EXTRACTS FOR DPI-WATER

2. RESPONSES TO ISSUES RAISED ABOUT THE AMENDED PROJECT

2.16 GROUNDWATER

2.16.4 Groundwater Controls

2.16.4.1 Representative Comment(s)

In addition to proposed monitoring the proponent should include detailed monitoring in the proposed "Water Management Plan" within the area of the intersection of the main pit and the alluvium. Should water quality levels exceed threshold values, and this is determined to be a long term trend, mitigation through the installation of a Low Permeability Barrier wall would be required.

Department of Primary Industry - Water – Page 2

Response

A Water Management Plan would be prepared for the mine after development consent is granted. The existing monitoring bores GR-P1, P2, P3, P10 and P11 (see **Figure 2.16.1**), which would remain unaffected by mining activity and accessible throughout the life of the amended Project, would serve to monitor for any drawdown in the alluvium beyond what is predicted. The monitoring of groundwater levels over groundwater quality is preferred in this instance, as a groundwater level response would be observed well before a water quality change.

If the observed drawdown is substantially greater in the alluvium than what is predicted, consideration would be given to installing a low permeability barrier to minimise direct groundwater inflow from the Quaternary alluvium to the open pits. However, the reduction in seepage mitigated through such a barrier is highly likely to be small and relatively insignificant when compared to the overall seepage to the open cut pits. The volume of groundwater potentially saved through the installation of a barrier wall is likely to be comparable to the water supply requirements during construction of such a barrier and therefore the feasibility and benefits of the installation of such a barrier would need to be carefully considered prior to implementation.

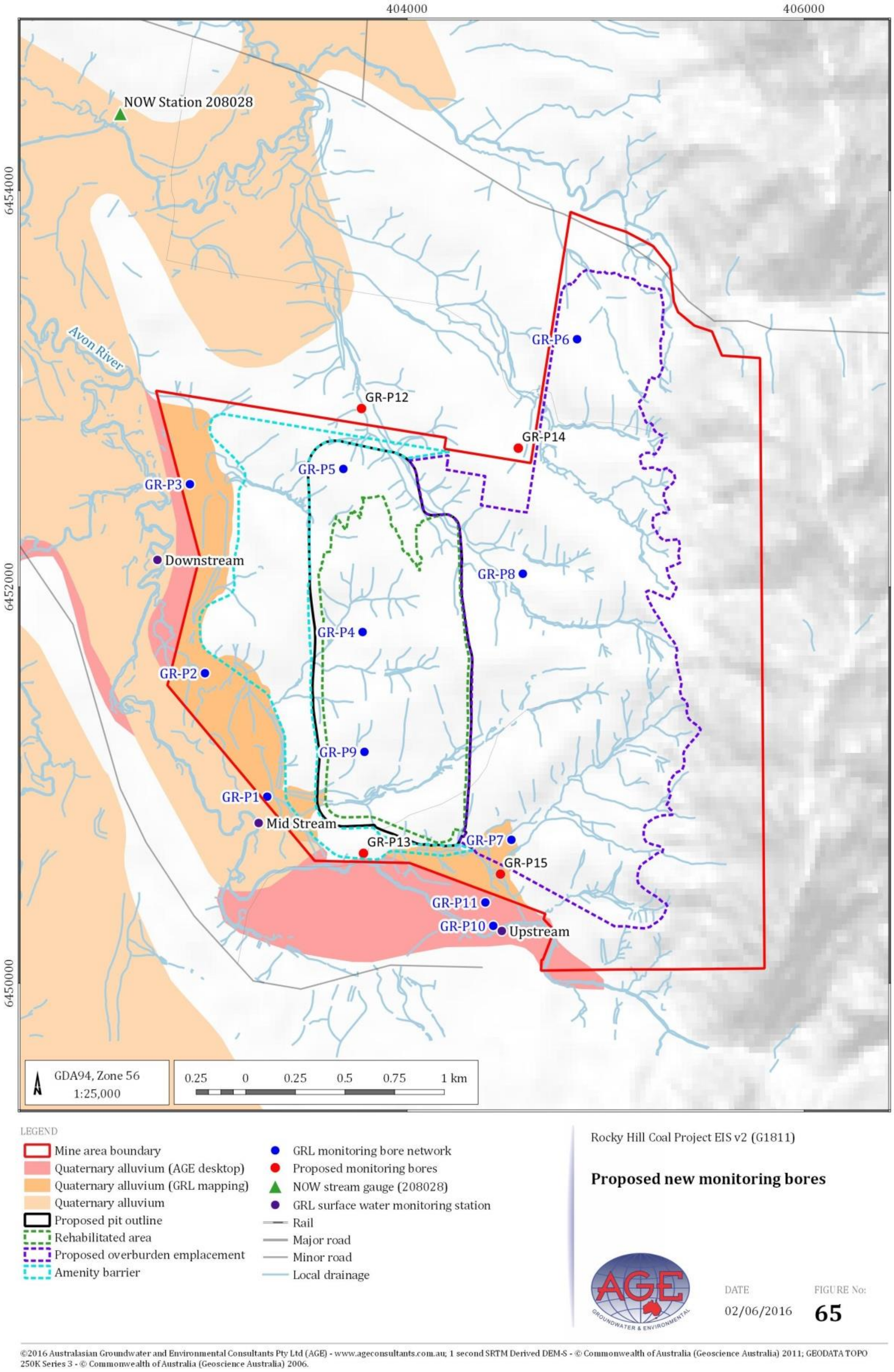

Figure 2.16.1 Proposed Groundwater Monitoring Bores

(From AGE (2016) Figure 65)

2.16.7 Licencing

2.16.7.1 Representative Comment(s)

The proponent has not sufficiently demonstrated ability to obtain sufficient groundwater entitlement to account for a maximum take of 1100ML/yr. The proponent should provide further information or modification to reduce the take of water. This should include an analysis of groundwater entitlement requirements already approved under Yancoal's other operations (including timing of maximum predicted take) as well as analysis around the carryover rules of the Water Sharing Plan.

Department of Primary Industry - Water – Page 2

The proponent should obtain a minimum of 1100 unit shares in the Water Sharing Plan for the Gloucester Basin Groundwater Source to offset inflows to the mine pit prior to commencement.

Department of Primary Industry - Water – Page 3

The EIS discusses the proponent's ability to account for an average loss of alluvium of 100ML/yr but the licensing strategy should be based around the proponent's ability to account for its maximum take, which is predicted to be 193ML/yr. The proponent currently holds unregulated river entitlement of 267 units within the Avon River Water Source. The proponent will be required to undertake a dealing to convert sufficient entitlement from its currently held unregulated river licences to aquifer category to account for the maximum predicted take of 193ML/yr within the alluvial aquifer.

Department of Primary Industry - Water – Page 2

The proponent should retain a minimum of 193 unit shares in the Lower North Coast Unregulated and Alluvial Water Sources Water Sharing Plan to offset reductions in flows to the Quaternary Alluvium.

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Response

The Groundwater Assessment (Section 4.2.1) records that GRL holds sufficient entitlements (267ML/year) to take water from the alluvium to account for the maximum groundwater inflow rate of 193ML/yr that was predicted to occur in Year 11 of operation. It is noted that this inflow rate was calculated based upon the maximum daily inflow rate of 0.53ML/day that had been calculated for quarterly inflows and then annualised. Since the Groundwater Assessment was prepared and, in response to the matters raised in submissions, AGE has recalculated the annual inflow rate for each year of mining. The predicted annual inflow volumes are presented in **Table 2.16.1**. This data shows that the maximum annual predicted volume of groundwater take from the alluvium is predicted to be 181 ML in Year 11.

Table 2.16.1
Predicted Annual Inflows from Alluvium

Year	Predicted Annual Alluvial Take (ML)
1	8.1
2	38.3
3	44.4
4	53.0
5	64.0
6	76.2
7	88.8
8	165.7
9	160.5
10	153.0
11	181.1
12	166.7
13	120.9
14	108.9
15	94.0
16	77.8

Inflow rates during other years would vary from 8.1ML (Year 1) to 77.8ML (Year 16). Therefore, the reported rate of 193ML/yr in the Groundwater Assessment that was predicted to occur in Year 11 of operations is considered conservative and overestimates the likely annual take from the alluvium. These entitlements held by GRL would be progressively converted from the currently held unregulated river licences to aquifer category. This conversion would be carried out under Part 12 Clause 71 of the *Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources 2009* which permits the conversion of an unregulated river access licence to an aquifer access licence.

It is acknowledged that GRL currently does not hold any licences under the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (North Coast WSP). However, as stated in Section 14.2 of the Groundwater Assessment, GRL is confident of being able to obtain sufficient licences to cover the predicted take of groundwater from the Permian water source. GRL would ensure that appropriate water licences are progressively sought and held for all stages of the amended Project in accordance with the relevant conditions of the development consent for the amended Project, the provisions of the *Water Management Act 2000* and the North Coast WSP.

In this regard, an agreement has been formulated between Yancoal Australia Limited (Yancoal) and Gloucester Resources Limited (GRL) which, subject to availability, provides for the transfer of surplus water access licence entitlements from Yancoal to GRL on an annual basis.

GRL has established through a search through DPI-Water for the Gloucester Basin Water Source defined within the North Coast WSP that there is a total of 1981ML entitlements within the Gloucester Basin with the following individual entitlements.

- AGL Upstream Investments Pty Ltd – 125 units[1]
- CIM Stratford / Stratford Coal Pty Ltd – 1 431 units
- CIM Duralie Pty Ltd – 300 units
- Private Parties – 75 units
- Community Water Suppliers – 50 units

Therefore, in total, Yancoal holds 1 731 units of entitlements (i.e. 1 731ML). It is also noted that GRL has negotiated the transfer of 20 units from AGL Upstream Investments Pty Ltd to GRL following receipt by AGL of a notice from Division of Resources and Geoscience to the effect that is satisfied with the rehabilitation of AGL's Waukivory Project.

In light of the above quantity of entitlements held by Yancoal, GRL commissioned AGE Consultants Pty Ltd to review the level of groundwater inflow likely to occur from the Permian water source at both the Stratford Mining Complex and the Duralie Mine to identify the extent of surplus water access licence entitlements that could be purchased from Yancoal, and compare those to the predicted inflows of Permian groundwater at the Rocky Hill Mine Area.

Stratford Mining Complex

For the Stratford Mining Complex, the latest publicly available groundwater assessment for the site is provided in a report by Heritage Computing (2012)[2]. Section A5.3 of this report documents the predicted pit inflows since mining commenced in 2003 (Figure A-47 – reproduced as **Figure 2.16.2**) with the average and maximum inflow rates listed in Table A-19 (reproduced as **Table 2.16.2**). The combined pit inflows (Heritage Computing (2012) Figure A-48 – reproduced as **Figure 2.16.3**) are predicted to peak around 1.3ML/day (475ML/yr between 2014 and 2020), with a minimum of about 0.7ML/day (256ML/yr between 2020 to 2025) at the end of the Stratford Extension Project. Section A5.7 of Heritage Computing (2012) states that the long term post-mining inflow rate to the combined pits is predicted to be 0.9 ML/day (328 ML/yr).

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1 Investigations conducted by GRL since conducting the search through DPI-Water have revealed that the actual number of units held by AGL Upstream Investments Pty Ltd is in fact 65 units.

2 Heritage Computing (2012), *"A Hydrogeological Assessment in Support of the Stratford Coal Project Environmental Impact Statement for Stratford Coal Pty Ltd"*, by Heritage Computing Pty Ltd Project Number: GCL-10-12 Report HC2012/2

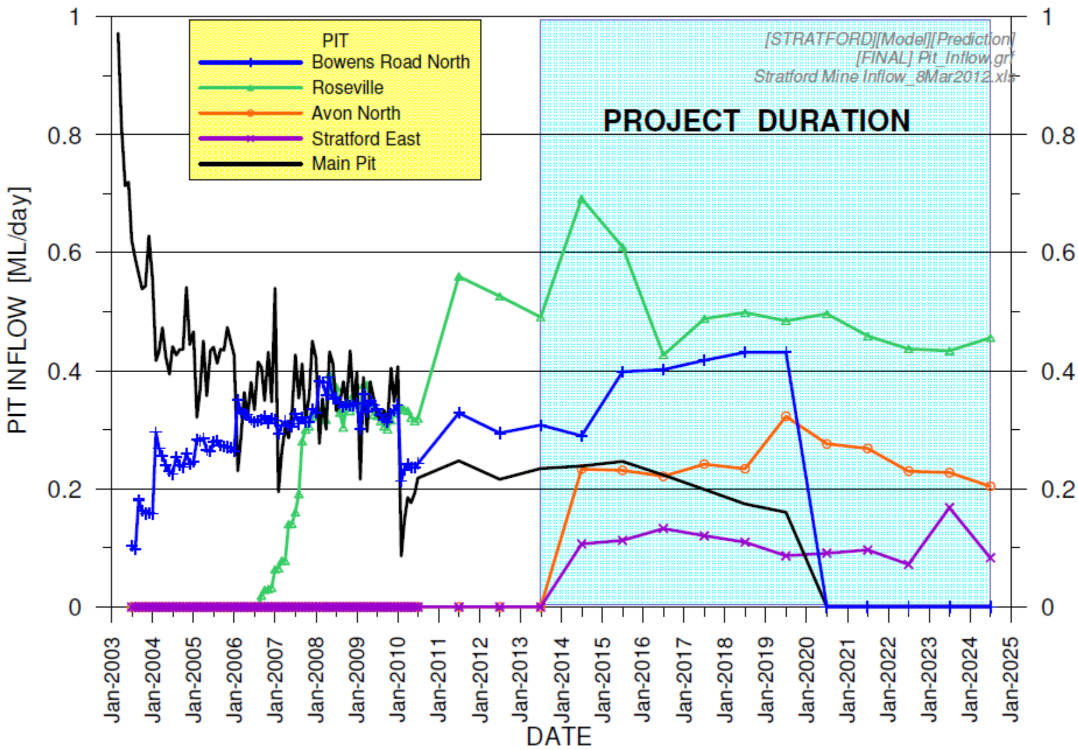


Figure 2.16.2 Simulated Groundwater Inflow to the Stratford Pits

Table 2.16.2
Predicted Pit Inflows – Stratford Extension Project

Pit	Project Average (ML/day)	Project Maximum (ML/day)
Bowen Road North Open Cut	0.22	0.43
Roseville West Pit Extension	0.50	0.69
Avon North Open Cut	0.25	0.32
Stratford East Open Cut	0.11	0.17
Stratford Main Pit	0.11	0.25

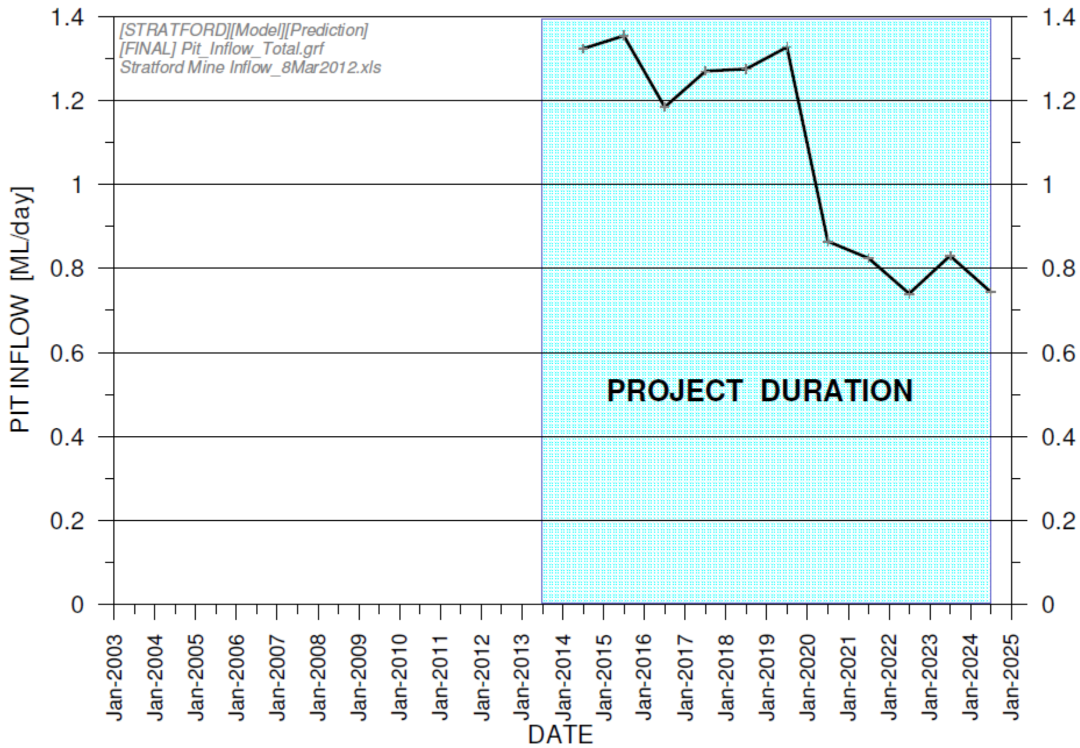


Figure 2.16.3 Simulated Total Groundwater Inflow to Bowens Road North, Roseville, Avon North and Stratford East Pits during the Stratford Extension Project

Duralie

For the Duralie Mine, the latest publicly available groundwater assessment for the site is provided by HydroSimulations (2014)[3]. Section 5.3 of HydroSimulations (2014) documents the predicted pit inflows and Table 5.3 (reproduced as **Table 2.16.3**) present these as annual totals. Total pit inflows range between 204ML/yr and 252ML/yr.

Table 2.16.3
Duralie Mine – Predicted Annual Pit Inflows

Year	Total Pit Inflow (ML/a)	Weismantel Inflow (ML/a)	Clareval Inflow (ML/a)
2013-14	230	172	58
2014-15	206	136	71
2015-16	206	70	136
2016-17	244	47	197
2017-18	252	104	148
2018-19	204	142	62

Source: Table 5.3 in HydroSimulations (2014) "Duralie Coal Mine Extension Project Modification Groundwater Assessment for Duralie Coal Pty Ltd" by HydroSimulations. Project number YAN001. Report HC2014/013

HydroSimulations (2014) Figure 5-7 – reproduced as **Figure 2.16.4** shows that the post-mining pit inflow rates at Duralie are predicted to be between 0.55 ML/day (200 ML/yr) following the cessation of coal extraction and 0.5 ML/day (182 ML/yr) some 10 years post closure.

[3] HydroSimulations (2014), *"Duralie Coal Mine Extension Project Modification Groundwater Assessment for Duralie Coal Pty Ltd"*, by HydroSimulations, Project number YAN001. Report HC2014/013

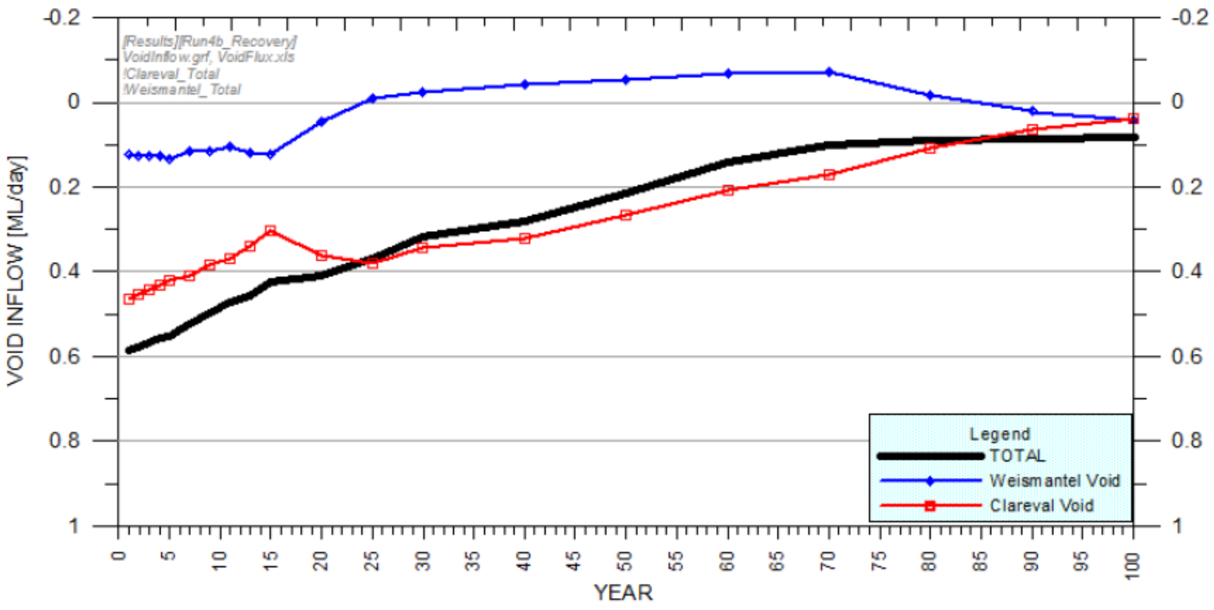


Figure 2.16.4 Simulated Groundwater Discharge to the Two Final Voids at Duralie Mine

Combined Predicted Inflows

Table 2.16.4 provides a summary of the predicted groundwater take for each of the Stratford Mining Complex and Duralie Mine and the amended Rocky Hill Coal Project. The combined licensed volumes are also provided together with the total of the surplus entitlements held by Yancoal based on the model predictions.

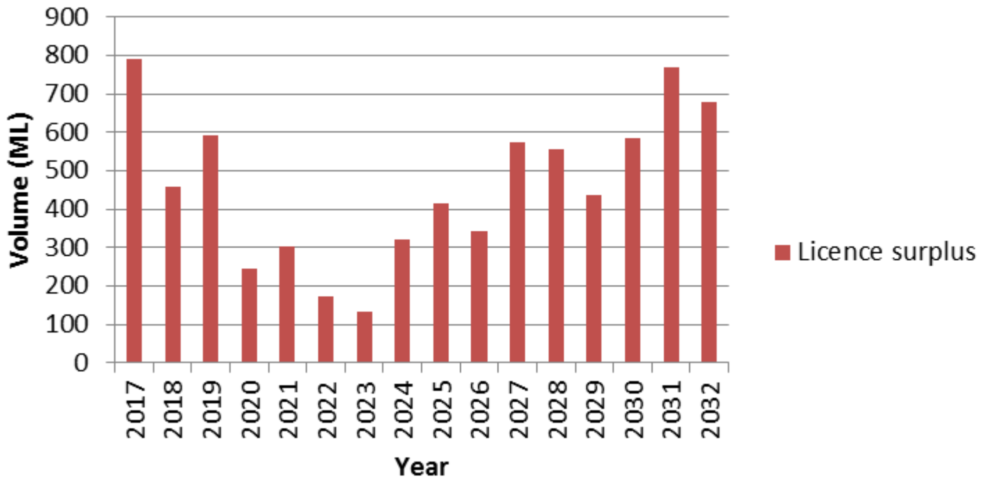
Table 2.16.4
Predicted Surplus of Water Access Licence Entitlements (ML)

Year	Duralie Inflow	Duralie Licensed	Duralie Surplus	Stratford Inflow	Stratford Licensed	Stratford Surplus	Yancoal Surplus	Rocky Hill*	Licence Surplus
2013		300	300	0	1 431	1 431	1 731	0	1 731
2014	230	300	70	482	1 431	949	1 019	0	1 019
2015	206	300	94	496	1 431	935	1 029	0	1 029
2016	206	300	94	431	1 431	1 000	1 094	0	1 094
2017	244	300	56	464	1 431	967	1 023	231	792
2018	252	300	48	467	1 431	964	1 012	553	458
2019	204	300	96	482	1 431	949	1 045	455	590
2020	200	300	100	314	1 431	1 117	1 217	971	246
2021	199	300	102	299	1 431	1 132	1 234	931	303
2022	197	300	103	270	1 431	1 161	1 264	1 090	174
2023	196	300	105	303	1 431	1 128	1 233	1 100	133
2024	194	300	106	274	1 431	1 157	1 263	942	321
2025	193	300	108	329	1 431	1 103	1 210	794	416
2026	191	300	109	329	1 431	1 103	1 212	869	343
2027	190	300	111	329	1 431	1 103	1 213	640	573
2028	188	300	112	329	1 431	1 103	1 215	658	557
2029	187	300	114	329	1 431	1 103	1 216	779	437
2030	185	300	115	329	1 431	1 103	1 218	634	584
2031	184	300	117	329	1 431	1 103	1 219	450	769
2032	182	300	118	329	1 431	1 103	1 221	542	679

* Source: EIS Figure 4.38

Surplus Water Access Licence Entitlements

When the predicted annual Permian groundwater inflows for the amended Project is included (source: EIS Figure 4.38) there would still likely be a surplus of water entitlements in the system (see **Figure 2.16.5**).



Source: AGE Consultants

Figure 2.16.5 Licence Surplus

It is GRL's intention to access water licence entitlements[4] which are in excess of Yancoal's demand in any year from Yancoal in accordance with the agreement between the two companies. The entitlements purchased would reflect the revised predicted inflows within the Rocky Hill Mine Area from the Permian groundwater source obtained through ongoing groundwater monitoring and modelling pursuant to the Water Management Plan, particularly given that AGE Consultants maintains that the predicted inflows derived through the modelling for the amended Project and listed in **Table 2.16.4** are conservative. The model would be reviewed and updated as necessary to reflect measured inflows so that, at all times sufficient entitlements are held.

Based upon the above, the requirements of the DPE and DPI-Water have been satisfied with respect to the water licencing required for the amended Project.

[4] The transfer of the licences held by Yancoal under the *Water Act 1912* are still in the process of being transferred as Water Access Licences under the *Water Management Act 2000*.

2.29 SURFACE WATER

2.29.1 General

2.29.1.1 Representative Comment(s)

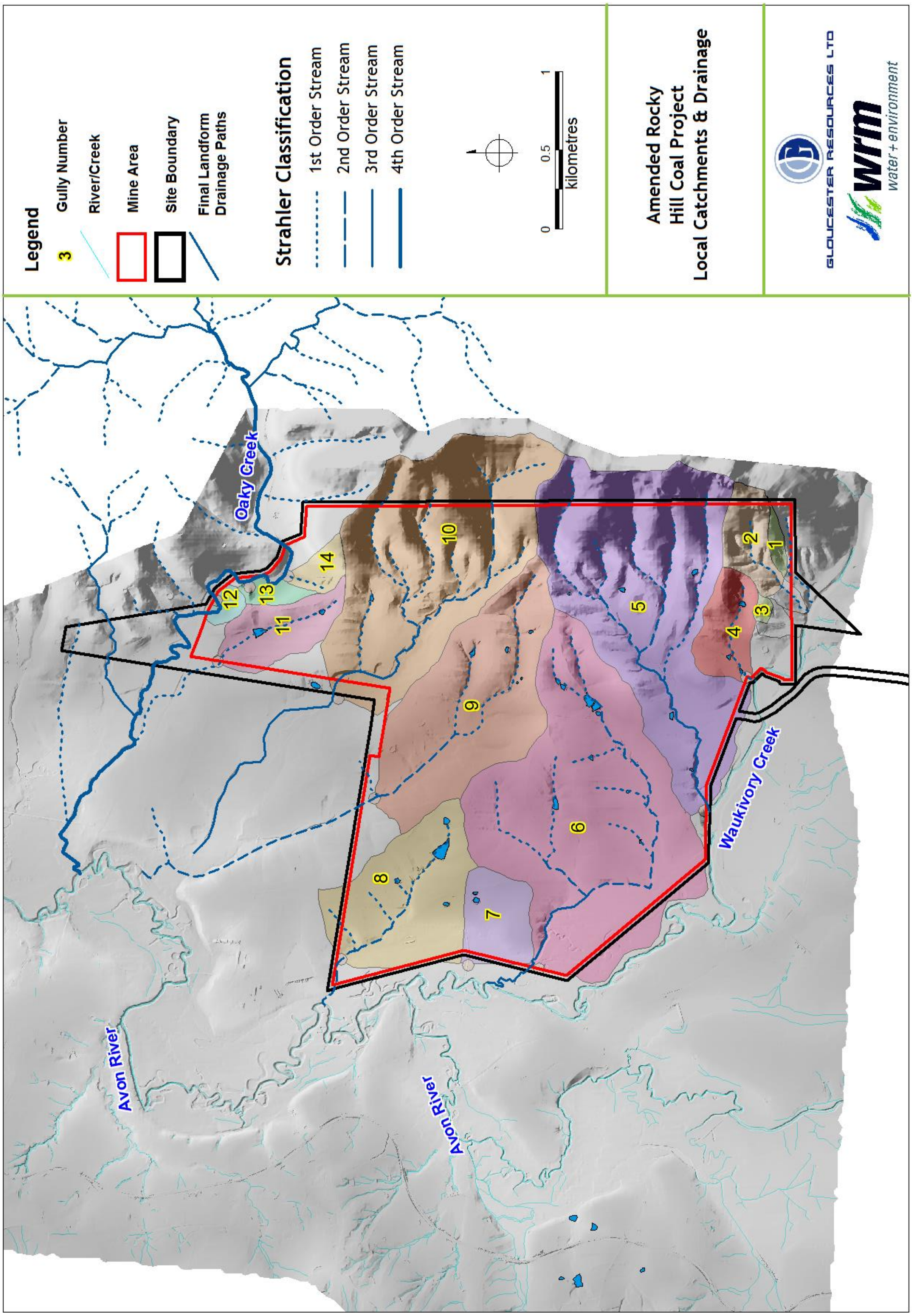
The EIS incorrectly identifies Oaky Creek from the mine area to its confluence with Avon River as a 3rd order stream, whereas at this location Oaky Creek is a 4th order stream. The proponent should amend the EIS to accurately reflect this stream order.

Department of Primary Industry - Water – Page 2

Response

WRM agrees that Oaky Creek is a fourth order stream from its confluence with the Avon River, upstream to a point about 1.6km upstream of the mine area. Though this was correctly shown in the SWA (Figure 2.20), the text incorrectly referred to Oaky Creek as a third order stream.

Figure 2.29.1 shows the stream order map revised using the latest topographic maps available via the NSW Government Spatial Services' Six Map Viewer, which were not available when the SWA was originally prepared.



Projection: MGA Zone Datum: GDA 94

Figure 2.29.1 Revised Strahler Classifications

2.29.2 Downstream Flows

2.29.2.1 Representative Comment(s)

Total catchment losses in the Avon River associated with the project are predicted to result in an increase in cease to flow conditions from 13.9% of the time to 16.8% of the time. The EIS concludes that this could increase the likelihood that cease-to-pump requirements are invoked more frequently. The analysis of possible impacts on reduced flows on water users (including licensed and basic landholder right users) within the water source should be improved. The proponent should provide further detail on the impact on these users, including any reduction, mitigation or compensatory measures proposed.

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Response

In respect of the report of Dr Richard Evans in the Gloucester Water Study Project (2014)[5] referred to by Groundswell Gloucester in its submission, we note that Dr Evans in that report states:

> *"Exactly how accurate the gauge is at these very low flows (0.01 and 0.1ML/day), may account for differences between the gauge data and observations by some community members that the Avon River ceases to flow in most years. Other causes of these differences may be the location within the catchment of the observations (i.e. generally there is less flow further up the catchment). Under very low flow conditions, it is possible that the river may flow in the alluvial sediments in the upper catchment (i.e. subsurface flow but no surface flow) but then discharge lower in along the catchment due to changing bed levels and/or increased baseflow contribution."*

Evans (2014) discusses the accuracy of the gauge and states that there may be differences between the gauge data and observations by some community members. Evans (2014) also provides several reasons why these differences may occur. The locations of these observations are not stated in Evans (2014), but Evans speculates that some may have been made in the upper reaches of the Avon River, where flows are more intermittent.

The Department of Primary Industry – Water notes that 20 gaugings were undertaken at the Avon D/S Waukivory gauge between 19/04/2005 and 04/11/2016. The plot in **Figure 2.29.2** compares the rating curve to flow and water level measurements undertaken for the gaugings. The flow control comprises a rock bar/willow 200m downstream of the gauge. The cross-section was surveyed in 2009, and a check survey undertaken in December 2015.

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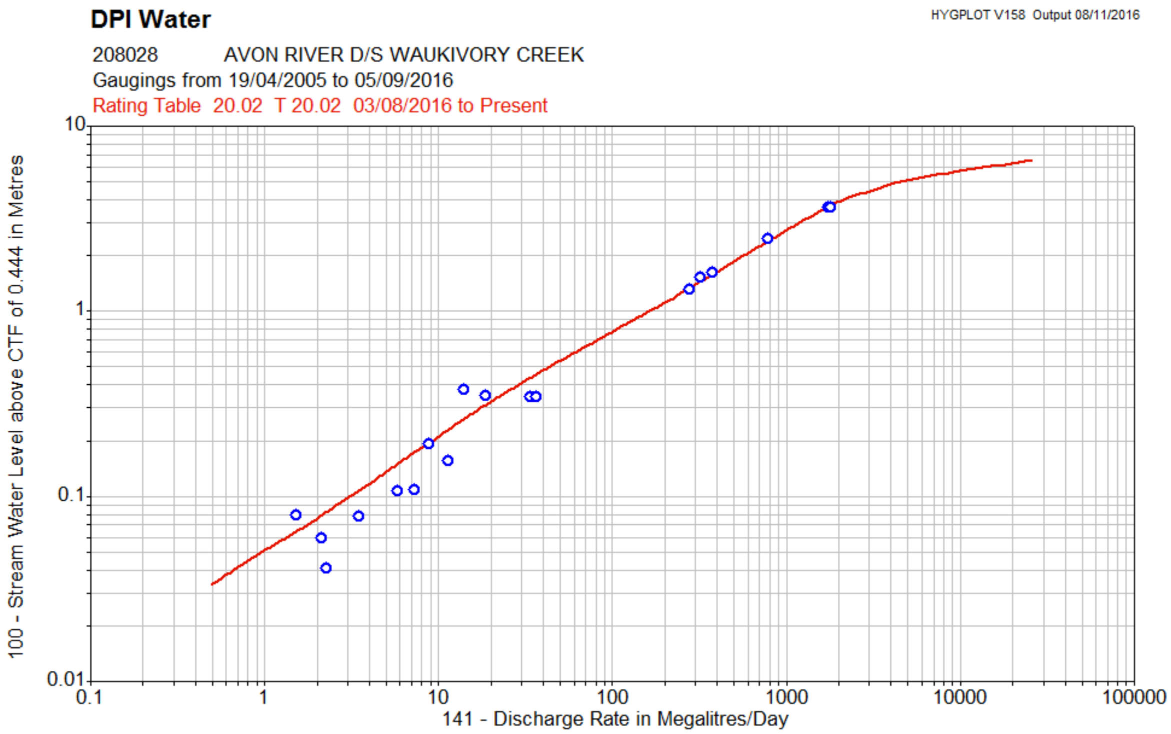
[5] Evans R. (2014), *Gloucester Water Study Project – Independent Peer Review*, Jacobs SKM, 6 June 2014



source: DPI Water

Figure 2.29.2 Comparison Plot of Gaugings and Latest Ratings

Figure 2.29.2 shows the rating curve underestimates the gauged flow in six of the seven gaugings undertaken at flows between 1.5ML/day and 10ML/d. As there is no evidence to suggest either the cross-section survey or gaugings are unreliable, it seems unlikely that the flow record overestimates streamflow in low flows between 1.5ML/day and 10ML/day. In fact, it suggests that the flow record underestimates low flows at the gauge by as much as 1ML/day.

Given the lack of gauging of flows less than 1.5ML/day, the accuracy of the gauge record over this range of very low flows cannot be directly verified without further field measurements at such times. However, the low flow portions of the recorded water level hydrograph show typical recession shapes, consistent with the slow decline of flow over time. This is inconsistent with cessation of flow at the gauge, which would be expected to result in sudden steepening of the recession curve as soon as (mostly evaporative) losses from the upstream pool exceeded inflows. However, as Evans notes, it is entirely possible that flow could cease in other locations, depending on the proximity of sources of recharge, the amount of sub-surface flow, and in particular extraction of water by nearby irrigators (see Section 2.29.2.2 of this document for additional discussion regarding downstream irrigators). As mentioned above, while the locations of reported observations of “no flow” are unknown, Evans speculated that some may have been made in the upper reaches of the Avon River, where flows are more intermittent.

It should be noted that inaccuracies in the low flow gauge data are unlikely to significantly affect the estimate of the change in duration of cease to flow periods caused by the amended Project. This is because it is the shape of the receding limb of the observed flow hydrograph (which would be largely unchanged by small changes to the rating curve) which is important. Also, the change in the rating curve would affect both the pre-mine and post-mine flows.

To illustrate this, the impact assessment was repeated after reducing all flows less than 10ML/day by 1ML/day. The results are presented in **Figure 2.29.3**, which compares the results shown in Figure 4.16 of the SWA to the results using the adjusted flows. The revised results show the impact of the amended Project on the frequency of very low flows would be minimal (frequency of 1ML/day flows reduced from 80% to 78% of time compared with (82% to 80% in the original analysis). The frequency of flow days with less than 0.01ML/day would increase from 17.6% of the time to 19.7% of the time (compared with of 13.9% of the time to 16.8% of the time).

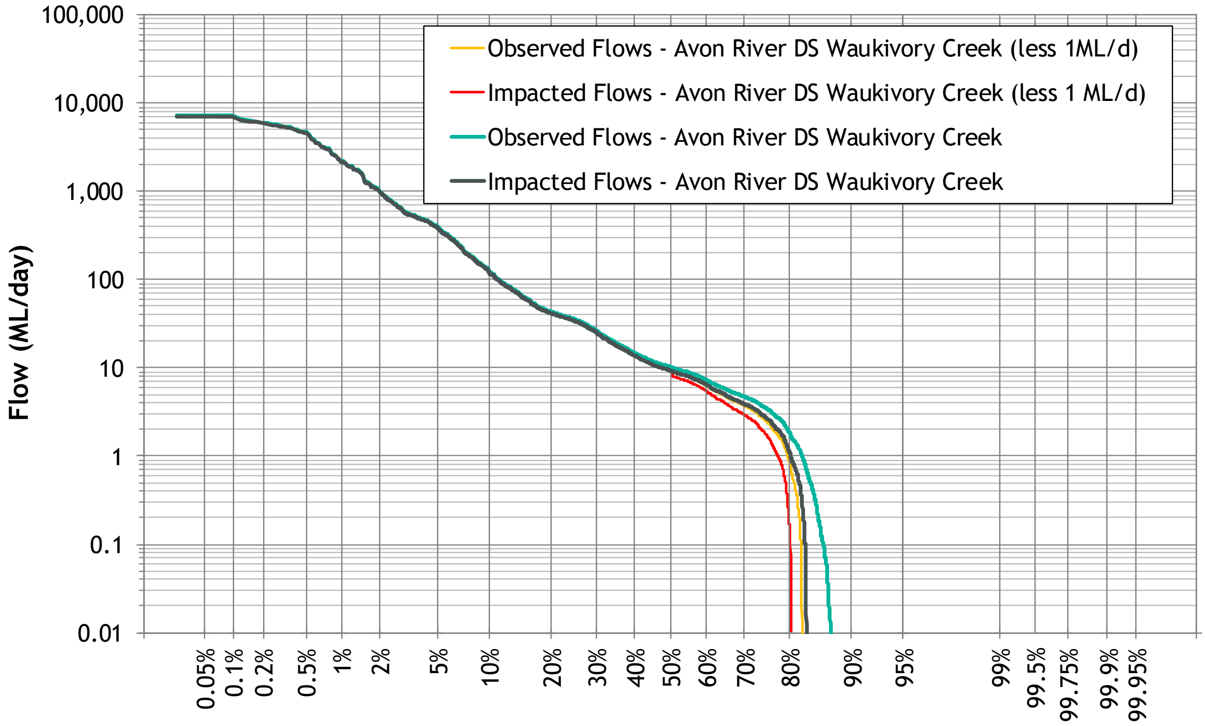


Figure 2.29.3 Percentage of Days Flow is Equalled or Exceeded

It is noted that the predicted reductions in stream flows attributable to the amended Project are conservative given the assumptions documented in the SWA (Section 4.9), namely:

- areas intercepted by the saline water zone are the maximum areas over the mine life;
- treated water releases are excluded from the assessment;
- changes to runoff characteristics from the Dirty Water Zone are the maximum predicted over the mine life; and
- the predicted baseflow losses would occur in Waukivory Creek (as this is where most of the affected alluvium is located), and would affect all downstream reaches.

GRL proposes to mitigate the impacts of the amended Project on downstream water users during periods of low flow by releasing treated water from the treatment plant to the receiving waters, when treated water is available and subject to compliance with any relevant conditions of the environment protection licence applicable to the Site and the provisions of the *Protection of the Environment Operations Act 1997* (instead of restricting releases to periods of high flow as proposed in the 2016 EIS) (see the introduction to Section 2.29.4.10 of this document regarding GRL's commitment to releasing treated water to the Avon River). It is also possible that during the extended dry periods that GRL's lessee could reduce the quantity of water pumped from the Avon River through his licences if he is able to rely upon the water from the treatment plant.

2.29.4 Saline Water Treatment, Use and Salt Disposal

Saline Water Treatment

2.29.4.1 Representative Comment(s)

The proponent should provide further detail on the water treatment processes proposed for the water treatment plant to be installed in year 4 of the project, and the quality of treated water compared to water in the Avon River. This detail should outline why releases are only proposed for high flow conditions, with reference to the reduced water flow outlined above.

Department of Primary Industry - Water – Page 1

Response

Based on the mine water balance for the amended Project, it was determined that a water treatment plant would be required in Year 4 of mining operations and beyond. The water balance, which was derived using the predicted groundwater and surface water inflows and losses from the system, e.g. by evaporation or dust suppression use, identified that a 2.5ML capacity treatment plant would most likely be appropriate, but noted that the plant throughput required would be confirmed through monitoring of the saline water zone during the early stages of mine development. This monitoring would involve both volumes and quality and the associated validation of the modelled predictions. The outcomes of these programs, and required permeate quality would be used in the detailed design of the water treatment components.

In the absence of site specific water quality data, it is impossible to provide other than a conceptual process and componentry design, as was the case in EIS (Section 2.11.5). The treatment plant would comprise two principal components, namely a desalination plant and brine processing system, with reverse osmosis (RO) technology to be utilised as a means of treating the saline water.

RO is a proven process for the removal of dissolved solids from brackish or saline feed water and is particularly effective as it can treat water to a variety of qualities depending on the end use. It uses pressure to ''force'' water through a semi-permeable membrane, leaving the ions behind a clean water stream and a concentrated brine solution, which may be further treated.

As noted in EIS Figure 2.16 (reproduced as **Figure 2.29.5**), the likely system proposed to treat the excess water within the saline water zone and its subsequent brine waste, would likely involve the following steps, as further described below.

1. Pre-treatment
2. Ultra filtration

3. Desalination – RO

4. Brine treatment involving brine concentration and salt crystallisation

The water treatment plant would reduce the volume of brine waste produced by maximising the amount of treated water produced from the saline feed and concentrating the brine into a concentrated salt and, as such, the brine would be an interim stage in the process, not a product.

The RO process is sensitive to the feed-water quality, with the correct pre-treatment process essential to promote the membrane lifespan and increase the process efficiency. The pre-treatment process would be designed reflecting the feed-water quality.

Y:\Jobs 531 to 1000\806\Reports\80613_Amended EIS_2016\CAD\806Base_MGA56.dwg_2.16 Schematic

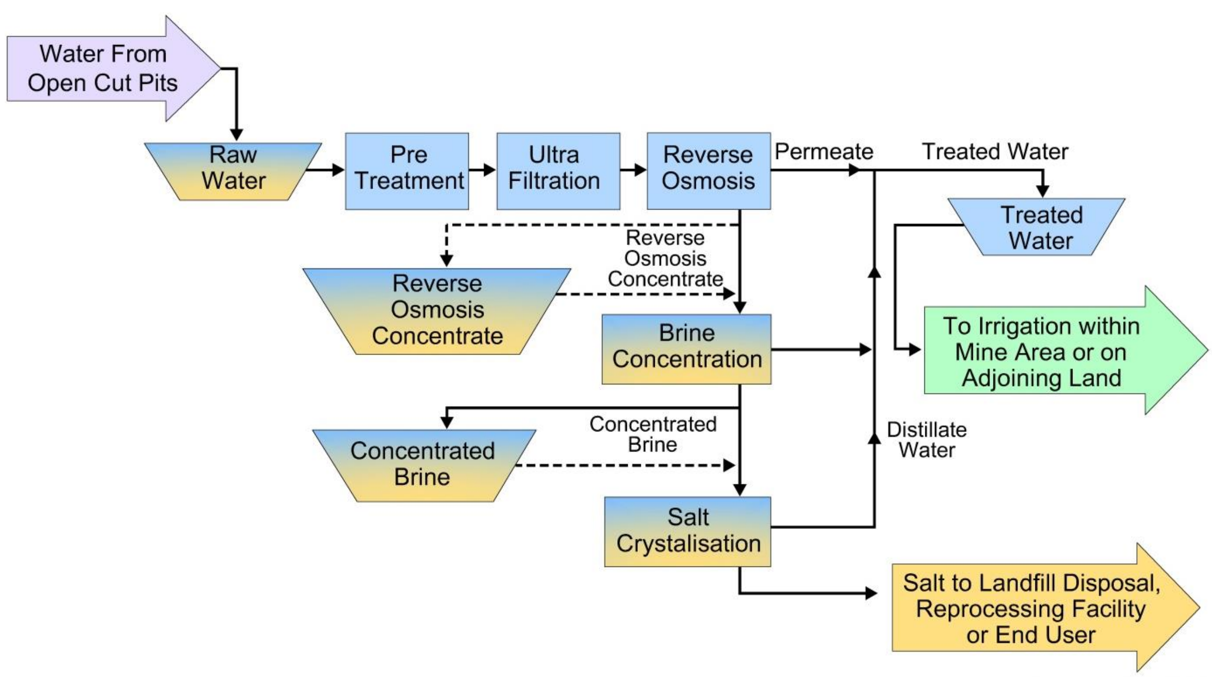


Figure 2.29.5
TREATMENT PLANT PROCESS

Pre-treatment

Pre-treatment of the saline mine water would be critical to the overall process and would be designed to remove suspended solids, biological contaminants and other constituents that may impact the subsequent membrane processes, with the overall goal of maximising system recovery to minimise waste flows.

Pre-treatment selection would be based on the detailed chemical characteristics of the mine water with the removal of suspended solids, dissolved organics and some heavy metals effectively achieved via coagulation/flocculation processes. This process would involve coagulant dosing with sufficient mixing and contact time for removal of the target contaminants. Depending upon solids levels, settling of flocculated solids may be required or alternatively the stream can be fed directly to the subsequent ultrafiltration unit for membrane separation.

Elevated levels of hardness (calcium and magnesium) and heavy metals (including arsenic, manganese, mercury, chromium) may favour a hydroxide precipitation or lime softening process. Lime softening is a physico-chemical precipitation process widely used to reduce hardness and heavy metals using a clarifier with sludge recirculation to ensure the most efficient removal of contaminants. It is effective in removing both calcium and magnesium, along with heavy metals, and can also be used to reduce silica. Alternatively, an ion exchange process can be selected to remove hardness for the saline mine water, with the use of a chemical regenerant.

Waste solids from either a clarification/flocculation process or a precipitation process would be thickened and sent to a solids handling process to produce a sludge cake suitable for off-site disposal.

The waste stream from the clarification/flocculation process would comprise both solid and liquid fractions. This would be combined with the liquid fraction returned to the process headworks and the waste solids sludge treated for off-site disposal at an appropriately licenced disposal facility. The nature of the waste, its classification and subsequent selection of an appropriate disposal site would be determined as part of the detailed process design stage once actual feed quality is known and following analyses of the sludge. If classified as a contaminated waste, it would be trucked to the EPA licenced recycling facility near Windsor, or a similar facility.

Management of wastes from cleaning activities within the ion exchange plant, if installed, would depend on the volume to be produced which, in turn, would be determined by feed water chemistry, plant operational requirements and economics. This would potentially involve blending with the RO plant discharge water stream as a water conditioning agent and/or a combination of process charcoal recovery/release and recycling and neutralisation followed by off-site trucking to a licenced disposal facility.

Ultrafiltration

Ultrafiltration (UF) is proven and widely used and accepted membrane process technology that produces a high-quality filtrate stream suitable as a feed water to the subsequent reverse osmosis membranes, removing turbidity, pathogens and bacteria and thereby protecting the RO membranes from physical and biological fouling.

The UF System includes fine screens for mechanical protection of UF membranes along with backwashing and chemical cleaning facilities. The backwash system is designed to prevent the build-up of debris on the membranes with the waste from the backwashing process returned to the front of the pre-treatment (dependent upon final pre-treatment selection) or further concentrated for disposal.

Chemical cleaning is used to prolong production runs by minimising membrane fouling through the use of cleaning agents, typically sodium hypochlorite (NaOCl). Solid wastes from the cleaning process would potentially be introduced to the clarification/flocculation process waste stream where the liquid wastes would be treated in a similar manner to the ion exchange plant waste stream. Neutralisation of cleaning solutions would be performed within the UF chemical cleaning facilities.

Desalination - Reverse Osmosis (RO)

The objective of the RO process is to separate the feed water into two streams: a high-quality stream (RO permeate) with low concentrations of dissolved salts, and a second, smaller stream

(RO concentrate) containing most of the dissolved salts present in the feed stream. RO removes most organic compounds and up to 99% of all ions, with a range of RO membranes available to address varying water conditions and requirements.

During the operation of a membrane system, dissolved solids, organic materials, and suspended solids in the incoming water can concentrate up to a level where they begin to precipitate or accumulate on the membrane surface, causing scaling and fouling which can result in unacceptably low production, high operating pressure, or an excessive pressure drop in the system which may lead to irreversible membrane damage.

If warranted, chemical pre-treatment would be used to reduce scaling and fouling potential, and again before the scale and foulants accumulate to a level where product water quality declines, or membrane damage can occur.

Chemical pre-treatment dosing typically involves sodium bisulphite dosing to remove any free chlorine present that may oxidise the RO membranes, with antiscalant dosing used to reduce fouling and scaling potential.

For the cleaning process, a combination of both acidic and alkaline cleaners would be used with the acidic cleaner formulation designed specifically to remove metal hydroxides, calcium carbonate, and other similar scales from membranes and alkaline cleaner formulation designed to remove organics, silt, and other particulate deposits from membranes. Waste from these processes would be managed in the same manner as those for the ultra-filtration process.

Post Treatment (e.g. Re-mineralisation)

Post-treatment of the RO permeate may be required to meet discharge requirements for pH, corrosiveness and Sodium Adsorption Ratio (SAR). Typically, this is performed via chemical dosing, such as with a lime slurry to increase hardness levels and alkalinity in the final treated water stream. Post-treatment of the permeate (if required) may also be achieved, at least in part, through the re-introduction of the outflow from the ion exchange plant cleaning process and would be undertaken following desalination within the RO plant and prior to discharge to the farm dam for its use for irrigation, or discharge to the Avon River system.

Brine Treatment

The proposed waste concentrate (brine) treatment process is based on proven technology and would involve brine concentration followed by salt crystallisation, both of which are well established and understood, reliable processes.

The brine (or concentrate) from the RO system would be treated in an evaporator or brine concentrator in which the waste concentrate feed from the RO process is evaporated to produce a high dissolved solids level brine stream with a typical total dissolved solids (TDS) of 100 000 – 200 000mg/L and a distillate pure water stream.

Concentrated brine is continuously discharged from the brine concentrator and pumped to the salt crystalliser.

The concentrated brine stream produced by the brine concentrator is then converted into a salt in a forced circulation salt crystallizer which uses flash evaporation to produce a crystalline salt material of approximately 10% to 15% moisture content suitable for handling, and a very pure distillate pure water stream.

2.29.7 Surface Water Controls

2.29.7.1 Representative Comment(s)

The surface water assessment outlines that as a result of the increase in catchment area discharging to Oaky Creek created by the northern clean water diversion there will be an increased risk of bank erosion. The proponent commits to monitoring for any erosion and mitigation measures involving increasing the amount of dissipation within the relevant section of the channel. The proponents proposed mitigation method utilising a small dam along the channel as an energy dissipation structure is inappropriate for this order of stream. Construction of a dam on Oaky Creek may lead to significant ecological impacts as well as potentially shifting flow regimes and patterns. The proponent should investigate alternative energy dissipation measures, including introduced large woody debris (LWD) structures (such as bed sills, apex jams or revetments) and/or increased riparian vegetation densities which may be necessary to protect Oaky Creek from induced scour and channel expansion.

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Response

Contrary to the statement by DPI-Water, there is no reference to the construction of a dam or any other form of energy dissipation on Oaky Creek in the EIS for the amended Project. The EIS text and figures and the SWA (Section 3.2) identify that, where the diversion channels cross deep gullies, small embankments would be constructed to maintain the slopes of the channels, thereby creating a series of detention structures or dissipation dams that would assist in reducing flow velocities within the channels at the downstream ends of both channels. Where the channels extend into steep watercourses draining to Oaky and Waukivory Creeks, they would be rock lined and incorporate energy dissipation. With respect to the impact of the diversion channel discharges on the geomorphic stability of Oaky Creek, the SWA (page 5-155) states:

> *The impacts of the amended Project on key hydraulic parameters affecting geomorphic stability are presented in Figure 4.29. The figure shows the results of hydraulic analysis of the Oaky Creek channel in a 1 in 10 AEP flood event (which is close to bank-full flow) using the HEC-RAS software (see Figure 4.30). The figure indicates the magnitude of the impact of the amended Project on section-averaged parameters along the length of the channel. The increase is reasonably uniform along the channel, with the median increase in velocity, stream power and shear stress being 5%, 14% and 8% respectively.*
>
> *Under existing conditions, 10% of cross-sections have parameter values, exceeding the following:*
>
> - *Channel Velocity 2.7m/s;*
> - *Channel Stream Power 181N/m^2;*
> - *Channel Shear Stress 482N/m^2.*
>
> *These high energy zones are identified in Figure 4.30, and are generally associated with a locally steep channel profile eroded into bedrock (see Photographs in Appendix A). Figure 4.31 shows the flood velocity impact predicted by the TUFLOW hydraulic model.*
>
> *While the small increase in energy resulting from the clean water diversion will result in a potential increased erosion risk along the channel, the resultant*

> *parameters are within the envelope of currently occurring values. It should also be noted that these conditions would be expected to occur naturally in a flood of a slightly larger magnitude (the design discharge of the 1 in 10 AEP flood is increased to that of the pre-mine 1 in 20 AEP flood).*
>
> *As the potential change in hydraulic conditions is small, and would only occur in floods during the relatively short period of mine operations, it is likely the amended Project would have no significant impact on the geomorphic stability of Oaky Creek.*
>
> *Notwithstanding, detailed baseline and post flow event stability monitoring should be undertaken along the affected reaches of Oaky Creek. The monitoring should include documenting all reaches through photographs ground survey and written descriptions so that changes to channel morphology attributable to the increase in streamflow can be identified through comparisons with the baseline channel survey, and appropriate erosion control measures implemented if necessary.*

GRL would also be prepared to undertake preventative revegetation works within those 'riparian' sections of Oaky Creek downstream of the diversion outlet that may be susceptible to increased rates of erosion, subject to the agreement with the landowner[6] and receipt of any requisite approvals from the relevant regulatory authorities, if required.

The impact of the diversion channels on flood behaviour in Oaky Creek has been assessed for a range of flood flows up to the 1 in 100 AEP design flood event (refer Appendix C – Section 4.5.2 of the SWA). The 1 in 10 AEP design flood event was used as the focus of the geomorphic stability analysis of Oaky Creek as this generally represents bank full flow along the length of the Oaky Creek channel.

Further details of the basis of the conclusion that the amended Project would have no significant impact on the geomorphic stability of Oaky Creek are provided below.

It is generally recognised that flows close to the bankfull discharge are the dominant conditions responsible for the shaping of river morphology (Parsons et. al., (2009)[7]) and National Water Commission – Waterlines, 2008[8]). Bank full flow is the flow that fills the channel from bank to bank before excess flow spills into the adjacent floodplain and is generally considered the channel forming flow or dominant discharge (Leopold et. al., 1964[9]). For this reason, and given the very low probability of occurrence during the life of the amended Project, it is not considered appropriate to assess the risk of increased flow volumes and velocities on steam bank and channel stability, up to the Maximum Probable Flood. During extreme floods,

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6 GRL owns the land across which most of Oaky Creek flows downstream from the northern diversion outlet. A 300m section of Oaky Creek is located on land owned by R.B. and L.R. Campbell.

7 Parsons M., Thomas M., Capon T., Capon S. and Reid M. (2009), *Resilience and thresholds in river ecosystems*, *Waterlines Report* Series No. 21, Australian Government National Water Commission, September 2009

8 Parsons M., Thomas M., Capon T., Capon S., Reid M. (2009), *Resilience and thresholds in river ecosystems, Waterlines report*, National Water Commission, Canberra http://content.webarchive.nla.gov.au/gov/wayback/20091002011152/http://www.nwc.gov.au/resources/documents/Waterlines_Resilience_exec_summary.pdf

9 Leopold L.B., Wolman M.G., and Miller J.P. (1964), *Fluvial Processes in Geomorphology*, W.H. Freeman, San Francisco, California

significant erosion of the Oaky Creek channel can be expected with or without the amended Project in place.

The applicability of this concept to streams within and adjacent to the Mine Area is supported by the fluvial geomorphological assessment for the Stratford Extension Project EIS undertaken by Fluvial Systems Pty. Ltd (Gippel, 2012[10]). That study assessed the impact of an existing diversion on the geomorphological character of an unnamed tributary of Avondale Creek. The diversion was constructed over 10 years ago and increased the catchment area of the unnamed tributary by 318%.

The assessment found there were no indications of major change in channel form, with the resilience of the channel attributed to the dense vegetation cover, high channel roughness and the relatively low absolute catchment area. Oaky Creek shares similar geomorphological characteristics to the unnamed tributary of Avondale Creek, including dense vegetation and high channel roughness. On the evidence of the channel conditions observed during field investigations, there has not been significant erosion in Oaky Creek in recent years, despite significant flows occurring over this period. Oaky Creek is therefore also likely to be relatively resilient to frequently occurring and minor increases in streamflows.

A commonly used measure of the potential for morphological change is stream power. Stream power varies significantly along Oaky Creek (refer Appendix C – Section 4.5.2 of the SWA). Hydraulic modelling showed there would be increases in stream power resulting from the clean water diversion. However, with the exception of conditions at a number of “nick points”, the resultant stream power is well within the envelope of currently occurring values, and would be unlikely to cause significant erosion in a well vegetated stream with a cobble bedload.

The increase in stream power would increase the risk of channel change in those areas where stream power is greatest. However, the increase would be temporary, and could be expected to eventually occur anyway during larger flood events (the design discharge of the 1 in 10 AEP flood is increased to that of the pre-mine 1 in 20 AEP flood). In the event that any damage to the banks of the creek are confirmed to be attributed to the additional runoff from the Mine Area, GRL would be investigate and implement relevant mitigation measures.

Finally, it is worth noting that the projected increase in catchment area in Oaky Creek attributable to the amended Rocky Hill Coal Project would be up to 13.3%, i.e. well below the 318% referred to in the study by Gippel (2012).

The maximum predicted decrease in flow in the 4.4 km reach of Waukivory adjacent to the site is 2.1%. The impact of this short-term, minor reduction in streamflow on the risk of stream erosion, morphology or ecology of Waukivory Creek would be minimal.

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[10] Gippel C.J. (2012), *Fluvial geomorphological assessment for Stratford Extension Project EIS*, Fluvial Systems Pty Ltd, Stockton, Stratford Coal Pty Ltd, May 2012

2.29.7.2 Representative Comment(s)

The volume of the proposed clean water dams appears to exceed the proponent's harvestable rights and surface water entitlement. Further information is required on how all proposed dams are to be accounted for, including proposed dams on 3rd order streams that do not fit within exemptions or harvestable rights provisions. This should include a table listing each dam, its strahler order, location, volume, purpose (e.g. clean water, sediment, saline), and the proposed accounting method (e.g. harvestable rights, WAL no., exempt) for different stages of the proposal.

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Response

The SWA (Section 1.5.2) gives a maximum harvestable rights dam capacity (MHRDC) for the amended Project of 194ML/yr. **Figure 2.29.10** to **Figure 2.29.15** reproduce Figures 3.2 to 3.7 from the SWA showing the location of all proposed dams. **Table 2.29.4** to **Table 2.29.9** give details of the various dams for each stage of the project including the Strahler classification of the watercourse on which they are proposed to be constructed as well as the proposed accounting method. Only those dams on watercourses with a Strahler classification of 1 and 2 can form part of the harvestable right requirement. It is, however, noted, that whilst three of the proposed dams are located on watercourses with a Strahler Classification of 3, during the life of the amended Project, upstream diversion of water would effectively reduce the Strahler classification of the watercourse on which the dam is located. It is noted that the farm dams constructed on the land to the north of the Mine Area (to receive/store treated water from the treatment plant) would effectively be turkey nest structures without any catchment and consequently would not be subject to any MHRDC requirement.

Water captured in clean water dams[11] and used on site would require an entitlement from the Avon River Water Source. The tables show the total volume required if all entitlements for clean water dams were to be offset against the Harvestable Rights held by GRL. From about Year 8, the total clean water dam capacity would exceed the MHRDC (352ML increasing to 436ML compared to the MHRDC of 194ML). GRL would rely upon its WAL entitlements (after offsetting baseflow losses) to account for the shortfall. Between Year 8 and Year 12, the remaining WAL entitlements would not be sufficient to make up for the shortfall (by up to 96ML), and GRL would compare the total clean water dam capacity to the MHRDC of 194ML and its WAL entitlements, and decide whether to decommission or reduce the capacity of the former sediment dams within the Mine Area or to acquire additional WAL entitlements during that period.

[11] The dams within the Mine Area would be considered as clean water dams once they are no longer sediment control dams.

Table 2.29.4
Status of Dams within the Mine Area - Year 0.5

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area[*1] (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Clean Water Dam	62.4	66.9	Harvestable Rights/WAL
S1	Tributary of Waukivory Creek	2	Sediment Dam	6.8	7.3	NA
S2	Tributary of Waukivory Creek	3	Sediment Dam	15.6	16.8	NA
S3	Toe of Environmental Bund	-	Sediment Dam	14	15	NA
S4	Tributary of the Avon River	2	Sediment Dam	18.3	19.7	NA
S5	Tributary of the Avon River	1	Sediment Dam	6.3	6.8	NA
S6	Tributary of the Avon River	2	Sediment Dam	24.2	26	NA
S7	Tributary of the Avon River	2	Sediment Dam	37.5	40.3	NA
S8	Tributary of the Avon River	1	Sediment Dam	12.6	13.5	NA
S9	Tributary of Waukivory Creek	1	Sediment Dam	66.7	71.6	NA
S10	Tributary of Waukivory Creek	2	Sediment Dam	34.7	37.3	NA
W1	Tributary of Waukivory Creek	2	Clean Water Dam	36.7	39.4	Harvestable Rights/WAL
W2	Tributary of Waukivory Creek	3	Clean Water Dam	76.9	82.6	Harvestable Rights/WAL
W3	Tributary of Waukivory Creek	3	Sediment Dam	7	7.5	NA
ED1	Tributary of the Avon River	2	Environmental Dam		310	NA
ED2	Tributary of the Avon River	1	Environmental Dam		1,000	NA
[*1] Maximum catchment area reporting to sediment dam over mine life.			Total non-exempt dam capacity		189	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

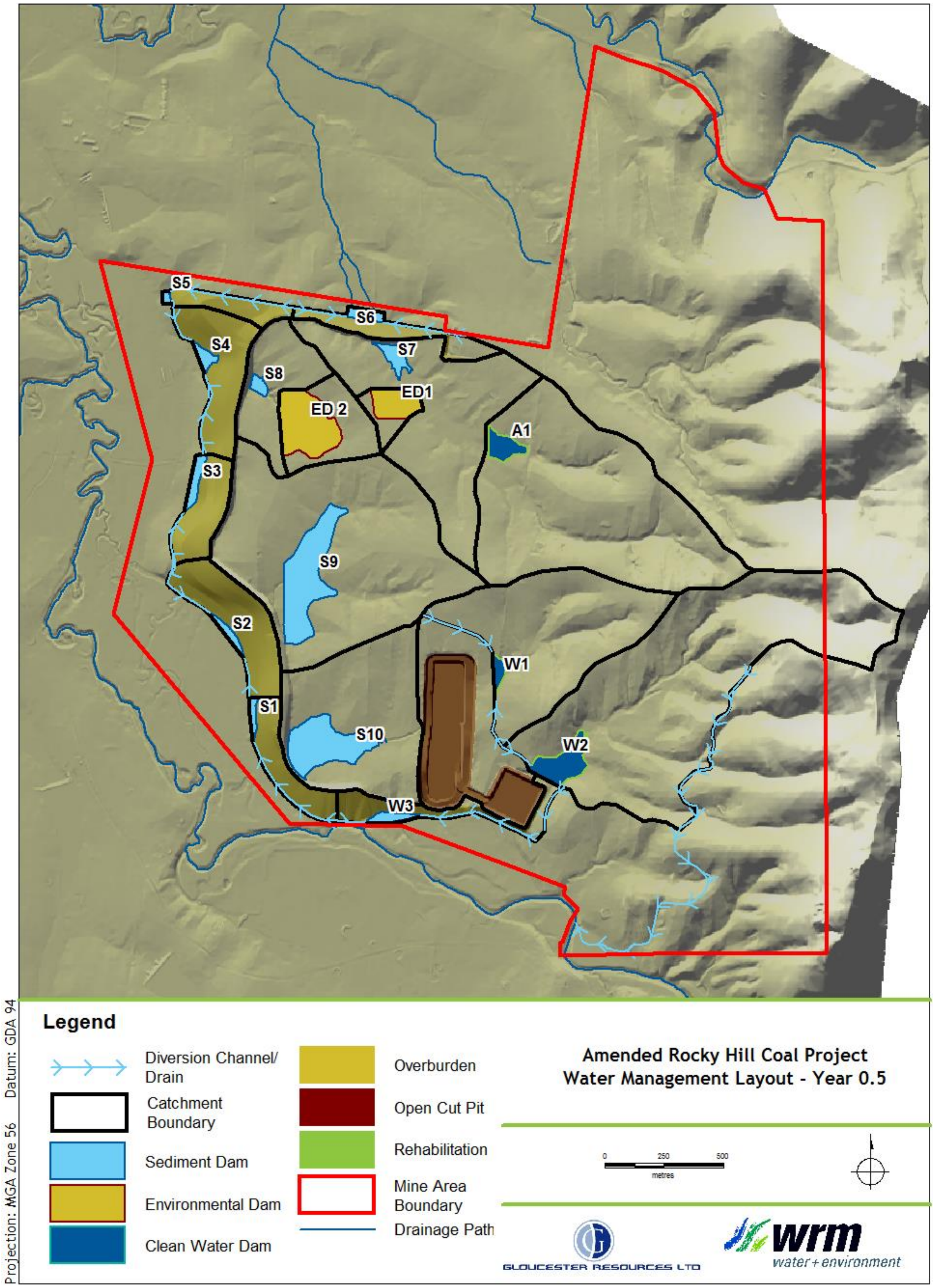

Figure 2.29.10
Year 0.5

Table 2.29.5
Status of Dams within the Mine Area - Year 2

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area*1 (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Clean Water Dam	62.4	66.9	Harvestable Rights/WAL
A2	Tributary of the Avon River	1	Sediment Dam	19	20.4	NA
S1	Tributary of Waukivory Creek	2	Sediment Dam	6.8	7.3	NA
S2	Tributary of Waukivory Creek	3	Sediment Dam	15.6	16.8	NA
S3	Toe of Environmental Bund	-	Sediment Dam	14	15	NA
S4	Tributary of the Avon River	2	Sediment Dam	18.3	19.7	NA
S5	Tributary of the Avon River	1	Sediment Dam	6.3	6.8	NA
S6	Tributary of the Avon River	2	Sediment Dam	24.2	26	NA
S9	Tributary of Waukivory Creek	1	Sediment Dam	66.7	71.6	NA
S10	Tributary of Waukivory Creek	2	Sediment Dam	34.7	37.3	NA
W1	Tributary of Waukivory Creek	2	Sediment Dam	36.7	39.4	NA
W2	Tributary of Waukivory Creek	3	Sediment Dam	76.9	82.6	NA
W3	Tributary of Waukivory Creek	3	Sediment Dam	7	7.5	NA
W5	Tributary of Waukivory Creek	2	Sediment Dam	20.1	21.6	NA
ED1	Tributary of the Avon River	2	Environmental Dam		310	NA
ED2	Tributary of the Avon River	1	Environmental Dam		1,000	NA
*1 Maximum catchment area reporting to sediment dam over mine life.			Total non-exempt dam capacity		67	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

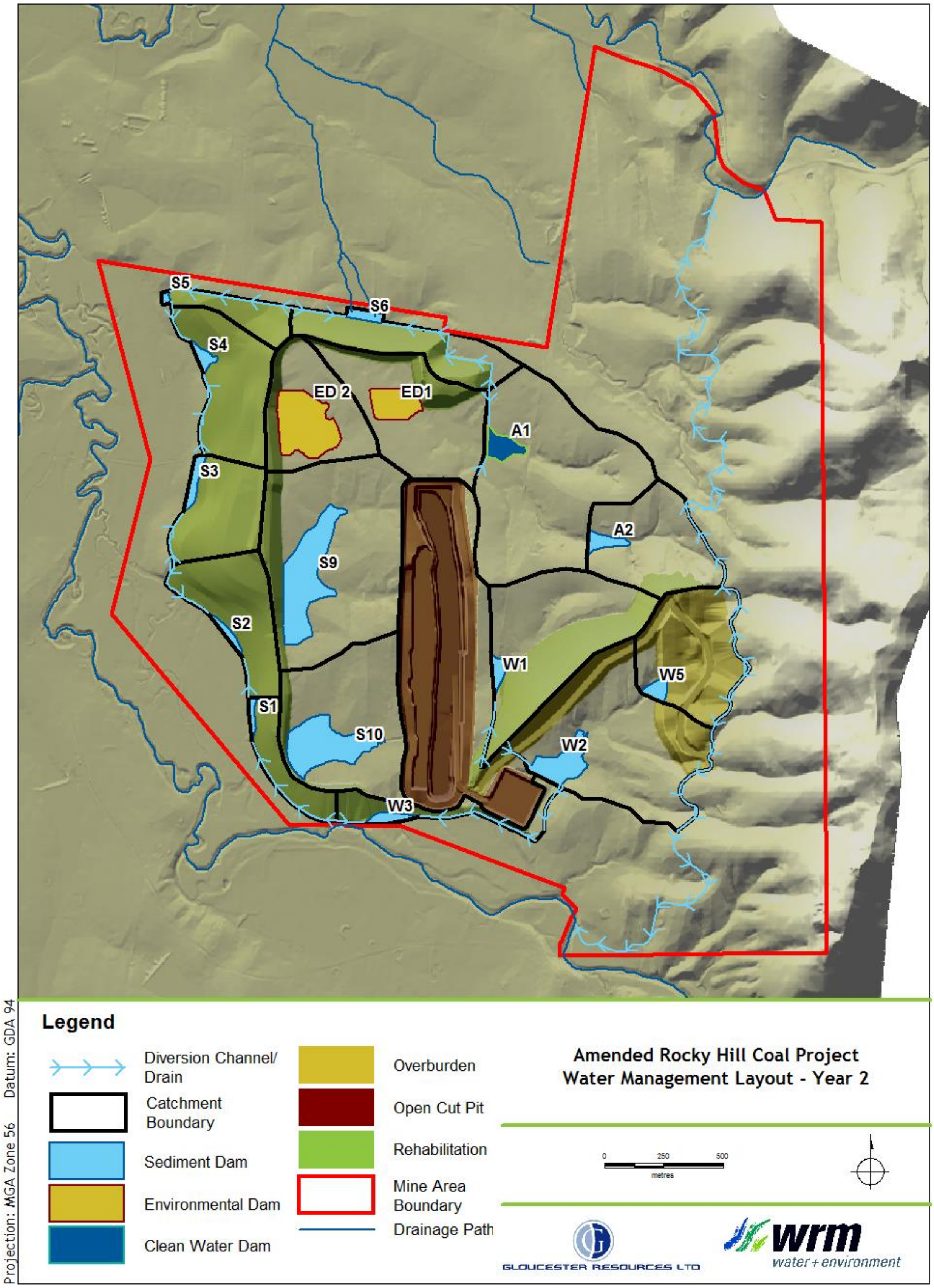

Figure 2.29.11
Year 2

Table 2.29.6
Status of Dams within the Mine Area - Year 4

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area*[1] (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Sediment Dam	62.4	66.9	NA
A2	Tributary of the Avon River	1	Sediment Dam	19	20.4	NA
S1	Tributary of Waukivory Creek	2	Clean Water Dam	6.8	7.3	Harvestable Rights/WAL
S2	Tributary of Waukivory Creek	3	Clean Water Dam	15.6	16.8	Harvestable Rights/WAL
S3	Toe of Environmental Bund	-	Clean Water Dam	14	15	Harvestable Rights/WAL
S4	Tributary of the Avon River	2	Clean Water Dam	18.3	19.7	Harvestable Rights/WAL
S5	Tributary of the Avon River	1	Clean Water Dam	6.3	6.8	Harvestable Rights/WAL
S6	Tributary of the Avon River	2	Clean Water Dam	24.2	26	Harvestable Rights/WAL
W1	Tributary of Waukivory Creek	2	Sediment Dam	36.7	39.4	NA
W2	Tributary of Waukivory Creek	3	Sediment Dam	76.9	82.6	NA
W3	Tributary of Waukivory Creek	3	Clean Water Dam	7	7.5	Harvestable Rights/WAL
W4	Tributary of Waukivory Creek	1	Sediment Dam	20.4	21.9	NA
W5	Tributary of Waukivory Creek	2	Sediment Dam	20.1	21.6	NA
ED1	Tributary of the Avon River	2	Environmental Dam		310	NA
ED2	Tributary of the Avon River	1	Environmental Dam		1,000	NA
*[1] Maximum catchment area reporting to sediment dam over mine life.			Total non-exempt dam capacity		99	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

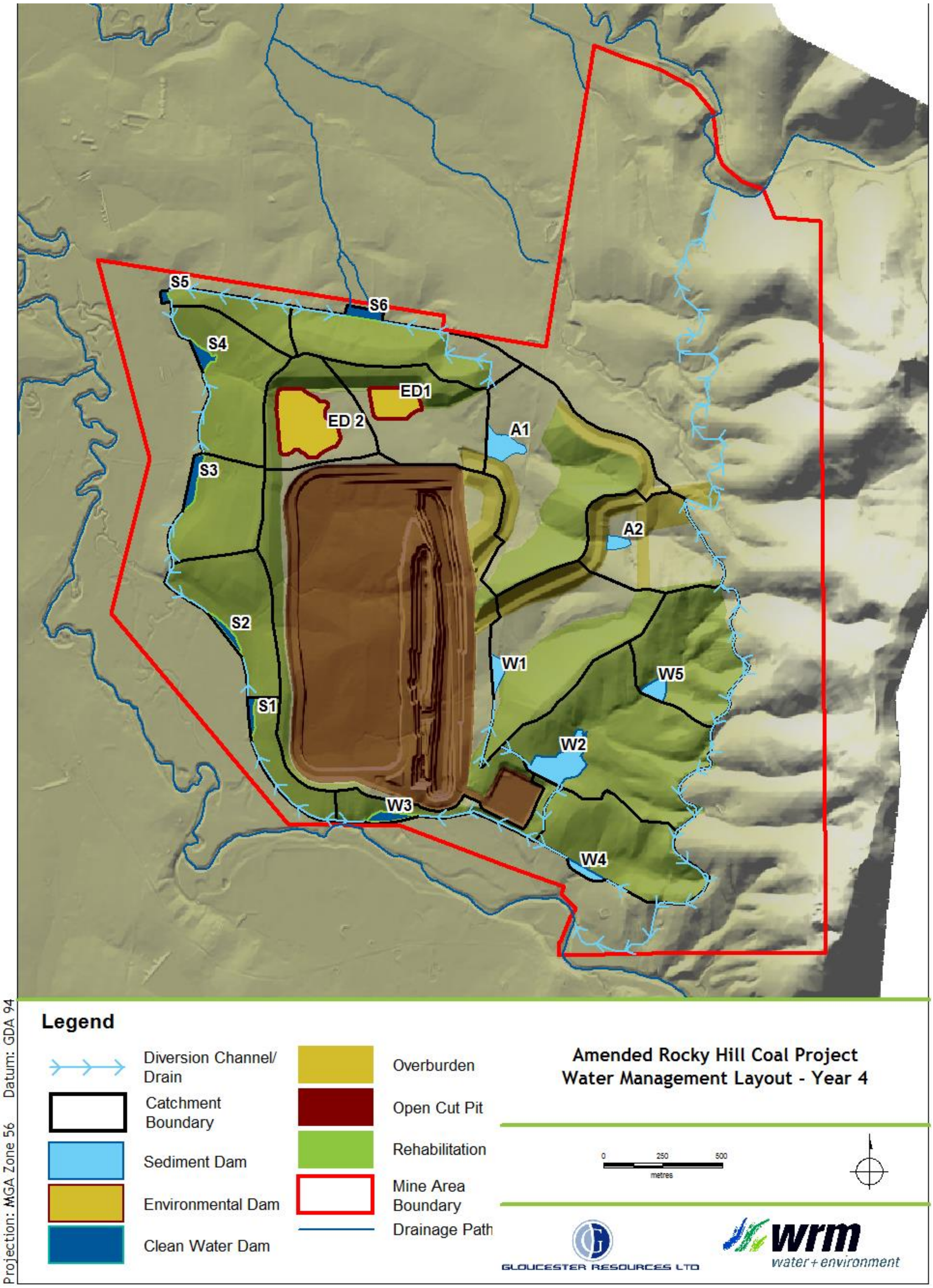

Figure 2.29.12
Year 4

Table 2.29.7
Status of Dams within the Mine Area - Year 8

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area*1 (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Clean Water Dam	62.4	66.9	Harvestable Rights/WAL
A2	Tributary of the Avon River	1	Clean Water Dam	19	20.4	Harvestable Rights/WAL
A3	Tributary of the Avon River	3	Sediment Dam	27.5	29.6	NA
A4	Tributary of the Avon River	1	Sediment Dam	10.9	11.7	NA
A5	Tributary of the Avon River	3	Sediment Dam	14.8	15.8	NA
O1	Tributary of Oaky Creek	1	Sediment Dam	25.2	27.1	NA
S1	Tributary of Waukivory Creek	2	Clean Water Dam	6.8	7.3	Harvestable Rights/WAL
S2	Tributary of Waukivory Creek	3	Clean Water Dam	15.6	16.8	Harvestable Rights/WAL
S3	Toe of Environmental Bund	-	Clean Water Dam	14	15	Harvestable Rights/WAL
S4	Tributary of the Avon River	2	Clean Water Dam	18.3	19.7	Harvestable Rights/WAL
S5	Tributary of the Avon River	1	Clean Water Dam	6.3	6.8	Harvestable Rights/WAL
S6	Tributary of the Avon River	2	Clean Water Dam	24.2	26	Harvestable Rights/WAL
W1	Tributary of Waukivory Creek	2	Clean Water Dam	36.7	39.4	Harvestable Rights/WAL
W2	Tributary of Waukivory Creek	3	Clean Water Dam	76.9	82.6	Harvestable Rights/WAL
W3	Tributary of Waukivory Creek	3	Clean Water Dam	7	7.5	Harvestable Rights/WAL
W4	Tributary of Waukivory Creek	1	Clean Water Dam	20.4	21.9	Harvestable Rights/WAL
W5	Tributary of Waukivory Creek	2	Clean Water Dam	20.1	21.6	Harvestable Rights/WAL
ED1	Tributary of the Avon River	2	Environmental Dam		310	NA
ED2	Tributary of the Avon River	1	Environmental Dam		1,000	NA
*1 Maximum catchment area reporting to sediment dam over mine life.			Total non-exempt dam capacity		352	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

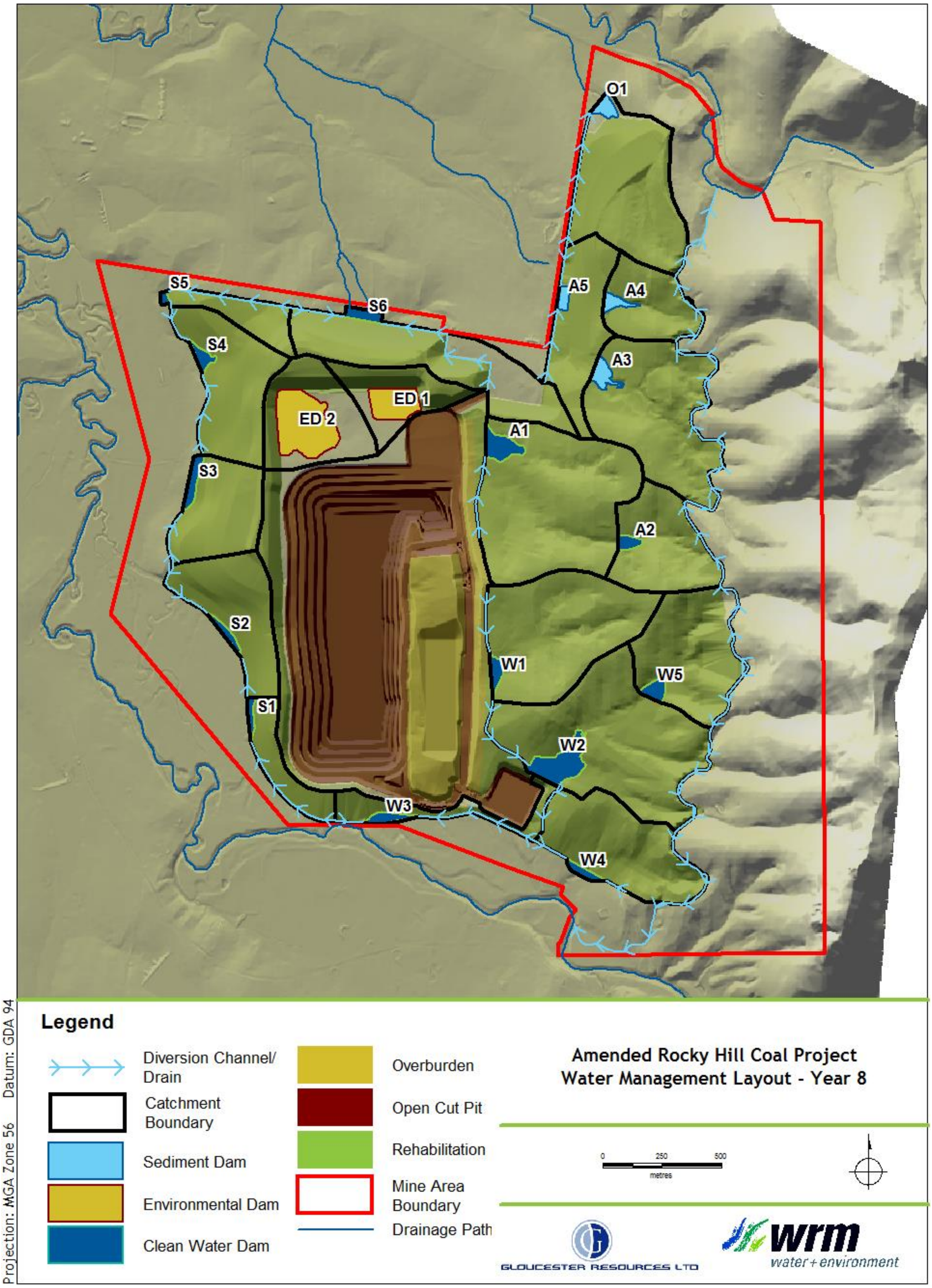

Figure 2.29.13
Year 8

Table 2.29.8
Status of Dams within the Mine Area - Year 15

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area*1 (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Clean Water Dam	62.4	66.9	Harvestable Rights/WAL
A2	Tributary of the Avon River	1	Clean Water Dam	19	20.4	Harvestable Rights/WAL
A3	Tributary of the Avon River	3	Clean Water Dam	27.5	29.6	Harvestable Rights/WAL
A4	Tributary of the Avon River	1	Clean Water Dam	10.9	11.7	Harvestable Rights/WAL
A5	Tributary of the Avon River	3	Clean Water Dam	14.8	15.8	Harvestable Rights/WAL
O1	Tributary of Oaky Creek	1	Clean Water Dam	25.2	27.1	Harvestable Rights/WAL
P1	Tributary of Waukivory Creek	1	Sediment Dam	76.1	81.7	NA
S1	Tributary of Waukivory Creek	2	Clean Water Dam	6.8	7.3	Harvestable Rights/WAL
S2	Tributary of Waukivory Creek	3	Clean Water Dam	15.6	16.8	Harvestable Rights/WAL
S3	Toe of Environmental Bund	-	Clean Water Dam	14	15	Harvestable Rights/WAL
S4	Tributary of the Avon River	2	Clean Water Dam	18.3	19.7	Harvestable Rights/WAL
S5	Tributary of the Avon River	1	Clean Water Dam	6.3	6.8	Harvestable Rights/WAL
S6	Tributary of the Avon River	2	Clean Water Dam	24.2	26	Harvestable Rights/WAL
W1	Tributary of Waukivory Creek	2	Clean Water Dam	36.7	39.4	Harvestable Rights/WAL
W2	Tributary of Waukivory Creek	3	Clean Water Dam	76.9	82.6	Harvestable Rights/WAL
W3	Tributary of Waukivory Creek	3	Clean Water Dam	7	7.5	Harvestable Rights/WAL
W4	Tributary of Waukivory Creek	1	Clean Water Dam	20.4	21.9	Harvestable Rights/WAL
W5	Tributary of Waukivory Creek	2	Clean Water Dam	20.1	21.6	Harvestable Rights/WAL
ED5	Tributary of Waukivory Creek	-	Environmental Dam		1,500	NA
*1 Maximum catchment area reporting to sediment dam over mine life.			Total non-exempt dam capacity		436	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

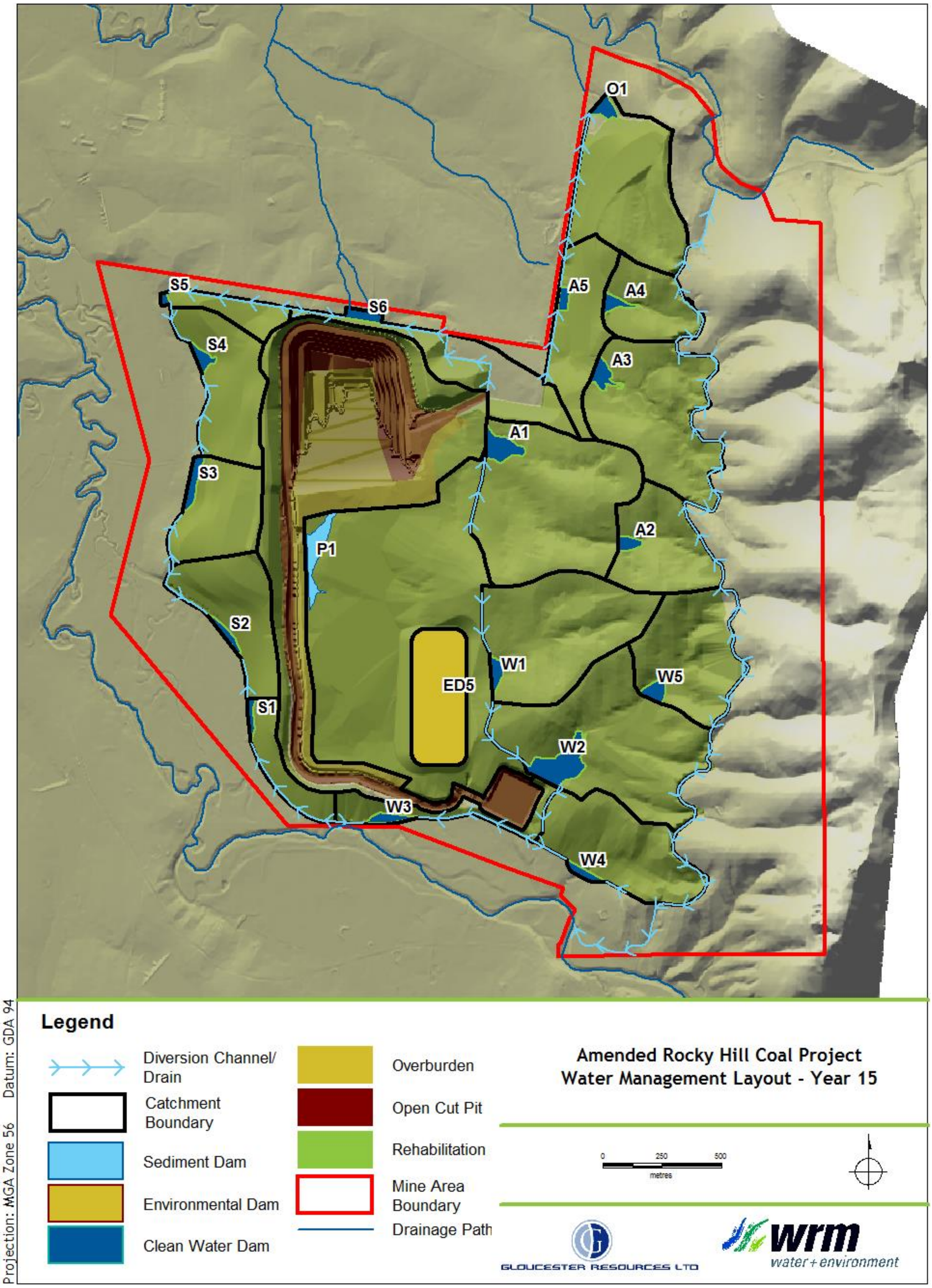

Figure 2.29.14
Year 15

Table 2.29.9
Status of Dams within the Mine Area - Final Landform

Sediment Dam	Location	Strahler Classification	Purpose	Catchment Area*1 (ha)	Total Volume Required (ML)	Accounting Method
A1	Tributary of the Avon River	1	Clean Water Dam	62.4	66.9	Harvestable Rights
A2	Tributary of the Avon River	1	Clean Water Dam	19	20.4	Harvestable Rights
A3	Tributary of the Avon River	3	Clean Water Dam	27.5	29.6	WAL or No Dam
A4	Tributary of the Avon River	1	Clean Water Dam	10.9	11.7	Harvestable Rights
A5	Tributary of the Avon River	3	Clean Water Dam	14.8	15.8	WAL or No Dam
O1	Tributary of Oaky Creek	1	Clean Water Dam	25.2	27.1	Harvestable Rights
S1	Tributary of Waukivory Creek	2	Clean Water Dam	6.8	7.3	Harvestable Rights
S2	Tributary of Waukivory Creek	3	Clean Water Dam	15.6	16.8	WAL or No Dam
S3	Toe of Environmental Bund	-	Clean Water Dam	14	15	Harvestable Rights
S4	Tributary of the Avon River	2	Clean Water Dam	18.3	19.7	Harvestable Rights
S5	Tributary of the Avon River	1	Clean Water Dam	6.3	6.8	Harvestable Rights
S6	Tributary of the Avon River	2	Clean Water Dam	24.2	26	Harvestable Rights
W1	Tributary of Waukivory Creek	2	Clean Water Dam	36.7	39.4	Harvestable Rights
W2	Tributary of Waukivory Creek	3	Clean Water Dam	76.9	82.6	WAL or No Dam
W3	Tributary of Waukivory Creek	3	Clean Water Dam	7	7.5	WAL or No Dam
W4	Tributary of Waukivory Creek	1	Clean Water Dam	20.4	21.9	Harvestable Rights
W5	Tributary of Waukivory Creek	2	Clean Water Dam	20.1	21.6	Harvestable Rights
*1 Maximum catchment area reporting to sediment dam over mine life.			Harvestable Rights Total Volume		284	

Note: Dams that form part of the harvestable right of a property cannot be located on a stream with a Strahler Classification of 3 or above.

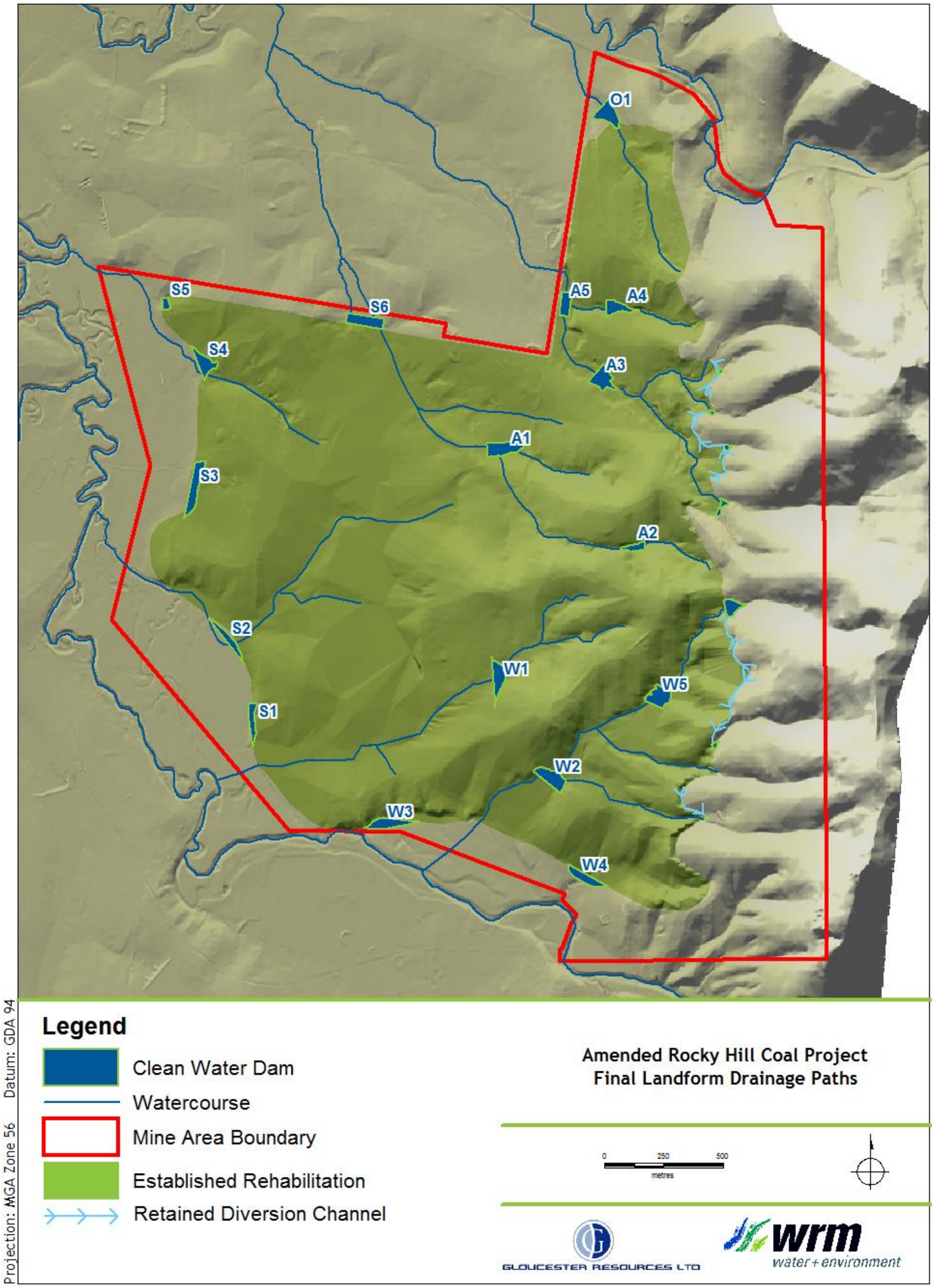

Figure 2.29.15
Final Landform

2.29.12 Final Landform

2.29.12.2 Representative Comment(s)

Revegetation of all watercourses in the final landform should be conducted in accordance with DPI Water Guidelines for Riparian Corridors on Waterfront Land (2012).

All watercourse crossings should be designed in accordance with DPI Water Guidelines for Watercourse Crossings on Waterfront Land (2012).

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Response

Details of the revegetation activities would be included in the rehabilitation section of the Mining Operations Plan and its various updates with details of all watercourse crossings included in the Water Management Plan. GRL would identify in the respective plan how the requirements in the nominated guidelines would be satisfied.