipe	313459	6410602	82.06	Liddell	130.4	0.3
WPP1	Single standpipe	311490	6413429	108	Lower Pikes Gully		-
WPP2	Single standpipe	311447	6413503	110	Lower Pikes Gully		-

Table E3.2 – Ravensworth Complex Groundwater Monitoring Schedule

Piezometer ID[1]	Water Level	pH	Electrical Conductivity (EC)	Speciation
Coffey Dam Borehole	Monthly	Quarterly	Quarterly	Annually
CS4658	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
CS4641C	Monthly	Quarterly	Quarterly	Annually
NPZ1	Monthly	Quarterly	Quarterly	Annually
NPZ2	Monthly	Quarterly	Quarterly	Annually
NPZ5B	Monthly	Quarterly	Quarterly	Annually
NPZ6	Monthly	Quarterly	Quarterly	Annually
NPZ7	Monthly	Quarterly	Quarterly	Annually
RNVW 1	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 2	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 3	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 4	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 5	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 6	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 7	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
RNVW 8	Every 12 hours	Not Sampled	Not Sampled	Not Sampled
Borehole P	Monthly	Not Sampled	Not Sampled	Not Sampled
WPP1	Monthly	Quarterly	Quarterly	Annually
WPP2	Monthly	Quarterly	Quarterly	Annually

Note 1: Refer to **Table 6.4** and **Figure 6.4.1** in WMP for monitoring locations.

Appendix F - Correspondence

Date	Stakeholder	Summary of Consultation	Ravensworth Contact
23/09/2013	NSW Office of Water (DPIE Water) Hemantha DeSilva	Copies of draft Bayswater Creek Remediation design report for consultation in accordance with Schedule 3 Condition 30 of PA 09_0176	Clinton Weatherall (Ravensworth Open Cut)
03/10/2013	Hemantha DeSilva (DPIE Water)	Email from DPIE Water stating that a specialist officer had been appointed to review the design	Clinton Weatherall (Ravensworth Open Cut)
17/10/2013	Hemantha DeSilva (DPIE Water)	Email to DPIE Water regarding the phone conference and when Ravensworth would receive feedback on the design	Clinton Weatherall (Ravensworth Open Cut)
25/10/2013	Hemantha DeSilva (DPIE Water)	Email received from DPIE Water with comments on the design report	Clinton Weatherall (Ravensworth Open Cut)
03/12/2013	Hemantha DeSilva (DPIE Water)	Submission to DPIE Water of the revised Bayswater Creek Design report and request for final comment on the design	Clinton Weatherall (Ravensworth Open Cut)
14/02/2014	Hemantha DeSilva (DPIE Water)	Resubmission of design report for final comment	Clinton Weatherall (Ravensworth Open Cut)
18/02/2014	Mitchell Isaacs (DPIE Water)	Approval of the Bayswater Creek Design report to satisfy Schedule 3 Condition 30 of PA 09_0176	Clinton Weatherall (Ravensworth Open Cut)
24/03/2014	Environment Protection Authority (EPA) Mitch Bennett	Draft copy of the BMP sent via letter and file transfer site, requesting comment back by 21/04/2014	Andrew Kelly (Ravensworth Complex)
24/03/2014	Department of Trade and Investment, Regional Infrastructure and Services (DRE) Monique Meyer	Draft copy of the BMP sent via letter and file transfer site, requesting comment back by 21/04/2014	Andrew Kelly (Ravensworth Complex)
24/03/2014	Hemantha DeSilva (DPIE Water)	Draft copy of the BMP sent via letter and file transfer site, requesting comment back by 21/04/2014	Andrew Kelly (Ravensworth Complex)
01/04/2014	DPIE Water, DRE and EPA	Email reminder to regulators requesting feedback on plan by 21 April 2014	Greg Newton (Ravensworth Open Cut)
01/04/2014	Cheryl Palmer (EPA)	Email to EPA with link to location of management plan	Greg Newton (Ravensworth Open Cut)

Date	Stakeholder	Summary of Consultation	Ravensworth Contact
02/04/2014	Bill George (EPA)	Letter received from EPA stating that EPA does not review management plans	Greg Newton (Ravensworth Open Cut)
02/04/2014	Bill George (EPA)	Email sent to EPA confirming which Management plans were being referred to in the letter dated 02/04/2014	Greg Newton (Ravensworth Open Cut)
09/04/2014	Bill George (EPA)	Email received from EPA confirming that the letter dated 02/04/2014 referred to all the management plans submitted to EPA	Greg Newton (Ravensworth Open Cut)
22/04/2014	Neil McElhinney (DRE)	Letter from DRE stating the plan satisfies components of the rehabilitation strategy in the approved Mining Operations Plan	Andrew Kelly (Ravensworth Complex)
28/07/2014	Department of Planning, Industry and Environment (DPIE) Ann Hagerthy	Email from DPIE stating the review of management plan is ongoing and undergoing a peer review	Andrew Kelly (Ravensworth Complex)
08/08/2014	Hermantha DeSilva (DPIE Water)	Email to DPIE Water confirming that interim repairs will be sufficient until the construction of the structure as detailed in the Bayswater Creek Design Report	Clinton Weatherall (Ravensworth Open Cut)
12/08/2014	Hemantha DeSilva (DPIE Water)	Email following up on telephone conference regarding the intention of the interim works	Clinton Weatherall (Ravensworth Open Cut)
22/08/2014	Hemantha DeSilva (DPIE Water)	Email from DPIE Water stating that controlled activity approval under the Water Management Act 200 is not required for the proposed activity.	Clinton Weatherall (Ravensworth Open Cut)
14/10/2014	Mitchell Isaacs (DPIE Water)	Email to DPIE Water with Interim Design works proposed and Remediation of Bayswater Creek Design report for approval and comment	Greg Newton (Ravensworth Open Cut)
29/10/2014	Mitchell Isaacs (DPIE Water)	Email following up phone call to see if Ravensworth needed to provide any other information to the review of designs	Greg Newton (Ravensworth Open Cut)
05/11/2014	Mitchell Isaacs (DPIE Water)	Letter from DPIE Water approving interim design and Bayswater Creek Design Report conditional upon large woody debris be consideration in final remediation in 2016	Greg Newton (Ravensworth Open Cut)
21/09/2017	DPIE	Final approval of management plan received	Environment and Community Coordinator
30/03/2020	DPIE	Final approval of management plan received	Environment and Community Manager

Newton, Greg (Ravensworth - Coal)

From: Mitchell Isaacs <Mitchell.Isaacs@water.nsw.gov.au>
Sent: Tuesday, 18 February 2014 3:13 PM
To: Weatherall, Clinton (Ravensworth - Coal); Hemantha Desilva; referrals
Cc: Kelly, Andrew (Ravensworth - Coal); Newton, Greg (Ravensworth - Coal)
Subject: Re: Meeting to discuss Bayswater Creek Remediation

Thanks Clinton

Following review of these plans the Office of Water is satisfied that the design is acceptable.

Please continue to liaise with Hemantha if you have any queries.

Regards
Mitchell

Mitchell Isaacs | Manager Strategic Stakeholder Liaison
Department of Primary Industries | NSW Office of Water
Level 11, 10 Valentine Ave Parramatta NSW 2124 | PO Box 3720 Parramatta NSW 2124
T: 02 8838 7529 | M: 0403 103 823 | E: mitchell.isaacs@water.nsw.gov.au
W: www.water.nsw.gov.au

>>> <Clinton.Weatherall@glencore.com.au> 14/02/2014 2:34 PM >>>
Hi Hemantha and Mitchell,

As discussed on the phone today, I have created another file transfer for the Bayswater Creek Remediation Project design drawings.

The file transfer can be accessed at:
https://nsw.xstratacoal.com.au/filexfer

The logon credenitals are:

File Area : 66885765
Password : uAORa@d%isF#0-8ww&2uaNBe$bAMWsM9

Can NSW Office of Water please review the design drawings and provide any required feedback.
Ravensworth and PB are more than happy to organise a round the table discussion to step NOW through the proposed works and designs.

Regards,
Clint Weatherall
Environment & Community Officer
Ravensworth Open Cut
Xstrata Coal

Direct: +61 2 6570 0784
Fax: +61 2 6570 0747
Mobile: +61 0417 062 858

Email: Clinton.Weatherall@glencore.com.au

1

NSW GOVERNMENT | Trade & Investment Resources & Energy

OUT14/12112
MCV13/1101

Andrew Kelly
Ravensworth Operations Pty Ltd.
PO Box 294
MUSWELLBROOK NSW 2330

Dear Andrew,

RE: Ravensworth Open Cut Water Management Plan, 12 January 2013

The NSW Trade & Investment - Division of Resources and Energy (DRE) acknowledges receipt of the **"Ravensworth Open Cut Water Management Plan" (WMP)** that was submitted on 24 March 2014.

DRE does not have regulatory authority to approve Environmental Protection Licence, water extraction and discharge volume aspects of the WMP. To satisfy the legal requirement of approving the Development Consent requirement of the WMP, DRE has determined that the WMP satisfies components of the intent of the rehabilitation strategy for the approved Mining Operations Plan (MOP).

DRE notes the reviewed WMP includes non-current information, such as proposed re-routing of electricity and road infrastructure, which has since been constructed. These have been described in the MOP approved 25 October 2013.

It is recommended that future amendment to the WMP references the intent of the rehabilitation management strategy is fulfilled by the MOP or equivalent at the time of amendment.

If you have any queries, please contact the undersigned on 4931 6522.

NEIL MCELHINNEY
Inspector Environment
Environmental Sustainability Unit
22 April 2014

CC
Ann Hagerthy – Department of Planning & Infrastructure

Mineral Resources – Environmental Sustainability Unit
PO Box 344 Hunter Region Mail Centre NSW 2310
516 High St MAITLAND NSW 2320
Tel: 02 4931 6666 Fax: 02 4931 6790 www.trade.nsw.gov.au **ABN 72189919072**

NSW EPA

Your reference:
Our reference: DOC13/94031-01, EF13/3485
Contact: Bill George 02 49056213
Electronic correspondence to: hunter.region@epa.nsw.gov.au

Ravensworth Operations Pty Limited
PO Box 294
MUSWELLBROOK NSW 2333

Attention: Mr Greg Newton

Dear Mr Newton

Ravensworth Mine Complex Management Plan

Thank you for forwarding the subject plan for our records.

The Environment Protection Authority (EPA) encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, the EPA does not review these documents as our role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies to achieve those objectives.

Should you have any questions please phone me on 02 4908 6821.

Yours sincerely

2.4.14

BILL GEORGE
A/Head Regional Operations Unit – Hunter
Environment Protection Authority

PO Box 488G Newcastle NSW 2300
Email: hunter.region@epa.nsw.gov.au
117 Bull Street Newcastle West NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 43 692 285 758
www.epa.nsw.gov.au

Department of Primary Industries
Office of Water

Contact Rohan Macdonald
Phone 02 4904 2642
Email rohan.macdonald@water.nsw.gov.au

Our ref ER20492
Your ref SSD 5156

Greg Newton
Environment and Community Coordinator
Ravensworth Open Cut
By email: Greg.Newton@glencore.com.au

Dear Greg

Remediation of Bayswater Creek Diversion
Review of design report and interim measures for creek drop structure

I refer to your request for review of the Remediation of Bayswater Creek Diversion Design Report and SLR Drop Structure Design 2014. The Office of Water is generally satisfied with the proposed measures to rehabilitate the Bayswater Creek diversion and interim measures to stabilise the drop structure.

With respect to long-term rehabilitation, the section from chainage 2700 – 4200 would benefit from installation of large woody debris (LWD) controls. These structures have been installed in a range of watercourses in the Hunter Valley, including high energy, gravel-bed streams such as the Williams and Hunter Rivers.

Any use of LWD should consider following the procedures outlined by Brooks et al:

Brooks A, Brierley G (2002) Mediated equilibrium: the influence of riparian vegetation and wood on long term character and behaviour of a near pristine river. Earth Surface Processes and Landforms 27: 343-367.

Brooks A, Brierley G (2004) Framing realistic river rehabilitation targets in light of altered sediment supply and transport relationships: lessons from East Gippsland, Australia. Geomorphology 51: 7-29.

Brooks, A. P., Abbe, T. B., Jansen, J. D., Taylor, M. & Gippel, C. J. (2001). Putting the wood back into our rivers: an experiment in river rehabilitation. In I. Rutherford, F. Sheldon, G. Brierley & C. Kenyon (Eds.), Proceedings of the Third Australian Stream Management Conference: the Value of Healthy Streams (pp. 1-8). Clayton, Australia: Cooperative Research Centre for Catchment Hydrology.

Brooks A, Howell T, Abbe T, Arthrington A (2006). Confronting hysteresis: Wood based river rehabilitation in highly altered landscapes of South Eastern Australia. Geomorphology 79: 395-422.

The Office of Water recommends consideration of the above prior to finalisation of the design and commencement of works in 2016.

Yours sincerely

Mitchell Isaacs
Manager Strategic Stakeholder Liaison
5 November 2014

Level 3, 26 Honeysuckle Drive, Newcastle NSW 2300 | PO Box 2213 Dangar NSW 2309
t (02) 4904 2500 | **f** (02) 4904 2503 | **www.water.nsw.gov.au**

NSW GOVERNMENT Planning & Environment

Contact: Ann Hagerthy
Phone: 6575 3403
Fax: 6575 3415
Email: ann.hagerthy@planning.nsw.gov.au
Our ref: MP 09_0176
DA 104/96

Andrew Kelly
Environment and Community, Complex Manager
Ravensworth Operations Pty Limited
PO Box 294
MUSWELLBROOK NSW 2333

Dear Andrew,

Ravensworth Complex – Approval of Ravensworth Complex Water Management Plan

Thank you for forwarding the Ravensworth Complex Water Management Plan to the Department of Planning & Environment (the Department or DP&E), as required by Condition 31, Schedule 3 of MP 09_0176.

The Department has conducted a review and wishes to advise that the Secretary has approved the Ravensworth Complex Water Management Plan (Version 4.0, dated 24 November 2014).

The Department requests that you place the approved plan, along with a copy of this letter, on your website in accordance with Condition 10, Schedule 5 of MP 09_0176.

If you require further information please do not hesitate to contact Ann Hagerthy on 6575 3403 or ann.hagerthy@planning.nsw.gov.au.

Yours sincerely,

Scott Brooks
Team Leader Compliance
26-11-2014
As nominee for the Secretary

Singleton Office: P.O. Box 3145, Suite 14, Level 1, 1 Civic Avenue Singleton NSW 2330
Website: www.planning.nsw.gov.au

Planning, Industry & Environment

Klay Marchant
Environment and Community Manager
Ravensworth Complex
PO Box 294
MUSWELLBROOK NSW 2333

30/03/2020

Dear Mr Marchant

Ravensworth Operations Project (MP 09_0176)
Revised Water Management Plan

I refer to the revised Water Management Plan which was submitted to the Department for approval in accordance with Condition 31 of Schedule 3 of the consent for the Ravensworth Operations Project (MP 09_0176).

The Department has carefully reviewed the document and is satisfied that it adequately addresses the relevant consent conditions. Therefore, the Secretary has approved the plan.

Please ensure that the approved plan is placed on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Caleb Ferry at caleb.ferry@planning.nsw.gov.au.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Appendix G - Remediation of Bayswater Creek Diversion Design Report – February 2014

Ravensworth Complex can provide access to a copy of the Remediation of Bayswater Creek Diversion Design Report upon request.

Appendix H - Interim Design Bayswater Creek Drop Structure