



Goulburn River Diversion Remediation Plan

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Preparation of Water Management Plan (WMP) and associated Goulburn River Diversion Remediation Plan (GRDRP)

Project approval was granted for the Ulan Coal - Continued Operations Project by the Minister for Planning on 10 November 2010 (Project Approval (PA 08_0184)). UCML has since been granted approval to modify the November 2010 Project Approval on the 7 December 2011 (i.e. MOD 1) and 29 May 2012 (MOD 2). An appeal against the Project Approval pursuant to Part 3A Division 2 Section 75L (since repealed) of the *Environmental Planning & Assessment Act 1979* (EP&A Act) was also undertaken in the NSW Land and Environment Court between 2011 and 2012 between the Hunter Environment Lobby Inc. and the Minister for Planning (No. 10998 of 2010). The court upheld the Project approval of November 2010, subject to the inclusion of a number of additional and updated conditions. The court issued orders are dated 5 April 2012.

Condition 34(a) of Schedule 3 of the project approval requires that a WMP be prepared by suitably qualified and experienced persons whose appointment has been approved by the Secretary. This Goulburn River Diversion Remediation Plan (GRDRP) forms one component of the WMP (ULN SD PLN 0017).

In developing this GRDRP, UCML has also given consideration to commitments identified in the Continued Operations Environmental Assessment and the Conceptual Mine Closure Plan. The Goulburn River Diversion (GRD) is referred to as Domain 14 in the Closure Plan.

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1 Commitment and Policy

1.1 Introduction

Ulan Coal Mines Limited (UCML) is situated in the central west of New South Wales. It is located in the Mid-Western Regional Council (MWRC) Local Government Area (LGA) near the village of Ulan. It is approximately 38 kilometres north-northeast of Mudgee and 19 kilometres northeast of Gulgong (refer to **Figure 1.1**). UCML is a joint venture between Glencore Coal Assets Australia (CAA) (90%) and Mitsubishi Development (10%), CAA maintains management responsibility for UCML. The mining operations at UCML are one of a number of mining assets owned and/or managed by Glencore.

Project Approval (08_0184) and subsequent modifications cover current and proposed mining of the Ulan Mine Complex for the next 15 years and production of up to 20 Mtpa (million tonnes per annum) of product coal. Condition 36, Schedule 3 of PA 08_0184, requires UCML to prepare the Goulburn River Diversion Remediation Plan (GRDRP). This plan is developed in accordance with conditions of consent specified in **Table 2.1**. The table provides the section of the GRDRP where relevant consent conditions are addressed. The GRDRP is intended to be read in conjunction with *Water Management Plan (WMP) (ULN SD PLN 0017)*.

1.2 Background

The construction of the Goulburn River Diversion was undertaken in accordance with a 1981 development consent associated with the commencement of open cut operations. It diverts a length of approximately four kilometres of the Goulburn River along the southern and eastern boundaries of the Ulan Mine Complex.

The diversion channel, which is between 10 metres to 20 metres deep, was cut primarily into bedrock and partly into a deep weathering profile that lies above the bedrock.

The construction of the river diversion was undertaken in accordance with the methodologies and standards of that time. While it satisfied its legal obligations, the current condition of the diversion may be improved to provide for the long term stability of the Goulburn River.

Detailed studies were undertaken over a number of years to identify and understand the issues associated with the Goulburn River Diversion and to develop a long term remediation strategy. A concept was proposed in the 2009 Continued Operation Environment Assessment (Goulburn River Diversion Remediation Strategy, URS Australia, 2009). A plan submitted in March 2011 was approved in September of that year, however, investigations into the constructability of the original plan identified limitations in terms of implementation and environmental risk. UCML subsequently advised the Department of Planning and Environment of its intention to submit a revised Remediation Plan.

In March 2013, an Expert Panel was convened to provide advice on river rehabilitation, site specific objectives for the project and alternate remediation options. Additional studies and modelling analysis were undertaken to compliment information from the above mentioned URS Remediation Strategy in the revised Plan. **Table 1.1** provides a list of the Expert Panel participants and their respective skills and experience.

Table 1.1 - Participants in Goulburn River Remediation Plan Expert Panel

| Goulburn River Diversion Remediation Plan Expert Panel | | |
|--|---|---|
| Third Party Participants | | |
| Saul Martinez | Senior Water Manager URS Australia Pty Ltd | <ul style="list-style-type: none"> Managed the development of the “Goulburn River Diversion Long Term Stability Strategy” Extensive experience with river rehabilitation issues across NSW & Queensland. |
| Chris Gippel | Principal Fluvial Systems | <ul style="list-style-type: none"> Expertise in geomorphology, ecology and hydrology. Extensive work in the coal mining industry, having designed and assessed several streams, most notably Bowmans Ck in the Hunter Valley. |
| Chris Dwyer | Waterway Management Practice Leader, Sinclair Knight Mertz. | <ul style="list-style-type: none"> Extensive experience in mine river diversions, waterway design and rehabilitation In depth geomorphic and rehabilitation experience. Extensive work in NSW rivers, specifically the Murray and Murrumbidgee Rivers |
| Daniel Lewer | Principal, Hunter Land Management Pty Ltd. | <ul style="list-style-type: none"> Extensive experience with Soil Conservation Service River Crews at Muswellbrook. Expertise in design and implementation of river rehabilitation works. Extensive experience in revegetation practices throughout the Hunter Valley. |
| Bruce Hundy | Senior Environmental Officer, Soil Conservation Service | <ul style="list-style-type: none"> Specialist expertise in mining rehabilitation and erosion and sedimentation control. Extensive experience with design and implementation of drainage systems for soil conservation and river |

| | | |
|--------------------------------|---|---|
| | | rehabilitation works. |
| Steve Downes | Water Infrastructure Manager Glencore Coal Australia | <ul style="list-style-type: none"> • Civil Engineer. • 20 years' experience in river hydrology and rehabilitation. • Construction and rehabilitation of a number of diversion projects in NSW and Queensland. |
| Site Based Participants | | |
| Rod Reinhard | Manager Major Projects, UCML | <ul style="list-style-type: none"> • Professional Engineer with 27yrs experience in industrial/mining operations and project delivery. • Responsible for delivery of major capital and operations projects across Ulan Complex. • Project Owner. |
| Steve Hawkins | Rehabilitation Superintendent, UCML | <ul style="list-style-type: none"> • 20 years' experience at Ulan operations. • Responsible for management of mine rehabilitation projects. |
| Robyn Stoney CEnvP | Environment and Community Manager, UCML | <ul style="list-style-type: none"> • Professional environmental practitioner with over 15 years' experience in environmental management and community engagement in Western Australian, Queensland, NSW and international operations. |
| Cathal O'Leary | Project Engineer, Glencore Coal Australia | <ul style="list-style-type: none"> • 15yrs experience in civil engineering and construction. 6 years with Glencore Coal on greenfield projects and rehabilitation works in the Hunter Valley. |
| Chris Glennon | GRDRP Coordinator Consultant | <ul style="list-style-type: none"> • 20 years' experience in senior management in the NSW natural resource management agencies and catchment management authorities • 30 years' experience in soil conservation, catchment management, water management, biodiversity restoration and community consultation. |

The Plan was further developed with contributions from regulatory and other relevant agencies, the Community Consultative Committee and the Aboriginal representative group. The responses to stakeholder comments are provided at **Section 2.4, Table 2.4.**

1.3 Purpose and Scope

This GRDRP has been prepared to:

- facilitate compliance with the conditions of the Project Approval (refer to **Section 2**);
- provide an integrated framework for the implementation of the Goulburn River Diversion Remediation Strategy (2009); and
- incorporate the outcomes from the Expert Panel process and subsequent investigations (2013).

The GRDRP includes:

- key risks identified in the *Sustainable Development Risk Register (ULN SD ANN 0054)* in accordance with the *Environmental Management Strategy (ULN SD PLN 0050)*, and details of the necessary mitigation & management measures;
- alignment of operating philosophy with the Glencore Standards and Protocols;
- the key criteria to be considered in the design of channel modifications;
- the objectives and criteria to be measured against to determine the success of the remediation project;
- the key issues that may impact upon the ability to successfully implement the project and how they are being addressed;
- the management strategies, procedures and controls to be implemented to meet the objectives and criteria;

- the timing of the remediation works;
- the care and maintenance program that will be implemented to allow the objectives and targets to be met in a timely manner;
- the monitoring program to measure performance of the remediation project; and
- project closure criteria which will indicate when the project objectives have been satisfactorily met.

1.4 Objectives and Design Criteria

The objectives of the Goulburn River Diversion Remediation Plan were developed by an Expert Panel process. This process is described in **Section 1.4.1**. The achievement of these objectives, and the ultimate success of the project, will be evaluated by a combination of processes such as engineering and geotechnical assessment, water quality/river health monitoring and measurement of ecological outcomes. The process for measuring project progress towards success is discussed in greater detail in **Section 1.4.2** and again in **Section 4**.

1.4.1 Goulburn River Diversion Remediation Plan Objectives

The Expert Panel recommendations were guided by the planning principles from the “Rehabilitation Manual for Australian Streams “ – Ian Rutherford, Kathryn Jeri and Nicholas Marsh and published by the Land and Water Research and Development Corporation and the CRC for Catchment Hydrology. The planning principles include the following steps:

1. Establish vision and goals.
2. Consult.
3. Assess the benchmark condition.
4. Identify assets and threats.
5. Establish priorities.
6. Implementation Strategy.
7. Develop objectives.
8. Confirm feasibility.
9. Design process.
10. Evaluate the investigations.
11. Plan to implement the works.
12. Post completion review.

From this process, the Expert Panel developed five project objectives based on the biophysical conditions existing in situ. The intent of these objectives is to maintain the long term geomorphological stability of the river landform, restore resilient revegetation cover throughout the channel Areas and mitigate negative offsite impacts from erosion within the diversion. It is also recognised that the achievement of these primary objectives and associated criteria as outlined in **Table 1.2**, will lead to improved visual amenity.

These objectives have been developed in the context of considering the channel as a diversion as per its original design, rather than attempting to recreate a pre-construction (pre-1980) condition.

The objectives and compliance criterion outlined in **Table 1.2** below should be read in conjunction with the conceptual framework discussed Section **1.4.2**.

Table 1.2 - Goulburn River Remediation Objectives and Criteria

| Objective | Criteria / Indicator | Compliance |
|-------------------------------------|--|--|
| Maintain safe hydraulic performance | Maximum slope of banks that have been re-profiled is 1:2.7 (V: H) or better. Where the landform exceeds 1:2.7 (V: H), a geotechnical assessment undertaken by a suitably qualified person concludes that the landform is either stable or does not pose a greater risk to the degradation of the environment downstream to that posed by current conditions. | <1:2.7 (V:H) or geotechnical assessment |
| | Remediation works should not adversely impact on flood tolerances and current flow characteristics. | Hydraulic and engineering assessment |
| | Surface water controls, and the basis of performance design criteria, for works undertaken in the channel will be designed to 1 in 100 year ARI unless stated otherwise. | Hydraulic assessment |
| Maintain or improve water quality. | Mitigate soil erosion in priority areas where sedimentation is occurring at levels above natural limits. This will be verified by monitoring bank stability and soil loss against benchmark sites as determined by a suitably qualified person. | Yes / No geotechnical assessment, Landscape Function Analysis (LFA) |
| | Appropriate drainage controls have been implemented to mitigate erosion and pollution by sediment downstream. | Yes / No engineering assessment |
| | Manage soil chemistry via the application of appropriate ameliorants. | Yes / No Soil Chemistry assessment |
| Improve ecological function. | Identify, protect and monitor in-stream aquatic values. | Annual macro invertebrate survey |
| | Maintain and improve ecosystem function via. <ul style="list-style-type: none"> Vital natural resources being retained and recycled at a rate trending towards representative analogue sites, Soil surface condition is at a level trending towards representative analogue sites. | Landscape Function Analysis (LFA) |
| | Maintain and improve terrestrial biodiversity. <ul style="list-style-type: none"> Groundcover diversity and abundance. Vegetation Structure and habitat characteristics. Understory density and growth. | Ecological monitoring |
| Constructability | Construction of works are in line with Safe Work Practices | Glencore Policy |
| | Works not to inadvertently create greater environmental risk. | Engineering and geotechnical assessment |
| | Analyse options to determine long term maintenance considerations | Engineering assessment |
| Maintain or improve visual amenity. | The process of revegetation and rehabilitation will improve visual amenity. Not all areas will be revegetated where disturbance may exacerbate environmental risk and where areas do not contribute significant erosion and sedimentation. | Geotechnical and channel stability assessment and stakeholder feedback |

1.4.2 Conceptual Framework for Achieving Project Success

The engineering objectives of the project, “*Maintain hydraulic performance*” and “*Constructability*” will be determined by engineering and geotechnical assessment of final works against project design criteria and specifications.

Channel stability will be measured by the Ephemeral Drainage Line Stability Indicators derived from the LFA process and developed by Tongway and Hindley (CSIRO)

The water quality and river health outcomes, *Improve Water Quality* and *Improve ecological function (identify, protect and monitor in-stream aquatic values)* will be assessed by water quality monitoring, macro invertebrate monitoring and providing more resilient vegetation cover. This is described in greater detail in **Section 4.1**.

The *Improve ecological function (Maintain and improve terrestrial biodiversity)* objective will be achieved by using a monitoring program that identifies ecological outcomes, performance indicators, performance measures and recommended management responses to guide implementation.

This process is intended to guide the project in a similar context to a Trigger Action Response Plan (TARP) in that they are not compliance criteria but indicators to drive adaptive management and continual improvement of project outcomes. This is explained in greater detail in **Section 4.4.2**.

This conceptual framework is illustrated in **Figure 1.2** on the following page.

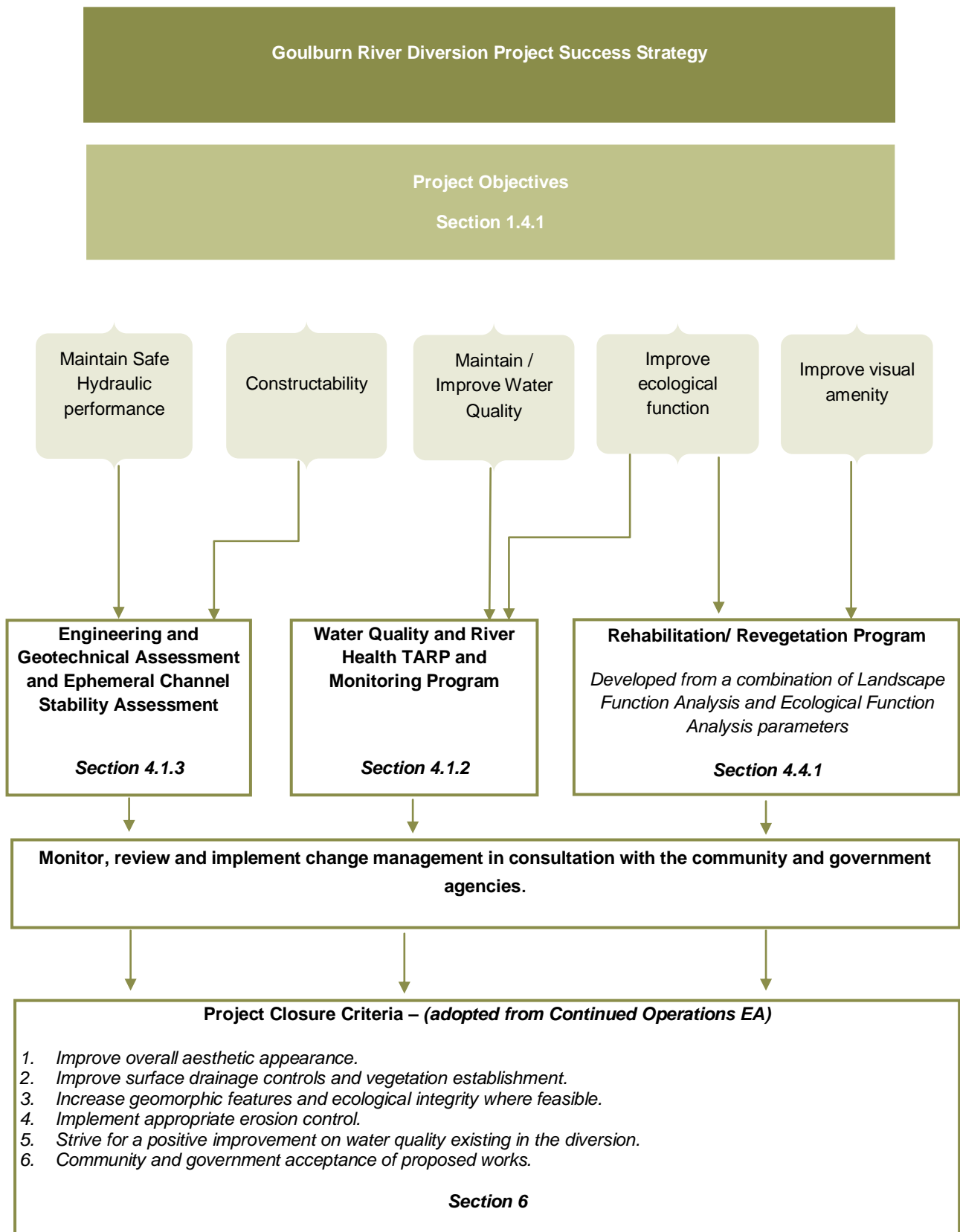
These performance measures are then reconciled back to the project objectives and the requirements of the EA for Continued Operations, Project Approval and the NSW Trade and Investment Mining Operation Plan Guidelines (2013) to provide the Project Closure Criteria in **Section 6**.

1.5 Related Documents

Documents within the UCML Environmental Management System that relate to, or provide support to this GRDRP include:

- Environmental Management Strategy (EMS) (ULN SD PLN 0050);
- Water Management Plan (WMP) (ULN SD PLN 0017);
- Erosion and Sediment Control Plan (ESCP) (ULN SD PLN 0025);
- Goulburn River Diversion Erosion and Sediment Control Plan (ESCP) (ULN SD PLN 0130);
- Surface Water Monitoring Program (SWMP) (ULN SD PLN 0055);
- Groundwater Monitoring Program (GWMP) (ULN SD PLN 056);
- Surface Water and Groundwater Response Plan (SWGWRP) (ULN SD PLN 0057);
- Integrated Mining Operations Plan (MOP) 2010 to 2017;
- Biodiversity Management Plan (ULN SD PLN 0026); and
- Conceptual Mine Closure Plan (ULN SD PLN 0084).

Figure 1.2 Conceptual Framework for measuring project success



2 Planning

2.1 Project Approval

The Project Approval was assessed under Part 3A of the *EP&A Act 1979* and received approval from the Minister for Planning on 15 November 2010 (PA 08_0184).

Since November 2010, two modifications have been made to the approval, as well as changes resulting from a court judgement and associated Orders. Conditions of the Project Approval relating to remediation of the Goulburn River Diversion and the relevant commitments from the *Ulan Coal Continued Operations Environmental Assessment (EA)* (Umwelt, 2009), and an indication of where they are addressed within this document, are contained in **Table 2.1**.

Table 2.1 - Project Approval Conditions

| Project Approval Conditions | Section of Document |
|---|-------------------------|
| 32. The Proponent shall remediate the Goulburn River Diversion to the satisfaction of the Secretary, in general accordance with the proposed strategy in the EA. | This entire document |
| 34. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must: | Refer to WMP |
| (a) be prepared in consultation with EPA, DPI Water, DRE and Council by suitably qualified and experienced persons whose appointment has been approved by the Secretary; | Section 2.4 |
| (b) be submitted to the Secretary for approval within 3 months of the date of final Orders being made by the Land and Environment Court in proceedings No. 10998 of 2010); and | Section 2.4 |
| (c) include: | |
| • a Site Water Balance; | Refer to WMP |
| • the Goulburn River Diversion Remediation Plan; | This GRDRP |
| • an Erosion and Sediment Control Plan; | Refer to ESCP |
| • a Surface Water Monitoring Program; | Refer to SWMP |
| • a Groundwater Monitoring Program; and | Refer to GWMP |
| • a Surface and Ground Water Response Plan. | Refer to SWGWRP |
| <i>Note: The effectiveness of the Water Management Plan is to be reviewed and audited in accordance with the requirements in Schedule 5. Following these reviews and audits, the plan is to be revised to ensure it remains up to date (see Condition 4 of Schedule 5).</i> | |
| 36. Goulburn River Diversion Remediation Plan must include: | Section 2.5.3 and 2.5.4 |
| (a) geomorphic and geotechnical assessment of the existing diversion; | |
| (b) assessment of flood hydraulics of the existing diversion; | Section 2.5.5 |
| (c) staging and timing of remediation works; | Section 3 table 3.1 |

| Project Approval Conditions | Section of Document |
|---|----------------------|
| (d) detailed design of bed and bank remediation works; | Section 3.3 |
| (e) revegetation and rehabilitation methods; | Sections 3.4 |
| (f) a program to monitor surface water flows, quality, stream health and channel stability; and | Section 4.1 |
| (g) an implementation program. | Section 3 Figure 3.2 |

2.1.1 Approvals that do not apply

Under Section 75J of the EP&A Act, as the Project is granted approval under Part 3A of the Act, separate authorisation under the following Acts is not required.

- Fisheries Management Act 1994
- Heritage Act 1974
- Water Management Act 2000
- Native Vegetation Act 2003
- Threatened Species Conservation Act 1995

2.2 Statement of Commitments

Table 2.2 provides the relevant Statement of Commitments as made in Project Approval 08_0184.

Table 2.2 - Statement of Commitments

| Statement of Commitments | Section of Document |
|--|---------------------|
| 6.5.2 The staged remediation strategy for the Goulburn River Diversion will be implemented, generally as described in the Approved Goulburn River Diversion Remediation Plan | Entire document |

The revised GRDRP builds on the staged remediation strategy and is consistent with Section 5.4 (EA).

2.3 Legislation and Guidelines

UCML will remediate the Goulburn River Diversion in accordance with the policies, principles, regulations and guidelines contained within:

- *Protection of the Environment Operations Act 1997 (POEO Act) administered by EPA;*
- *Water Management Act 2000, administered by Department of Primary Industries (DPI) Water;*
- *Water Act 1912, administered by DPI Water;*
- *Environmental Planning and Assessment Act 1979 (EP&A Act), administered by DP&E;*
- *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), 2008);*
- *Managing Urban Stormwater – Soils and Construction, Volume 2C Unsealed Roads (DECC, 2008);*

- *Managing Urban Stormwater – Soils and Construction, Volume 2D Main Road Construction (DECC, 2008);*
- *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries (DECC, 2008); and*
- *National Water Quality Management Strategy: Australian Freshwater Guidelines for Fresh and Marine Water Quality (ANZECC, 2000);*
- *Work Health and Safety Act 2011 No 10; and*
- *Work Health and Safety (Mines) Act 2013 (NSW) and Work Health and*
- *Safety (Mines) Regulation 2014 (NSW) Mining Lease Approval*

UCML 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 GRDRP has been developed in accordance with these requirements.

UCML notes advice from the Division of Resource and Energy (DRE), that as the GRD is a mining related disturbance within Consolidated Coal Mining Lease No 741 and that portions of the security bond held by DRE are in relation to remediation commitments, that the GRDRP requires DRE approval under Condition 3 & 7 of CCL 741 prior to implementation.

2.4 Consultation

In accordance with Condition 34(a), Schedule 3 of the Project Approval, this revised GRDRP was developed in consultation with:

- NSW Planning and Environment (DP&E);
- Division of Resources and Energy (DRE);
- Department of Primary Industries (DPI) Water
- NSW Environment Protection Authority (EPA);
- Mid-Western Regional Council (MWRC);
- NSW Fisheries (NSWF); and
- Hunter Central Rivers Catchment Management Authority (HCR CMA).

In addition to this agency review, consultation has also occurred with the Commonwealth Department of Environment (DoE), neighbouring mines, the Ulan Community Consultative Committee (CCC) and the Registered Aboriginal Representative Group.

Consultation was conducted in two stages, initially through a site visit and discussion and secondly through the review of the draft plan with the opportunity for written feedback. The response to this feedback is incorporated in this plan.

A summary of the consultation undertaken in the development of the Plan is outlined in **Table 2.3**.

Table 2.3 - Summary of consultation in the development of the GRDRP

| Consultation Process | Agency | Issue | Response |
|---|---|---|--|
| Regulatory Focus meeting 10 th April 2013 | <ul style="list-style-type: none"> DP&I DPI Water EPA MWRC HCR CMA | <ul style="list-style-type: none"> Generally endorsed principles brought forward from Expert Panel process. Requested detail regarding design plans, location of works and erosion and sediment control. Requested UCML undertake additional consultation with NSW Fisheries and DRE. Requested draft GRDRP by 30th June for comment and final Plan by 30th August 13. | Contained within this document |
| Agency briefing 13 th May 2013 | NSW Fisheries | <ul style="list-style-type: none"> Provided guidelines on fish friendly river crossings. Requested consideration of "re snagging" for fish habitat. | <ul style="list-style-type: none"> Guideline accepted. Expert Panel originally advised that re-snagging had low potential for success due to lack of target fish populations and difficulty to safely anchor snags. Section 3.2.2 |
| Agency briefing 3 rd & 12 th June 2013 | DRE | <ul style="list-style-type: none"> Relevance of the project through their departmental responsibilities under the Mining Act 1992. Biosecurity concerns with contractors and/or imported materials potential to spread weeds. Reinforced the need to manage soil chemistry and establish competent vegetation cover. Staging of works important to maximise revegetation potential. | <ul style="list-style-type: none"> Supply wash down facilities for contractors to ensure vehicles entering site are clean. Incorporate biosecurity issues into contractor induction. Test imported materials for "cleanliness". Soils inventory, mapping and characterisation. Section 3.2.4 Work sequencing. Section 3.1 |
| Stakeholder meeting 4 th June 2013 and previous quarterly meetings | CCC | <ul style="list-style-type: none"> General agreement with proposal as presented. Requested consideration of "re snagging" for fish habitat. Erosion and sediment control. Management of soils in situ. Long term stability of works | Entire document |
| Stakeholder meeting 12 th June 2013 | Registered Aboriginal stakeholders Group | No issues of concern. | |
| Stakeholder Meeting 22 nd April 2013 | Wilpinjong and Moolarben Mines | Agreed With principles of minimal disturbance and need for thorough erosion control. | Section 3.2.3 |
| Stakeholder Meeting 23 rd April 2013 | (DoE) | Agreed With principles of minimal disturbance and need for thorough erosion control. | Section 3.2.3 |

| | | | |
|--|--|---|---------------|
| Stakeholder Meeting 23rd April 2013 | EPA | Agreed With principles of minimal disturbance and need for thorough erosion control. | Section 3.2.3 |
| Stakeholder Meeting 7 th September 2016 | <ul style="list-style-type: none"> • DP&E • DRE • EPA | <ul style="list-style-type: none"> • Revision of water directed to East Pit. • Long-term turbidity assessments. • Achievability of the current plan. • Why the length of time small • Teams low levels of disturbance at one time. • Reinstate sediment dam • Remediate slump area – Identify why it happened – correct riling between turf rows. • Hole erosion review batter surface. • Small contour drain feasibility. • Where will catchment drain? • Long-term monitoring vegetation of summer species – ensuring turf stability effective, certainty. • Hand seeding over turf. • Mangoola hand seeding. • Web cams on dams. • Drain agreed in concept. • Rock revetment drop structure. • Performance indicator analysis. | |
| Feedback by correspondence email received 12 th September 2016 | DP&E | <ul style="list-style-type: none"> • <i>Number of Error! Bookmark not defined and Error! Reference source not found throughout document.</i> • Table 2.4 row 2 – reference 3.2.3 not 3.3.3 – row 3 should reference 3.2.6 not 3.3.6. • Department of Planning and Infrastructure changed to Department of Planning and Environment. • Page 29 paragraph 2 states works are continuing throughout 2013 – to be updated. • Figure 3.2 should reference Area 4 and be updated to reflect revised schedule. • Page 65 paragraph 3 states that an Erosion and Sediment Control Plan will be submitted prior to commencement of works – statement to be updated. • Section 4.3 – recommended inspections documented. • Are there any learnings from the Pilot and Stage 3b which should be discussed in the report to identify any deviations to what was | |

| | | | |
|--|-----------------|--|--|
| <p>Feedback by correspondence within draft document 8th February 2017</p> | <p>DP&E</p> | <p>previously proposed?</p> <ul style="list-style-type: none"> • Consultation in 2016 missing. • Section 3.2.2.1 update paragraph addressing Bobadeen Quarry as it has already been confirmed and approved. • Section 3.2.6 page 63 update with recommendations from EPA Tailings and Sediment Dam audit. • Section 3.3.1.3 page 64 update dot point referring to monitoring program. • Section 4.1.4 last paragraph should be updated from “will be” to “have been”. • Table 4.5 under frequency – where is continuous monitoring undertaken? • Table 4.5 under response – what is a trend? Two or more points? Over what period? • Table 4.5 under response – are there other causes apart from contamination? • Table 4.5 under frequency – Is there a designated location in each remediation area at which the measurement will be undertaken? • Section 4.3 last paragraph remove CMS. • Section 4.4.1.2 page 79 section seems out of place and cut and paste from another document. Supposed to be dot points? • Section 4.6 under reporting heading – this plan is more than relating to water management. • Table 8.4 under change summary – Include this latest version submitted. • Appendix A – Correspondence – Has the ESCP for the Goulburn River Diversion been submitted to the Department for approval? Approvals should be incorporated into this document. | |
|--|-----------------|--|--|

A summary of formal agency responses to the Plan is provided in **Table 2.4**.

Copies of Agency correspondence are contained in **Section 11**.

Table 2.4 - Summary of Agency Responses to Goulburn River Diversion Remediation Plan

| Issue | Response |
|--|--------------------------------|
| NSW Planning and Environment | |
| Supports Pilot process however questions the time period allowed to verify the appropriate methodologies and still finalise works in a continuous program over 12 months. | Section 3.1 |
| Requests consideration of, or justification for exclusion of, removal of sediment build up in the channel and installation of structures to create pools for aquatic fauna habitat. | Section 3.2.3 |
| Requests an overarching ESCP to be approved by the DG prior to implementation of works. | Section 3.2.6 |
| Requests information on nature, location and timing of monitoring activities and trigger levels for corrective action. | Section 4.1. |
| Requests measurable indicators for project closure. | Section 6 |
| Office of Water | |
| Raises concerns that excavation in the channel floor will lead to headward bed incision and possibly effect Ulan Road crossing and Ulan Road bridge. Raises concerns that excavation disturbance may release heavy metals contained in channelised sediments. | Section 3.3 |
| Agrees that rock armour revetment works will have little impact on fish habitat. Requests detail on the tractive stress limits for foreseeable flood events. | Section 3.3 |
| Raises concerns of ongoing maintenance if works are not sufficiently designed to accommodate storm events. Raises the need to incorporate drop structures into the revetment works. | Section 1.4 Section 3.3.1.1 |
| Recommends monitoring and performance reporting as critical to achieving beneficial outcomes from the proposed works. | Section 4. |
| Recommends improved soil management, and the use of ameliorants, to promote revegetation opportunities. | Section 3.3.5 |
| Environment Protection Authority | |
| Supports the use of the Pilot Area concept and requests a site inspection by the relevant agencies prior to the commencement of the remaining works. | Section 3.1 |
| Requests continuous turbidity monitoring to be installed upstream and downstream of the diversion. The period of such monitoring to be determined in consultation with the EPA. | Section 4.1 |
| Erosion and sediment controls to be inspected following defined rainfall events and in addition to the weekly inspections identified in the draft plan. Inspection following defined events should continue after construction is complete. | Section 3.3.6 |
| Erosion and Sediment Control Plan to include water quality monitoring, incident response, and wet weather contingency procedures. | Section 3.3.6 |
| Primary Industries – Fisheries NSW | |
| Requests consideration of installing in-stream rehabilitation works, i.e., re-snagging. | Section 3.3.3 |
| Suggested possible authorisation under the <i>Fisheries Management Act 1994</i> . | Section 2.1.1 |
| Primary Industries - Division of Resources and Energy | |

| Issue | Response |
|--|--------------------------------|
| Restate ecological objective from <i>Maintain and/or improve ecological function to Improve ecological function</i> , Benchmark the objectives against analogue river sections. | Section 1.4 Section 4.4.1.1 |
| Requests quantitative indicators for performance measures. | Section 4. |
| Soil Parameters to be included in a monitoring programme. | Section 4.4 |
| Consolidated Coal Mining Lease No 741 advises that under the mentioned lease, DRE approval for the GRDRP is required prior to implementation. | Section 2.3.1 |

2.4.1 Post Pilot Review

This post-pilot revision of the Goulburn River Diversion Remediation Plan is provided for comment and in preparation for consultation with agencies. The Community Consultative Committee (CCC) were consulted on 26 November 2015. Their comments are included in **Table 2.5** below.

Table 2.5 - Summary of CCC Responses to Goulburn River Diversion Remediation Plan

| CCC Comment | UCML Response |
|--|---|
| Consider key species which are common in the downstream undisturbed reaches (Lomandra sp., Teatree – <i>Leptospermum polygalifolium</i> , River Wattle – <i>Acacia floribunda</i> (atypical form), <i>Callistemon rigidus</i> (range extension). | There is opportunity for further tree species to be included within the rest of the Project area |
| Identified that further improvement opportunities could include the use utilisation of natural looking design as opposed to an engineered structure appearance. The usage of logs and other wooden structures would also help the appearance of the Project area whilst providing micro habitat and sediment and erosion control benefits. | Opportunities for inclusion of logs or wooden structures and more natural features above the river bank will be considered. The expert panel found there were no defined species of fish requiring reconstruction of habitat and there is little woody debris in representative sites above or below the river. Woody vegetation on the banks has potential to bank water and increase erosional pressure at those points so no changes within the banks are recommended. |

2.5 Baseline Data

2.5.1 Land Use

The site is situated in a rural area, primarily surrounded by rural landholdings, native bushland and primary industries including agriculture, forestry, mining and extractive industries. Grazing is widespread throughout the surrounding area while the area to the south and south-west is dominated by rural residential landholdings.

The Ulan Village is located approximately 1.5 kilometres west of the Coal Handling and Preparation Plant. Three areas of higher density rural residential landholdings are located to the south, west and south-west of the site along Ridge Road (approximately 7 kilometres south of the project area), Cope Road (approximately 6 kilometres to the south-west of the project area) and Wonga Roo Road (immediately adjacent to the western project boundary). Smaller rural holdings are located immediately to the north, north-west and west of the underground mining area.

2.5.2 Local Topography

The Ulan Mine Complex straddles the Great Dividing Range and is located at the headwaters of the Goulburn River system (which drains to the east to the Hunter River catchment) and the Talbragar River system (which drains to the west to the Macquarie River catchment).

The elevation of Ulan Village is about 420 metres AHD and local relief varies above that up to 540 metres AHD. The topography of the UCML site and surrounding area is typical of the landforms evident in the eastern uplands of the Great Dividing Range and can be characterised into three main landform types; broad valleys, transitional rocky uplands and areas of elevation.

The broad valley floors within the Ulan Mine Complex are associated with the Goulburn River and Talbragar River and the lower reaches of Ulan Creek near the junction with the Goulburn River. These areas have been almost entirely cleared for agricultural activity such as grazing of sheep and cattle, and for the construction of the mining operations.

2.5.3 Geomorphology

2.5.3.1 Natural

The natural geomorphology of the Goulburn River, as described in the URS Report (2009), was gently sinuous in form and followed a generally north-east and then north alignment.

The original channel geomorphology was not recorded prior to construction of the diversion but the river most likely occupied a narrow valley constrained either side by bedrock.

The channel may have had alluvial characteristics with an overall slope of approximately 0.003 m/m but there was probably no adjacent floodplain. The natural channel most likely had geomorphic characteristics similar to the reaches directly upstream and downstream of the diversion.

The upstream reaches retain natural morphological features. The valley floor is alluvium, with a poorly defined shallow 5 to 10 metre wide low flow channel and a broad 30 to 50 metre wide valley floor (URS, 2009).

The downstream channel has variable sediment accumulations, forming distinctive mounds up to 1 metre high across much of the channel bed. A wider floodplain is also evident downstream, resulting in lower stream power and velocity in extreme rainfall events.

An insight into the pre diversion condition of the GRD has been provided in a geomorphic assessment undertaken by Fluvial Systems in August 2013. The study investigated, amongst other things, a review of all available aerial photographs from 1955 to 2008 with the aim of describing the pre diversion stream form. The assessment determined that:

- The river was already highly modified and that there appears to be evidence that the river was diverted from its original course pre 1955 to allow for agricultural production;
- The valley on the eastern bank, was cleared for agriculture and showed evidence of gully erosion and contained no floodplain features such as wetlands and meanders; and
- Photographs reveal that some of the largest gullies that are present on the side slopes today can be seen as incipient features on the 1988 aerial photograph. Areas of bare soil and areas affected to various degrees by rill and gully erosion were distributed throughout the Diversion. Bare areas can also be observed on the banks of the Goulburn River upstream of the Diversion and downstream of the Diversion. Although the banks upstream and downstream of the Diversion are mostly well vegetated and stable, the existence of areas of poorly vegetated banks with apparent erosion illustrates the reality that a degree of bank erosion is natural and expected.

2.5.3.2 Existing Geomorphology of Diversion

The URS Report (2009) describes the current diversion geomorphology as having a trapezoidal channel cross section along most of its length, with a more box cut canyon like form through the

central reaches of the diversion. Benches were constructed on the channel banks and raised bar-like structures were constructed to act as low weirs during low flow.

Unlike the alluvial, low-flow reaches upstream and downstream of the diversion, the diverted reaches are characterised by deep bed-rock channels with high stream power. The diverted reaches provide little replicating geomorphic characteristics and sediment is trapped around dense reed vegetation. The trapezoidal reaches of the channel have sufficient capacity to convey a 100 year Average Recurrence Interval (ARI) flood event.

The specific stream power values are high, particularly immediately downstream of the confluence with Bora Creek (a tributary entering from the east of the diversion). Observations along these reaches showed the banks were not being eroded by fluvial action and were generally stable, which is consistent with the bedrock characteristics of these reaches.

The downstream extent of the diversion is however formed in deeply weathered rock materials. The evaluation of stream power was consistent with that for an alluvial channel, however the assessment suggests that stream power slightly exceeds the appropriate thresholds. However fluvial erosion features were not identified and hence the diversion channel in these reaches is considered reasonably stable (URS, 2009).

The Eco Logical Australia report (2014) confirms that the overall morphology of the diverted river has remained unaltered since it was formed. However, extensive erosion has occurred and there has been substantial loss of topsoil along parts of the mid and lower banks. In many areas low fertility and highly dispersible subsoil is exposed.

2.5.4 Geotechnical Assessment

Geotechnical investigations were carried out to characterise and assess the engineering properties of the bank material. As a result of the investigation, two main geologic units that were found to be present within the Goulburn River Diversion (URS, 2009) included:

- Saprolite (highly weathered bedrock) – forms the underlying unit along the Goulburn River Diversion and has been measured up to 10 metres deep. Saprolite breaks down to soils comprised of sandy clays and clayey sands with some gravelly sands with clay; and
- Bedrock – forms the underlying unit below the saprolite. This unit is hard and durable, mainly consisting of mudstone and carbonaceous material.

Erosion is evident throughout the Goulburn River Diversion in the form of rills and gullies running horizontally down the diversion slope and several locations show evidence of deep scouring in the slope face. Erosion within the dispersive saprolite unit is generally caused by physically weathering in the form of raindrop impact on the exposed slopes and overland flow. The bedrock unit is resistant to erosion from overland flow, showing only minor evidence of rockfall accumulations.

Stability investigations were conducted to determine the slopes V: H (vertical to horizontal) ratio that would minimise instability risks. The results of the stability analysis determined that a ratio of 1:3 (V: H) was suitable to minimise the erosion and stability issues.

The rock revetment slopes of the pilot project ranged from 1:2.5 to 1:5.5, which is steeper than the design slope. URS performed a check of batter chute drainage and this was found to be consistent with the design intent. The stability of the batter will be monitored and repaired if needed. This approach will guide the larger rehabilitation of other river reaches (URS, 2015).

Specifications for re-profiling to enhance slope stability are outlined in **Section 3.3**.

The batter slopes of the pilot project ranged from 1:2.7 to 1:3. On site observations, supported by detailed survey advice, indicates that when the batter slopes in situ are 1:2.7 or better, the batter appears to be stable and capable of maintaining suitable levels of vegetation.

2.5.5 Hydraulic Assessment

A hydraulic model (URS, 2009) was developed to guide the design of the channel improvement works. Specifically, the hydraulic model was used to determine the following:

- predict the natural flow characteristics through modelling of upstream and downstream reaches;
- determine existing flow characteristics of the diversion; and
- allow testing of the potential measures that channel modification requires to lead to natural flow characteristics for a hydraulically stable stream.

The process of hydraulic modelling as described in the URS Report (2009) involves modelling of the Goulburn River Diversion, including reaches upstream and downstream, using a one-dimensional steady state HEC-RAS hydraulic software. The software allows calculation of stream characteristics including flow depth, velocity, stream power and bed shear. Both natural and existing conditions were modelled to assess the changes in flow characteristics.

The hydraulic model (URS, 2009) indicates that stream power has been slightly increased in the diverted channel from the natural non-diverted condition. An increase in stream power in the diverted reaches of Goulburn River indicates a high potential for greater sediment transport than in other reaches of the river. The lack of floodplain leads to an increase in stream power and subsequent potential for channel, bed and bank erosion, particularly during high flow conditions (i.e. > 20 year ARI event).

In May 2013, URS were again engaged to review the impacts of the revised GRDRP recommendations and concluded that the intended stability works for the Goulburn River Diversion will have a relatively minor effect on the hydraulic behaviour of the channel.

Generally this effect will be to slow down the flow, reducing the potential for erosion. The results of the hydraulic modelling and rock sizing, is discussed further in **Section 3.2.2.1**.

2.5.6 Existing Vegetation Condition

The area downstream of the diversion channel is a widespread corridor of sclerophyll forest with broad vegetation cover, riparian species diversity and bank stability. The reaches upstream of the diversion have minimal vegetation cover and fragmented habitat. The condition of vegetation above and within the diversion is generally poor with minimal diversity of native species within the riparian zone, having been cleared and heavily disturbed in the past by agriculture, road construction and mining-associated activities.

Previously, URS advised that enhanced canopy vegetation would improve bank stability and reduce the occurrence of erosion and sediment transport. Subsequently, and conversely, Eco Logical Australia (2014) have advised that stabilisation works on banks ought to be focussed on soil landscape reforming and that trees and shrubs would potentially increase rilling and erosion. This characteristic was evident where mature *callytris* species were allowed to remain in the bank near the rock drain of the pilot project. Eco Logical recommended that a grass cover (using a species with runners) be used as a sustainable vegetation cover to stop runoff and scouring and stabilise the bank (report attached Appendix B).

2.6 Risks to this Strategy

A risk assessment was facilitated by SP Solutions Pty Ltd. A list of issues and risks that may impact upon the ability to successfully implement the GRDRP and where they are addressed in this document is outlined in **Table 2.6**.

Table 2.6 - Issues and Risks

| Key Issues and Risk (Reference) | Response (updated with Pilot Review Findings) |
|---|---|
| Adequacy of erosion and sediment control plans (Section 3.3.6) | <p>Rock baulks were effective as sediment control measures during the pilot, however, sediment fencing in some applications was counterproductive.</p> <p>The use of sediment fencing in the ESCP for the project will be reviewed, in consultation with the EPA. A site specific ESCP is developed for each section of work as part of the GDP process.</p> |
| Slope steepness and construction meet with design intent. (Pilot review finding) | <p>Scope of engineering review for next phase of work to include the sign off expectation.</p> <p>Confirm final design with the engineers prior to commencement.</p> <p>Consider local suppliers for engineering services.</p> |
| Rock revetment installed in the pilot project was not tested by a significant flow event. Trees at the toe of revetment could increase turbulent flow and allow scour along the toe of the revetment. | <p>If scour develops around tree bases remove trees.</p> <p>Remove sediment fences.</p> <p>In later sections, plant trees at least 1m from rock revetment.</p> |
| Transitions from the table drains to the drop structures. Detailed design for this was not included in the plan | <p>Repair lead in to existing drop structures, remove sediment fences, some areas of sediment need to be collected but others are able to remain.</p> <p>Commission supervising engineer for structural sign off.</p> <p>Review size of rock (smaller rock will be easier to work with and improve definition).</p> |
| | |
| Pollution of creek line as a result of construction machinery (i.e. hydrocarbon spills from earthmoving equipment) (Section 3.3.2) | <p>During the pilot study, regular and ongoing maintenance of machinery meant that there were no hydrocarbon spills. This strict maintenance regime will continue for the duration of the project.</p> |
| Failure to meet revegetation targets (Section 4.4.2) | <p>The pilot study identified that;</p> <ul style="list-style-type: none"> trees (<i>Callitris endlicherii</i>) were causing denudation of cover; and in some areas strike rates were low. <p>Part application of turf and revised species list are included in remaining sections. A permanent water line for watering will be installed.</p> <p>Avoid over compaction of soil.</p> <p>Improve topsoil condition by increasing intensity of soil sampling and increase composting rates.</p> |
| Delay to remediation project due to unseasonal or creek flood flow conditions (Section 3.1) | <p>This did not occur during the pilot study, however, could have the potential to cause delays to future</p> |

| | |
|--|---|
| | phases of work. |
| Turnover of staff and loss of corporate knowledge of project (Section 3.1) | The pilot project and reviews were documented by URS (construction report) and Eco Logical, (vegetation assessment and revegetation recommendations). These reviews will be undertaken annually until the completion of the project |
| Manage change to project design throughout construction by proper documentation (Entire GRDRP) | This document updated and submitted for consideration of agencies. |
| Contractor capability | Project Induction process and Pilot study |
| Work Health and Safety issues with installation of works on high and steep batters | Glencore and UCML Standards and Protocols apply |

3 Implementation

3.1 Proposed Remediation Program

The diversion is delineated into six Areas which are primarily based on catchments, geology, degree and causes of erosion and recommended remediation works.

The Areas are generally consistent with the URS 2009 report.

These areas are from Ch 0 upstream to Ch 4200. Bank references are defined by left hand side (LHS) and right hand side (RHS) when facing downstream. **Figure 3.1** shows the spatial distribution of recommended works while **Table 3.1** details the preferred options, and timing, for the delineated Areas of the Goulburn River Diversion:

- Area 1 Ch 0 – 1000 Both Sides
- Area 2 Ch 1000 – 1840 LHS
- Area 3 Ch 1000 – 1840 RHS (Pilot area)
- Area 4 Ch 1700 - 2840
- Area 5 Ch 2840 - 3540 Both Sides
- Area 6 Ch 3540 - 4200 Both Sides
- Above stream drainage Ch 1140 - 3360

The Pilot Area: This site was chosen as it is representative of the broader project works and allows all design options to be trialled before commencement of broad scale operations. The Pilot concept is of strategic importance to the successful implementation of the Plan as it allows UCML to:

- test all its construction methodologies to be applied elsewhere on the project;
- test rehabilitation/revegetation methodologies; and
- observe operator capability.

The Pilot Area was originally defined as Ch 1000 – 1480 RHS in the draft Plan. This has been expanded to Ch 1000 – 1840 (RHS) and incorporates the previous 3(a) and 3(b) Areas respectively. The reason for the expansion is to provide the Pilot Area with a more appropriate scale. On commencement of the pilot study, this decision was reversed, with only Area 3(a) included in the pilot.

Works on the Pilot Area occurred in second and third quarter of 2014. At the post construction inspection, the URS engineer recommended allowing at least 12 months to assess the construction performance of the Pilot area and adjust methodologies as required.

The Pilot Area will also provide an opportunity for stakeholders to review implementation results early in the remediation process.

The remaining areas are:

- Area 3(b) Ch 1480 – 1840 RHS (completed)
- Area 2 Ch 820 – 1700 RHS
- Area 4 Ch 1700 - 2840
- Area 5 Ch 2840 - 3280 Both Sides
- Area 6 Ch 3280 - 4060 Both Sides
- Above stream drainage Ch 1140 - 3360

Works will also include provision for temporary access during construction.

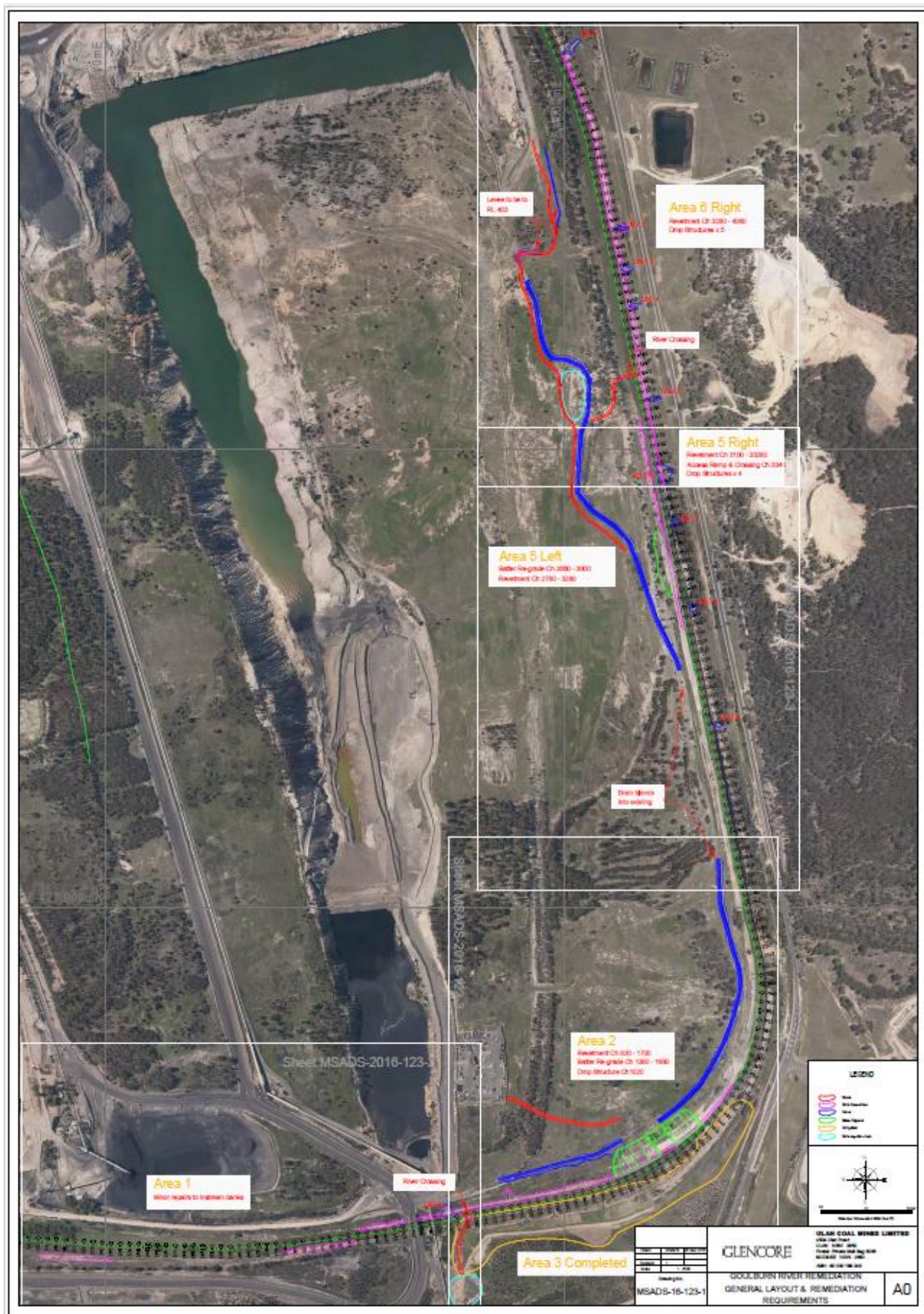


Figure 3.1 - Spatial distribution of Recommended Works for the Goulburn River Diversion Areas.

Table 3.1 - Proposed Remediation Works and Indicative Program – Updated

| Area | Location | Proposed Remediation Works | Timing |
|--|---------------------------|--|------------------------------------|
| <ul style="list-style-type: none"> Finalise detailed design, engineering calculations and geotechnical assessment. Invite, evaluate and award tenders. | | | |
| Rock Production for Erosion Control | | | |
| Production of basalt rock for erosion protection | Bobadeen Quarry | <ul style="list-style-type: none"> Confirm approvals and quarry operator | Q3 2016 |
| | | <ul style="list-style-type: none"> Site establishment Production and delivery of rock. | Q3 & Q4 2016 Q1 & Q2 2017 |
| Civil Works | | | |
| Area 3A PILOT AREA | 1000 – 1480 RHS | <ul style="list-style-type: none"> Rock toe protection, batter reshaping, surface water managed via the construction of upstream drainage channels and drop structures. | Q3 & Q4 2014 |
| Area 3 B | 1480- 1840 RHS | <ul style="list-style-type: none"> Batter repairs and revegetation. Surface water managed via the construction of upstream drainage and drop structure. | Q1 & Q3 2016 |
| Area 1 | 0 to 820 RHS & LHS | <ul style="list-style-type: none"> Batter shaping. Disturbed soils treated with ameliorants, soil conditioner and protective cover. | Q1 2018 |
| Area 2 | 820 – 1840 LHS | <ul style="list-style-type: none"> Rock toe protection, batter reshaping, surface water managed. Batter reshaping | Q1 & Q2 2017 Q3 & Q4 2017 |
| Area 4 | 1700 - 2840 | <ul style="list-style-type: none"> Minor repairs were possible, above stream drainage | Q2 2017 |
| Area 5 | Ch 2840 = 3540 RHS&LHS | <ul style="list-style-type: none"> Rock toe protection, surface water managed via the construction of upstream drainage channels and drop structures to suit. Batter reshaping | Q1 & Q2 2017 Q3 & Q4 2117 |
| Area 6 | Ch 3540 -4200 RHS&LHS | <ul style="list-style-type: none"> Rock toe protection where required | Q4 2017 & Q1 2018 |
| Upstream Drainage and access roads | 1000 – 3500 LHS | <ul style="list-style-type: none"> Construction of upstream drainage channels and drop structures. | Q1 & Q2 2017 |
| Tree / shrub establishment | | | |
| Pilot Area | 1000 – 1480 RHS | Revegetation of channel batter where possible and surrounding riparian land. | Q1 & Q2 2015 |
| Area 3 B | 1480- 1840 RHS | | Q2 2015 |
| Areas 1,2,4,5 & 6. | Remainder | | 2017 & 2018 Spring Autumn |

The initial schedule intended implementation of works over an approximately a three year period (first quarter of 2014 to second quarter 2016). The Pilot Area, mentioned in **3.1 Proposed Remediation Program**, was remediated in the second and third quarters of 2014. On advice from the project engineer, commencement of the remaining remedial program was postponed to allow time to understand if significant deficiencies would occur in the pilot area.

A review of project success indicators in November 2015 identified the following changes that would be implemented as part of the larger project implementation:

- Trees were found to be significantly reducing vegetation establishment and provided potential for erosion and scouring to take place. It is considered important to have grasses on the banks to maintain stability, rather than trees;
- Sediment fences perpendicular to drainage lines caused water to bank up and fail on the drainage bunds. Sediment fences should not be used in these locations. The most appropriate way to avoid this effect is to taper the rock check into the drain to facilitate flow into the drop structures;
- Surface treatments intended to provide germination microclimate had the effect of over compacting on batters. Light ripping and seeding will be used on batters going forward;
- Sandstone surfaces that appear as solid rock faces in initial excavations have eroded rapidly to sandy, dispersive soil. Going forward, exposed materials that cannot be revegetated will be covered in rip rap; and
- Trees planted in the base of the diversion may be too close to the rock revetment, this has the potential to increase water velocities adjacent to the rock revetment which could in turn destabilise it.

Area 3b of the project was commenced in 2016, and completed by July 2016. That section of the project was hampered by above average rainfall conditions. The steep batters in this section, combined with the consolidated surfaces presented a risk that, if a hydromulching method was implemented, the predicted rainfall events could mobilise the topsoil before groundcover could establish. Hence turfing was used to protect batter surfaces. This method was effective in minimising sediment movement. Inspections and assessment of root development will be undertaken as part of the monitoring of establishment.

Area 3b also showed that the time frame of works may be considerably affected by weather conditions. The base of the diversion was inaccessible for approximately 8 months. Which has affected the program schedule. The timeframes in this revision of the plan reflect the delays encountered to date and are more conservative for the remaining work.

Revegetation and shrub/tree establishment will be aligned with climatic windows that maximise opportunities for vegetation establishment and therefore may be implemented over a slightly longer timeframe.

Linking the drainage structure in area 2 with the drainage structure in area 4 will minimise major drop structures in steep sections of the diversion bank and provide containment of the work area within the dirty water catchment during construction.

The following (**Figure 3.2**) provides an indicative project plan for the implementation of the remediation works. This project plan will be refined during consultation with the preferred contractors.

| | |
|----------------|--|
| Title | Indicative Work Schedule for the GRD Remediation Project (October 16). |
| Project Start | 1 st Quarter 2014 |
| Project Finish | 4 th Quarter 2018 |

| Work Areas | Task | 2016 | 2017 | | | | 2018 | | | |
|-------------------------------------|------------------|------|------|----|----|----|------|----|----|----|
| | | Q3 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Bobadeen Quarry | Quarry rock | | | | | | | | | |
| Area 3B ch1450 to ch1720 | Batter repairs | | | | | | | | | |
| Drain ch1080 to ch3660 | Construct Drains | | | | | | | | | |
| Area 2 ch860 to ch1800 | Rock revetment | | | | | | | | | |
| Area 2 ch1380 to ch1680 | Batter repairs | | | | | | | | | |
| Area 4 ch 1860 to ch2640 | Construct Drains | | | | | | | | | |
| Area 5R ch3080 to ch3540 | Rock revetment | | | | | | | | | |
| Area 5L ch2780 to ch3540 | Rock revetment | | | | | | | | | |
| Area 5L ch3080 to ch3280 | Batter repairs | | | | | | | | | |
| Area 6 ch3540 to ch4200 | Rock revetment | | | | | | | | | |
| Area 1 ch0 to ch1000 | Batter repairs | | | | | | | | | |
| Revegetation of all areas | Revegetation | | | | | | | | | |
| Review Monitor and repair all areas | Monitor repair | | | | | | | | | |
| Contingency for weather delays | | | | | | | | | | |

Figure 3.2 - Indicative Project Plan Goulburn River Diversion Works by River Remediation Area

Refer to **Figure 3.1** for a spatial representation of Goulburn River Diversion Remediation Areas. The Figures in this section are a general representation of works and there may be minor changes to final design pending additional analysis.

3.1.2 Remediation Area 1 (Ch 0 to 820 RHS & LHS)

This area is from Ch 0 to 1000 and runs west to east. It is constrained between mine facilities that have been constructed on both sides at its beginning and extends to the double bridges.

The banks are artificial and composed of fill from the diversion cut.

The channel is approximately 50 m wide and narrows as it approaches the bridges.

HEC–RAS modelling shows that all floods to a 100 year ARI are contained with a 1.5 – 4.5 m freeboard. The depth of flow at the 5 year ARI is approximately 2.2 m.

The channel has mounds of sediment up to 1.5 m high. At Ch 400 exists a mound occupying approximately 40 m and separates flows to either side of the channel. Banks are approximately 8 m high and there are minor incised erosion sites on both sides including minor rilling to the upper bank and at the base.

Figure 3.3 shows the scope and spatial distribution of the works.

Figure 3.4, Figure 3.5 and Figure 3.6 shows the design detail for Remediation Area 1



Figure 3.3 - River Remediation Area 1 – Spatial Distribution of Remediation Options

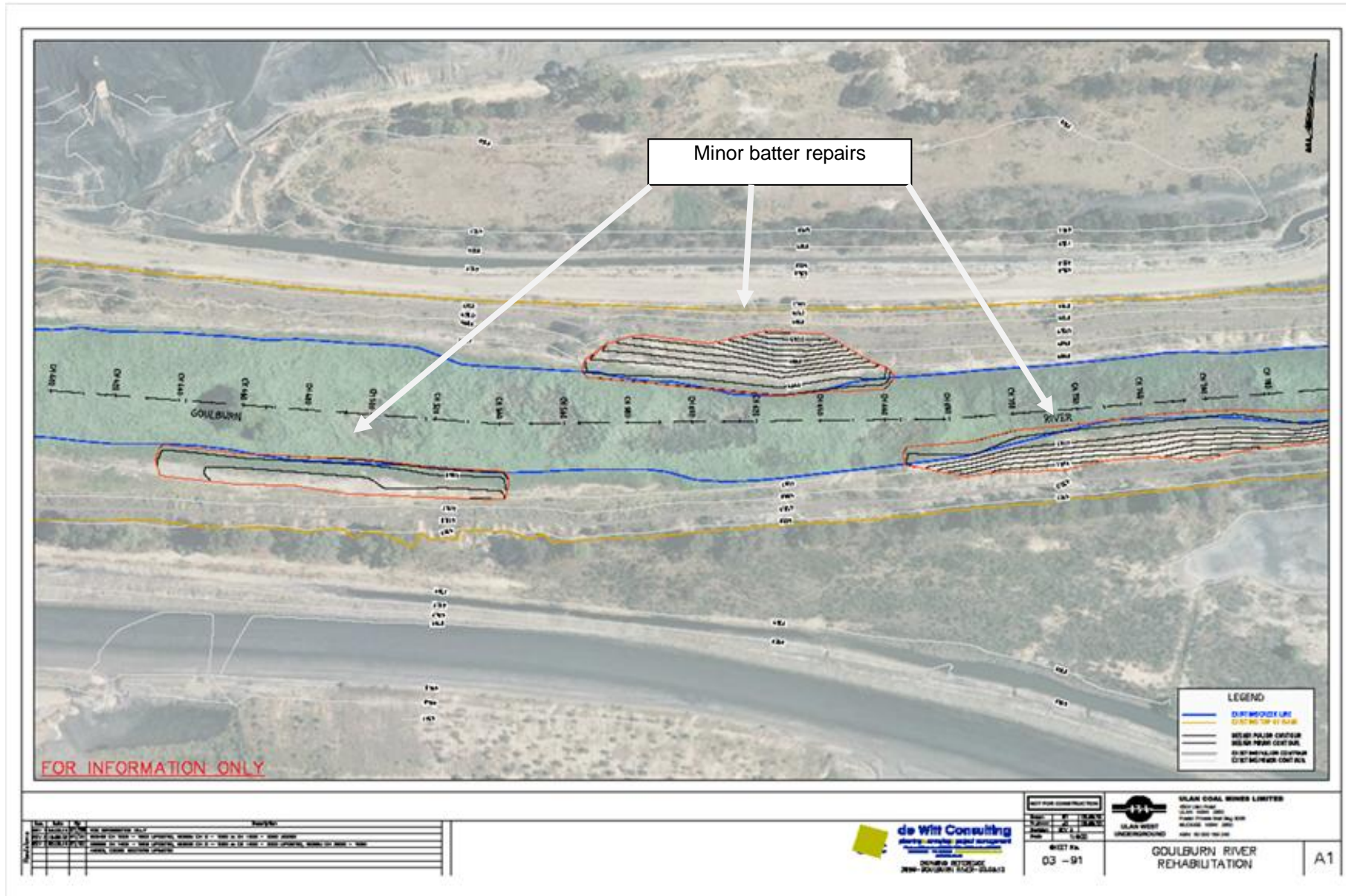


Figure 3.5 - Design drawings for Remediation Area 1 Ch 440 to 780 RHS & LHS

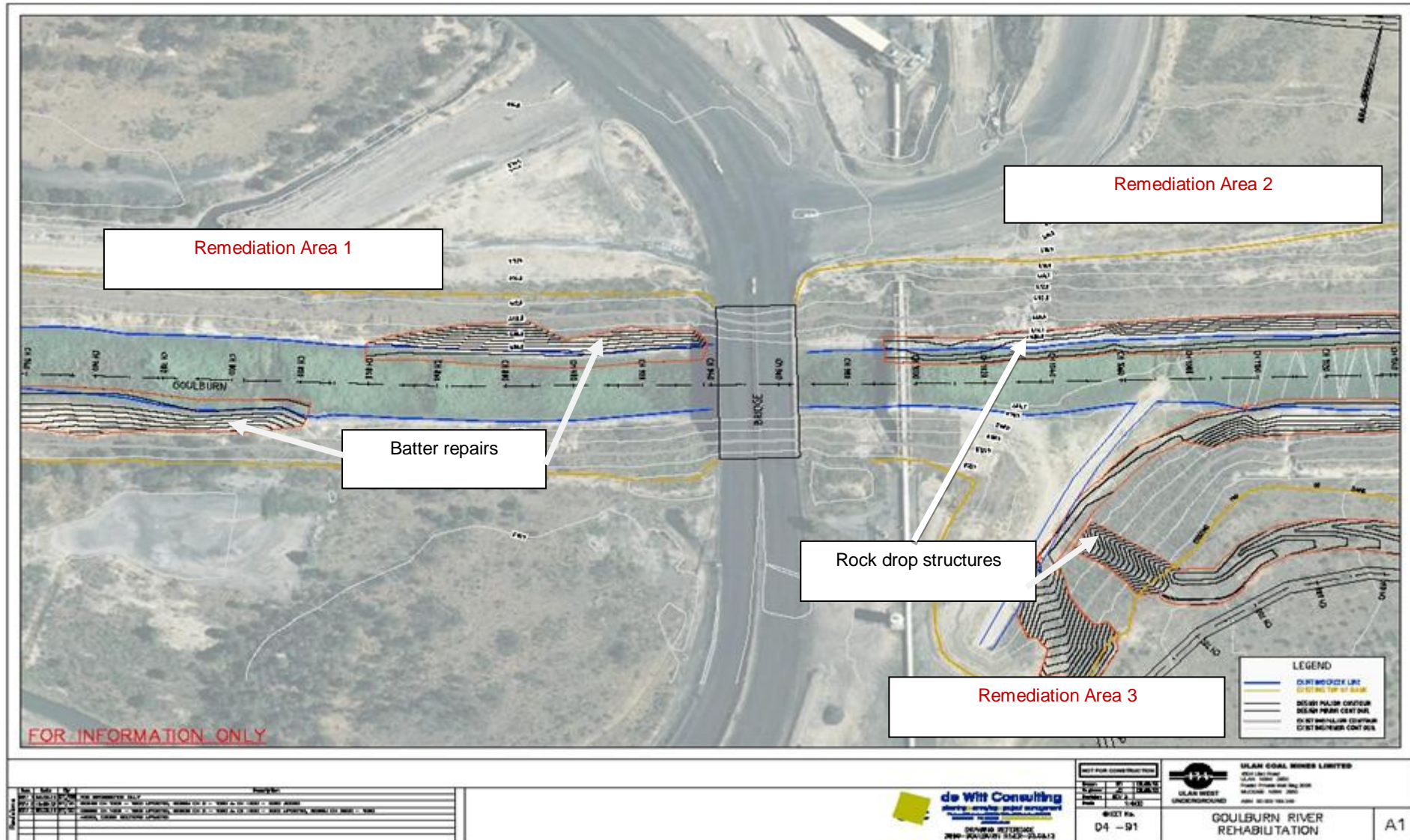


Figure 3.6 - Design drawings for Remediation Area 1 Ch 740 to 940 RHS & LHS

3.1.3 Remediation Areas 2 (Ch 820 to 1700 LHS) and 3 (Ch 1000 to 1720 RHS)

The two areas occur from approximately Ch 820 to 1700. It is the part of the diversion that runs east from the twin bridges and then begins to swing at approximately 90 degrees to commence its northern path parallel to the mine boundary and Ulan Road.

Area 2 is the LHS of this channel, Area 3 is on the RHS, and is from Ch 1000 to 1840.

The channel is a trapezoidal cut and is narrower than Area 1, on average 27 m wide. The grade is gentler at 0.0064 m/m.

HEC-RAS modelling indicates that the 100 year ARI is contained with 1.5 to 12.3m freeboard. The depth of flow at the 5 year ARI is 3.7 m.

Cross sections show sediment mounds of 1 m high in the central parts of the channel bed and the mean bank height is 18.8 m.

Up to Ch1400, batter grades are generally between 1:2.7 and 1:3. After this they are slightly steeper, which appears to have a direct correlation with the presence of erosion and rilling.

At Ch 1500, rilling exists for nearly 50 meters running the full length of the bank. The diversion is cut into highly dispersible saprolite material and erosion by undercutting exists for the first 2 to 3 metres of the batter slope.

At the eastern end of the area, the channel is cut into bedrock and the toe of the batter is naturally protected.

Figure 3.7 shows the scope and spatial distribution of the works for the respective areas.

Figure 3.10 and Figure 3.12 shows pilot and 3B areas completed

Figure 3.7, Figure 3.8, Figure 3.10 and Figure 3.11 shows the design detail for Remediation Area 2. These proposed remediation works includes rock armour at the toe of the batter for almost the entire length of the Area. In all cases within the diversion, the rock protection is placed on a rock platform designed to keep machinery out of the channel bed.

The batter from Ch 1000 to 1400 is comparatively well vegetated however there are isolated sections that require shaping and revegetating. More extensive batter shaping is to occur at Ch 1400 to 1660m.

An upstream drainage channel protects the batters and transports overland flow east and west.

This section has one access point.

Figure 3.10 outlines the proposed remediation works for the Pilot area from Ch 1000 to 1420 RHS. The works includes rock armour at the toe of the batter for almost the entire length of the area.

The batter from Ch 1000 to 1425 has significant rilling and will be shaped and revegetated.

An upstream drainage channel protects the batters and conveys overland flow westerly to a drop structure at Ch 1100.

This section also has an access point.

Figure 3.11 photo shows the completed area Ch 1420 to 1845 RHS. The drop structure that was to be at Ch 1700 has been moved to Ch 1600 due to constructability and taking advantage of the lowest point at Ch1600 and coincide with the large washout at this point.

The batter toe is stable at this point and no toe protection is recommended.

The batter from Ch 1420 to 1820 has eroded and batter shaping and revegetation is recommended.

An upstream drainage channel protects the batters on the LHS and conveys overland flow easterly towards the East Pit. The drop structure on the LHS at Ch 1660 has been removed and drain extended **Figure 3.21**

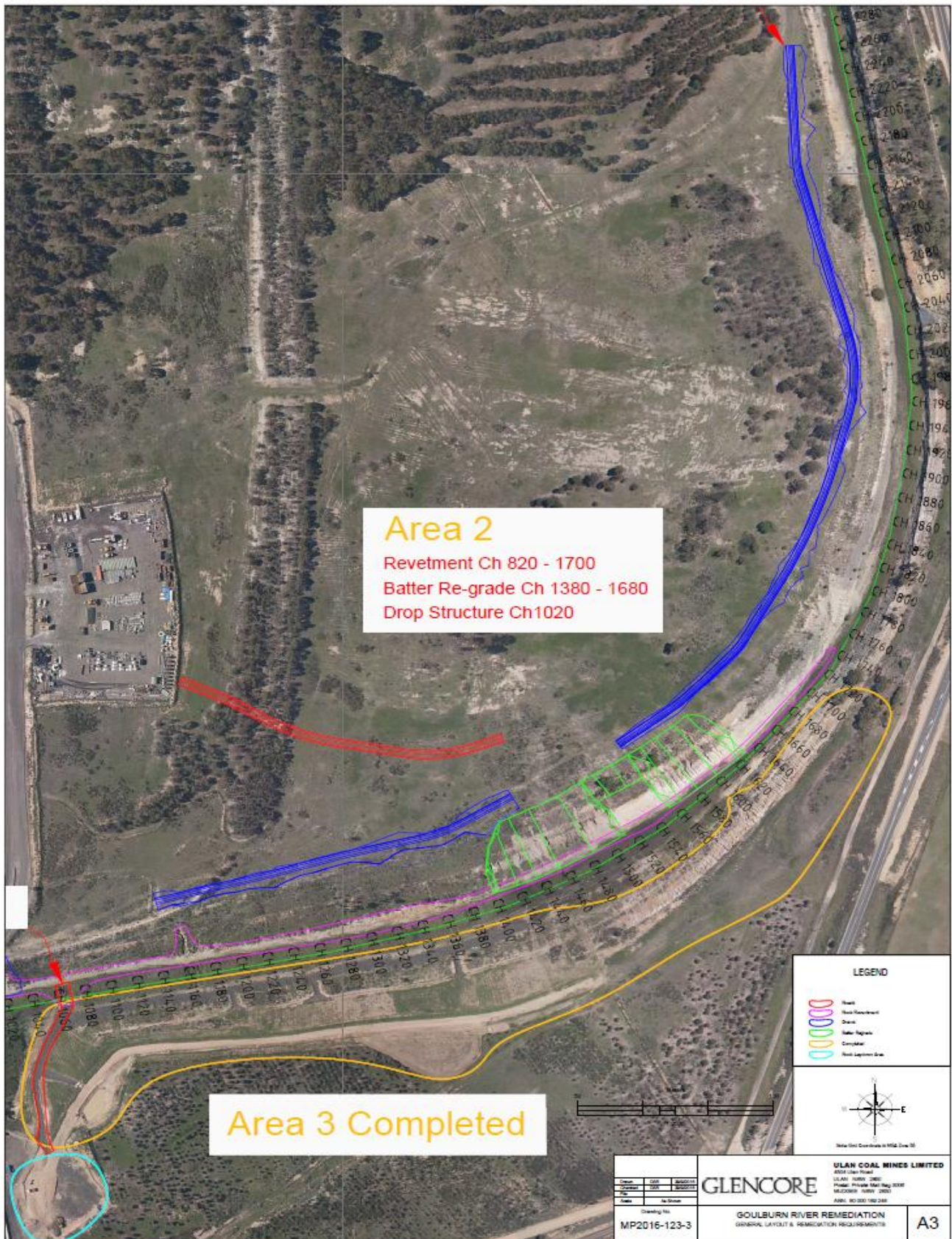


Figure 3.7 - River Remediation Area 2 – Spatial Distribution of Remediation Options

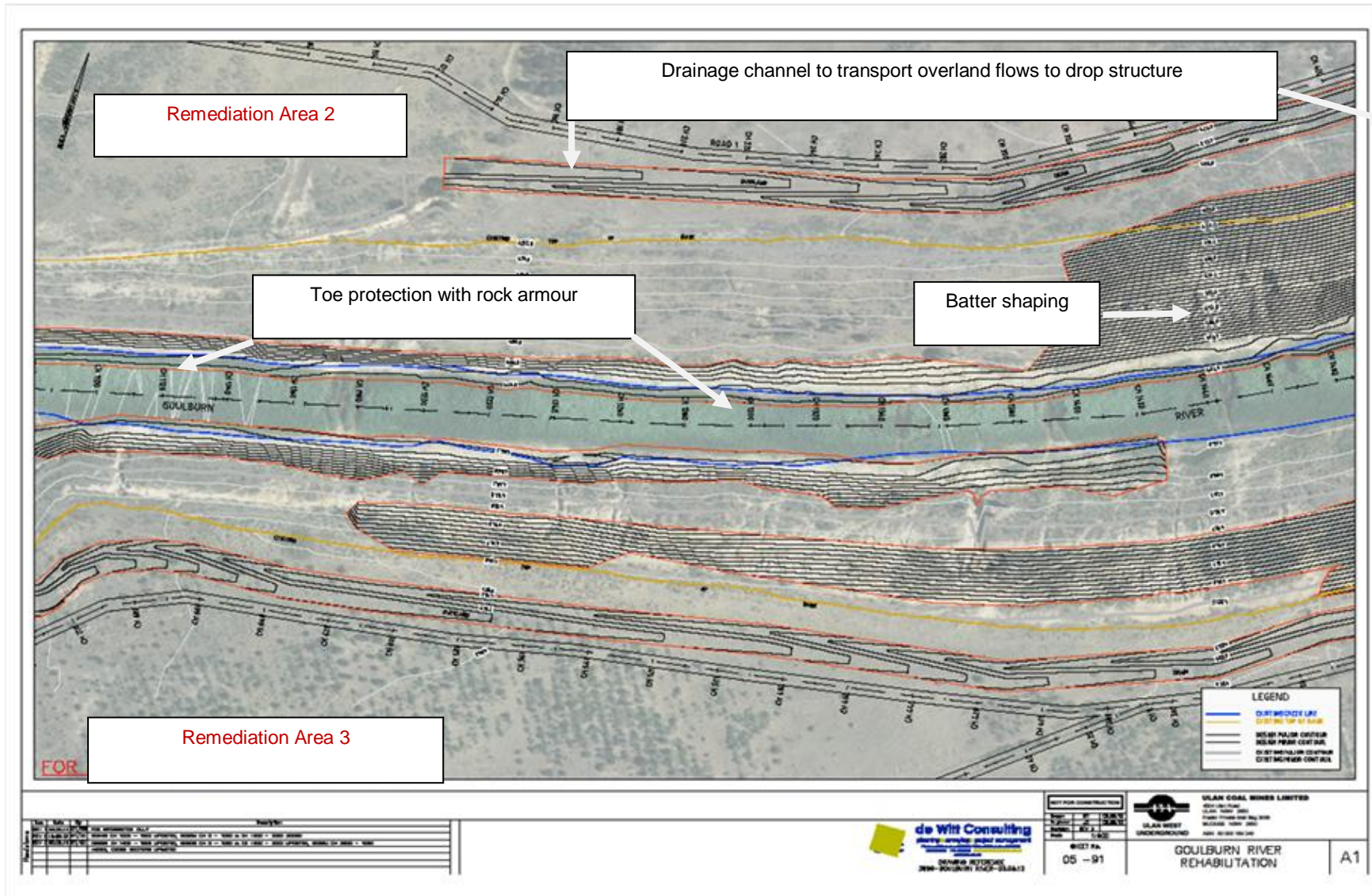


Figure 3.7 - Design drawings for Remediation Area 2 Ch 1000 to 1460 (approximately) LHS

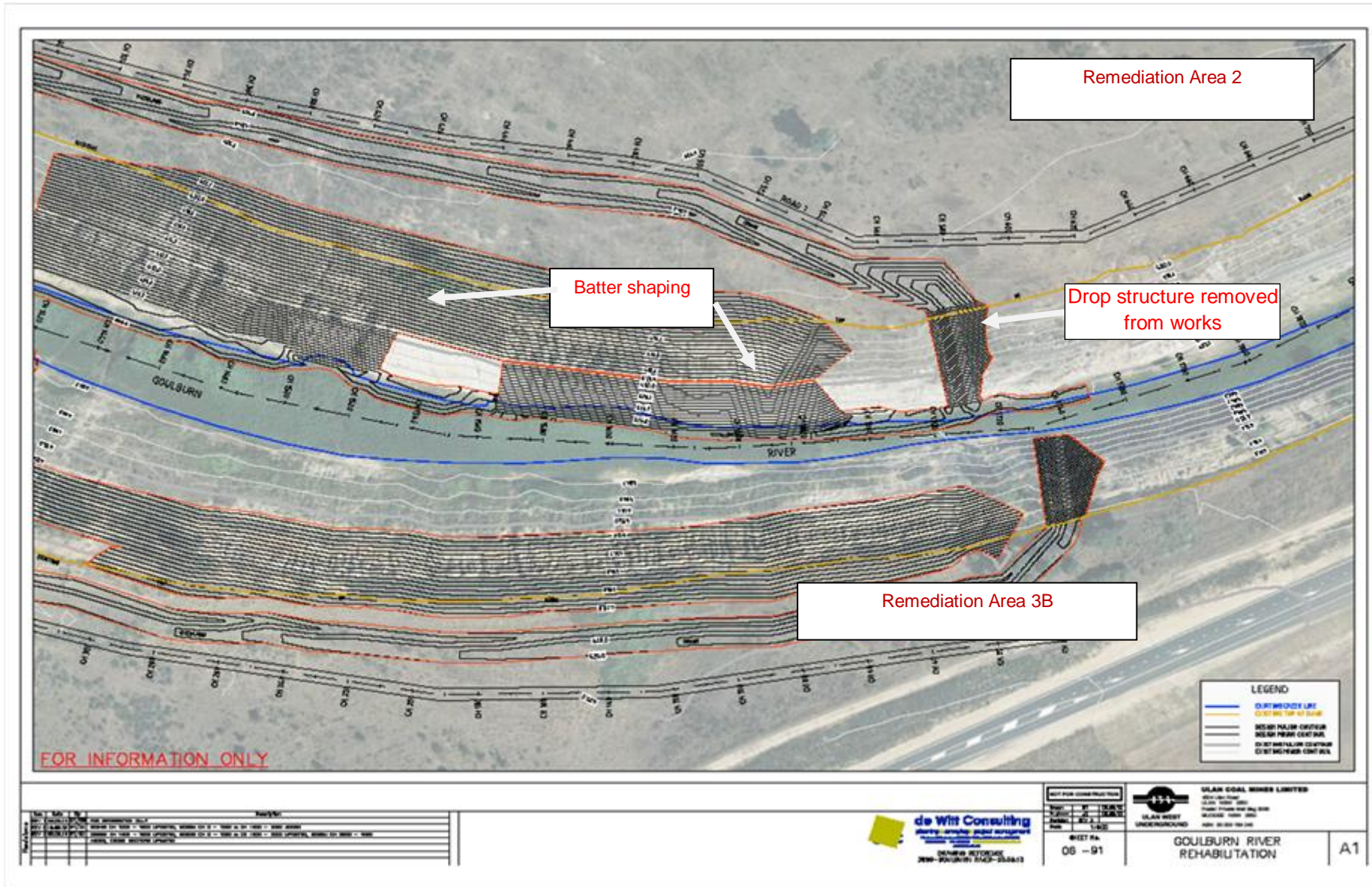


Figure 3.8 - Design Drawings for Remediation Area 2 (approximately) Ch 1460 to 1760LHS



Figure 3.9 - River Remediation Pilot Area 3 Ch1000 to 1420 RHS – Completed

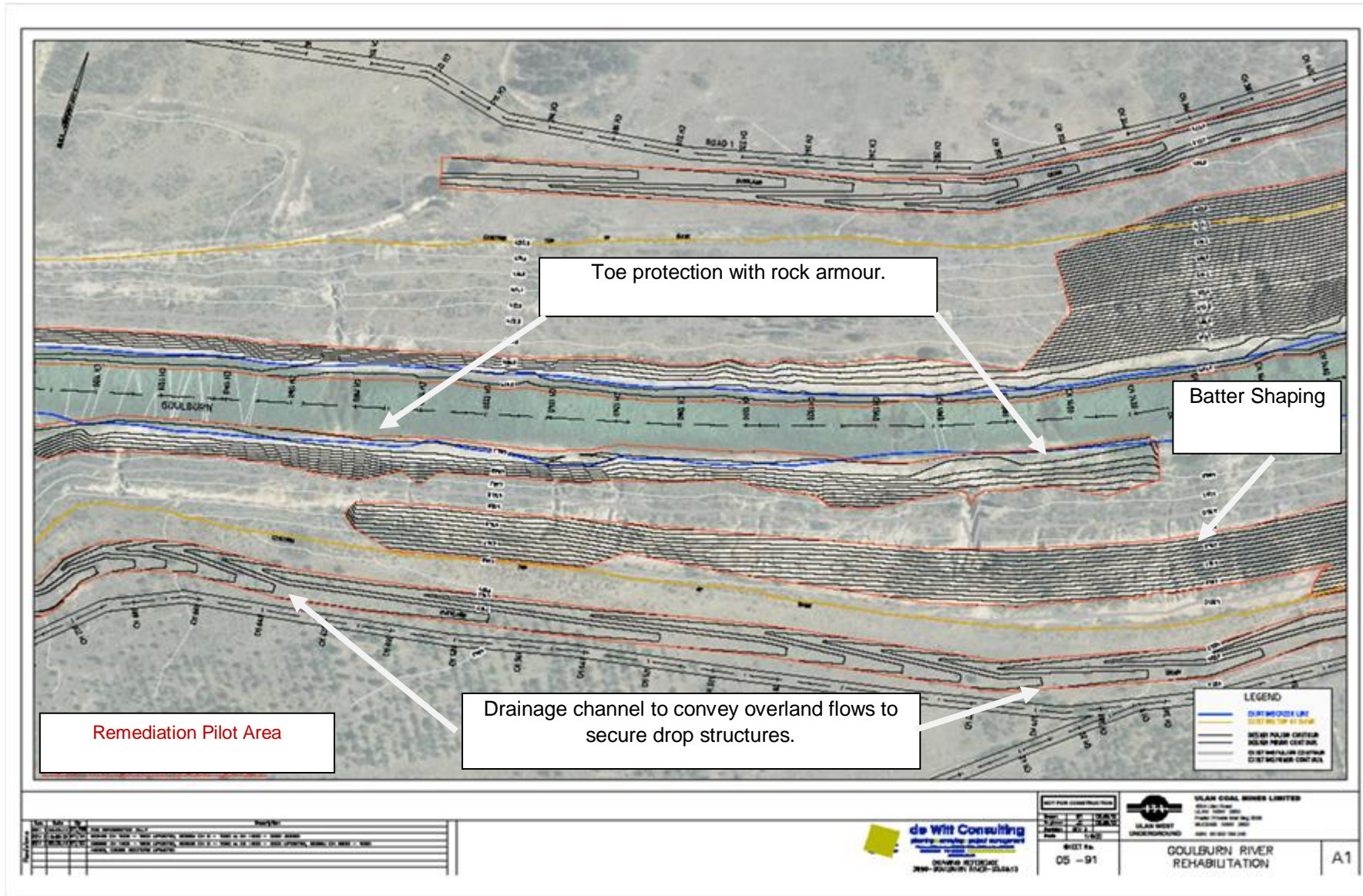


Figure 3.10 - Design Drawings for Remediation Area 3 (approximately) Ch 1000 to 1420 RHS

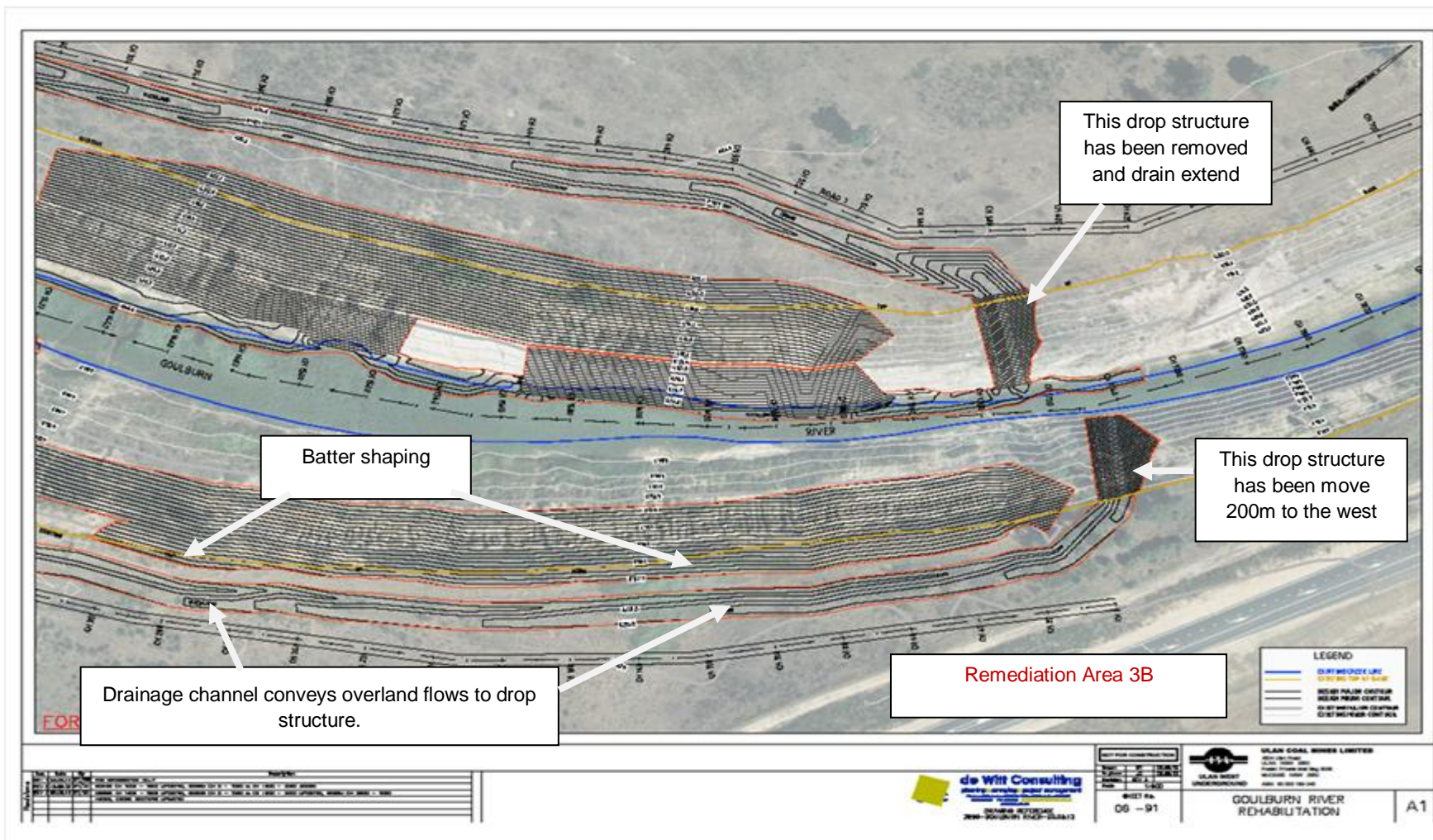


Figure 3.11 - Remediation Area 3 (approximately) Ch 1420 to 1820 RHS



Figure 3.12– Completed River Remediation Area 3 Ch1420 to 1840 RHS

Number: ULN SD PLN 0054
Owner: Environment and Community Manager

Status: Approved
Version: 7.0

Effective: 31/05/2016
Review: 3 years

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3.1.4 Remediation Area 4 (Ch 1840 to 2640 RHS & LHS)

This section of the diversion rounds the bend from its east–west orientation at approximately 90 degrees and runs northwards parallel to the mine’s eastern boundary and Ulan Road.

This is the narrowest part of the channel with a mean width of 23 m, and is formed by a box cut through the coal measures.

The bank height is 15 m at the southern end and declines to 8 m at the northern end. The bank is made from intact bedrock. The downstream section of the area has weathered material appearing close to the base of the banks.

HEC-RAS modelling shows that all floods up to the 100 year ARI are contained with 3.2 m to 12.7 m freeboard.

Sediment mounds exist in the channel floor.

As the channel is a box cut through intact bedrock, there is no in stream works proposed in the section.

Isolated areas of disturbed land in the riparian zone will be dressed and rehabilitated. An upstream diversion channel will be constructed to take overland flow to secure drop structures.

Figure 3.13 shows the spatial distribution of works in the area.

Figure 3.15 and **Figure 3.15** shows the design detail for these works.

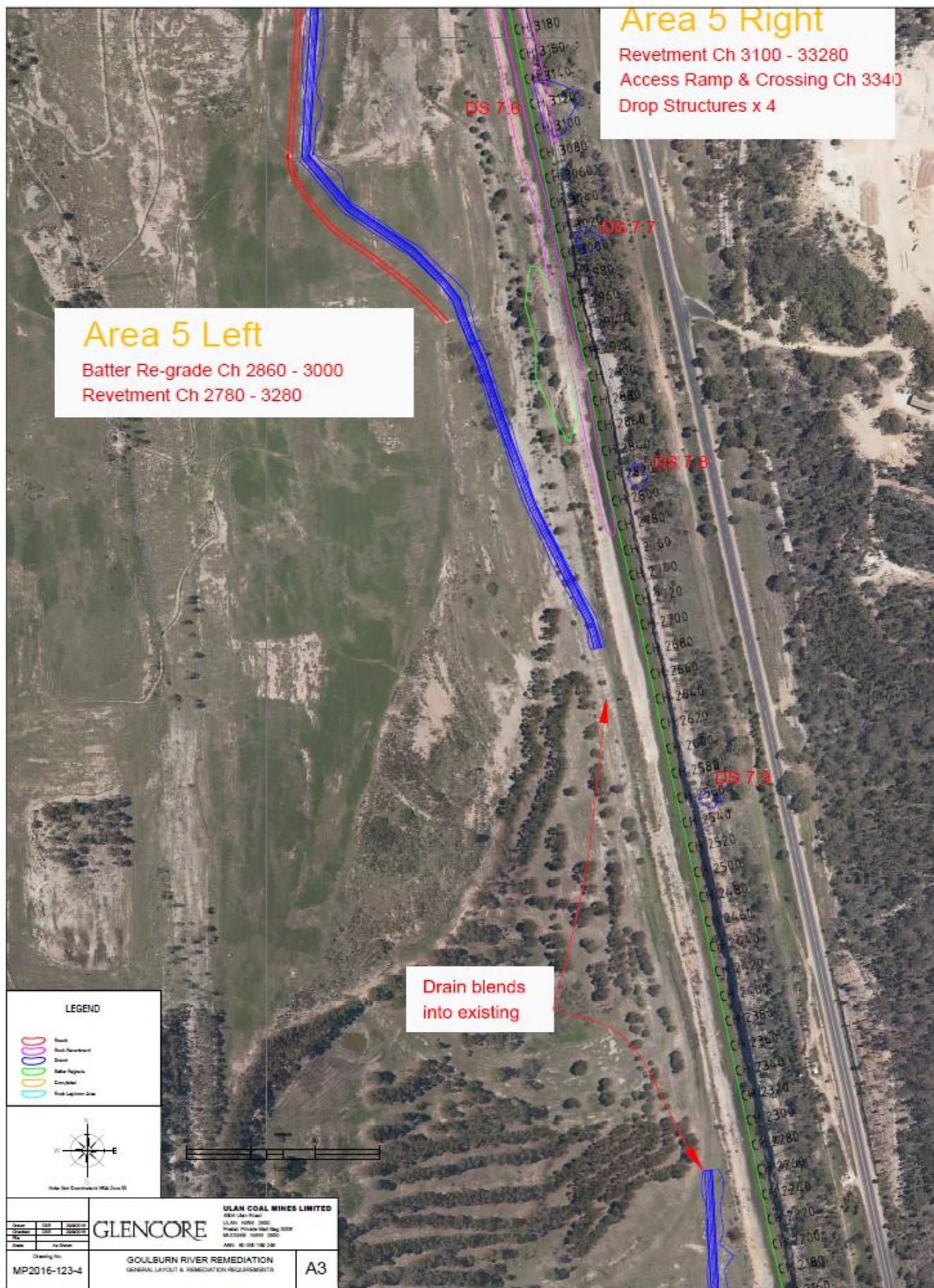


Figure 3.13 - River Remediation Area 4 – Spatial Distribution of Remediation Options

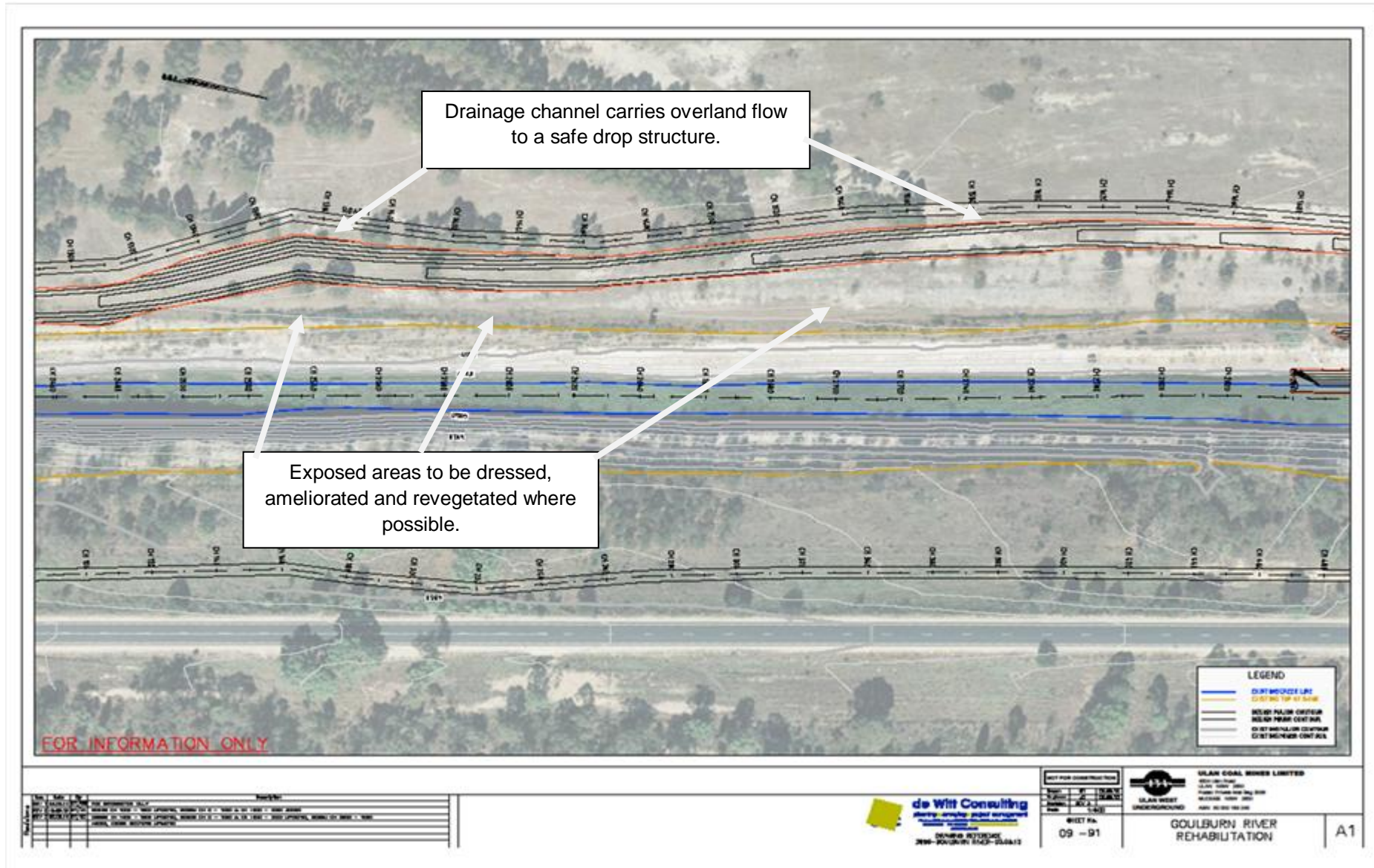


Figure 3.15 - Design Drawings for Remediation Area 4 (approximately) Ch 2400 to 2840 RHS & LHS

3.1.5 Remediation Area 5 (Ch 2860 to 3280 RHS & LHS)

This part of the diversion channel continues its south-north orientation out of the canyon section.

This area is a benched trapezoidal cut with generally low banks (mean height of 13 m at the upstream section, lowering to 4.1 m downstream) and a wide channel (mean width 34 m).

At Ch 2700 bedrock overlain by saprolite exists for about 300 m. On the lower part of the true left bank, the material is eroded with deep rills on near vertical banks to form 2 m to 4 m high pillars. On the true right side at Ch 3150, drainage from the Ulan-Cassilis road has resulted in deep gully erosion.

Undercutting from diversion flows has resulted in the collapse of blocks of saprolite material.

Along with areas 2 and 3, this section is the area of main works.

Batter repairs on the RHS from Ch 3060 to Ch 3260 is a presently under an engineering review to determine if there is a better alternative to the extensive batter repairs recommended for this area.

Figure 3.16 shows the recommend works for this area and **Figure 3.17** and **Figure 3.18** Design Drawings provide the design detail.

In both cases rock armour protects the batter/ channel toe at exposed points. Batters above the rock toe are shaped, dressed, ameliorated and revegetated.

An upstream diversion channel will be constructed to carry overland flows to secure drop structures at designated points.

At area 5 a channel crossing is proposed and will be constructed at approximately Ch 3340 (**Figure 3.18**) as per NSW Fisheries guidelines.

3.1.6 Remediation Area 6 (Ch 3280 to 4060 RHS & LHS)

This Area runs from the end of Area 5 at Ch 3540 to the Mark Patrick Dwyer Bridge at the entrance of the Ulan Underground Complex at Ch 4200.

It is the section of diversion with the gentlest slope at 0.0014 m/m.

HEC-RAS modelling showed that 100 year ARI floods are contained in the diversion with a freeboard of 0.2 m. This has been revised and now indicates that the RL of this section of the diversion needs to be raised to a minimum of 403 m to ensure that waters can be contained in the diversion. A new levee will be designed for this prior to commencement of works in this area **Figure 3.21**.

In the downstream section, batter slopes are close to 1:3 and have comparatively good vegetation, and relatively little erosion exists.

Figure 3.16 indicates the works for this section and **Figure 3.19** and **Figure 3.20** shows the design detail. Rock armour is recommended on the toe from Ch 3280 – 4080 on the RHS. Toe protection is also recommended on the LHS at strategic locations.

Any disturbed areas will be dressed, ameliorated, protected and revegetated.



Figure 3.16 - River Remediation Area 5 – Spatial Distribution of Remediation Options

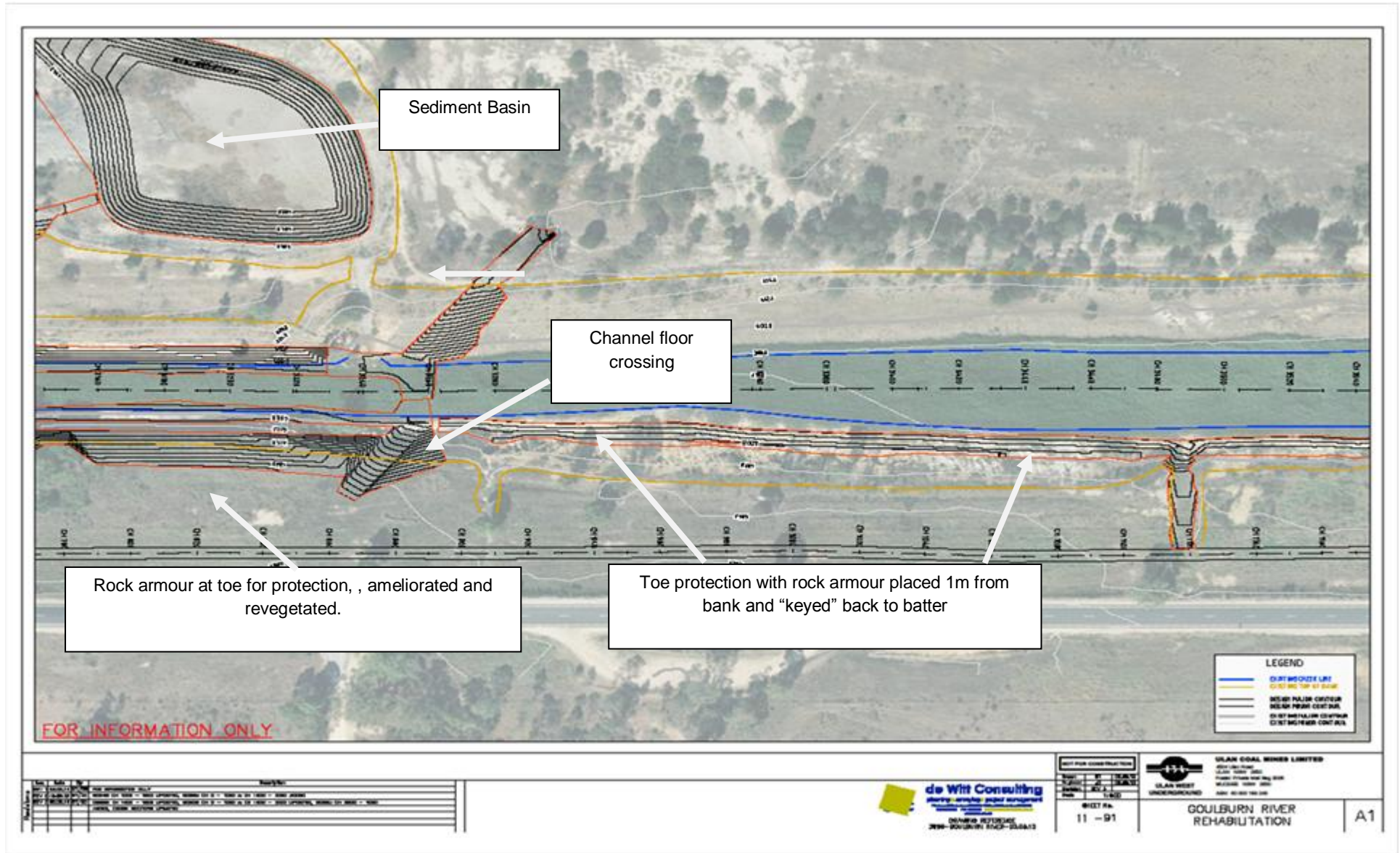


Figure 3.18 - Design Drawings for Remediation Area 5 (approximately) CH 3180 to 3540 RHS & LHS

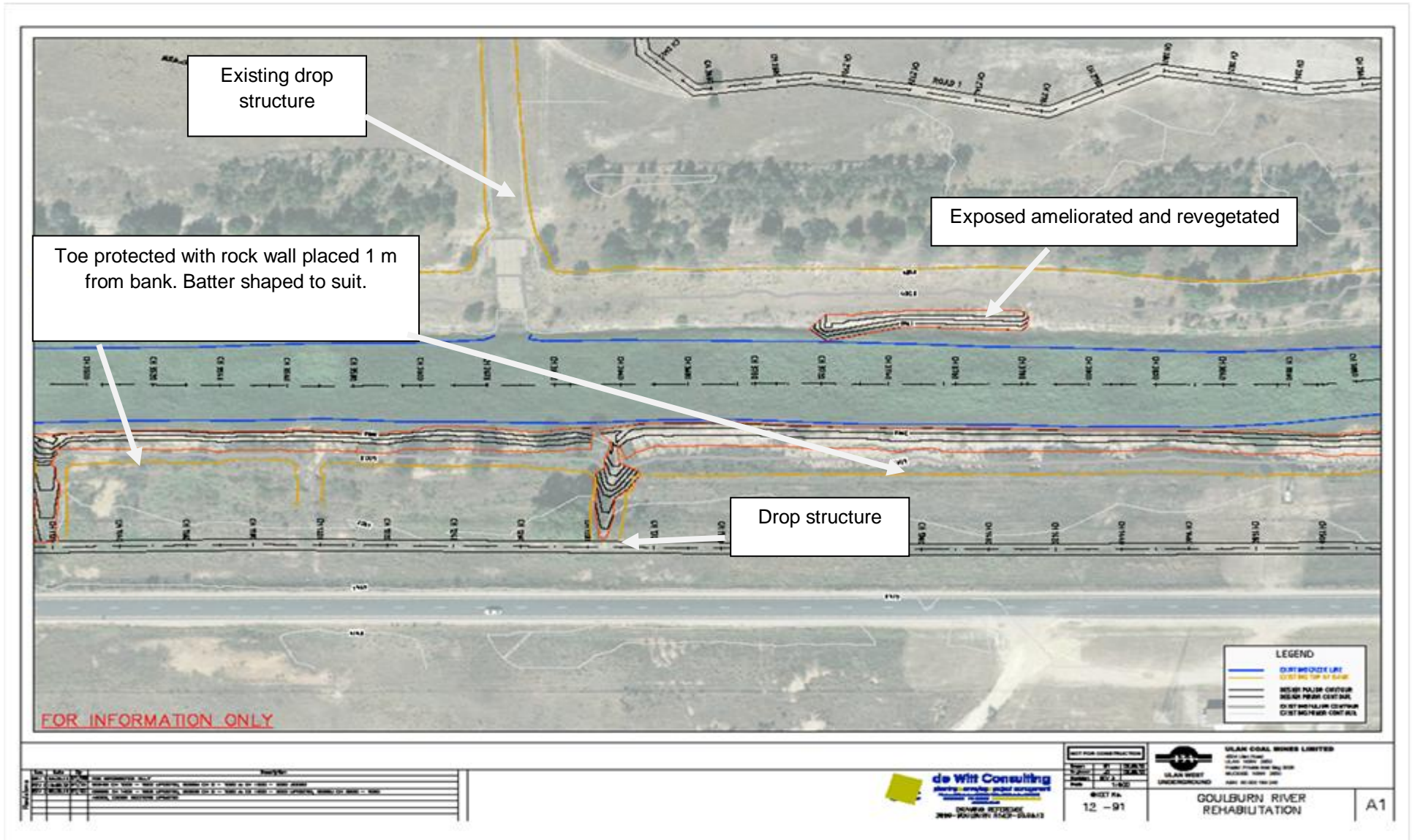


Figure 3.19 - Design Drawings for Remediation Area 6 (approximately) Ch 3540 to 3880 RHS & LHS

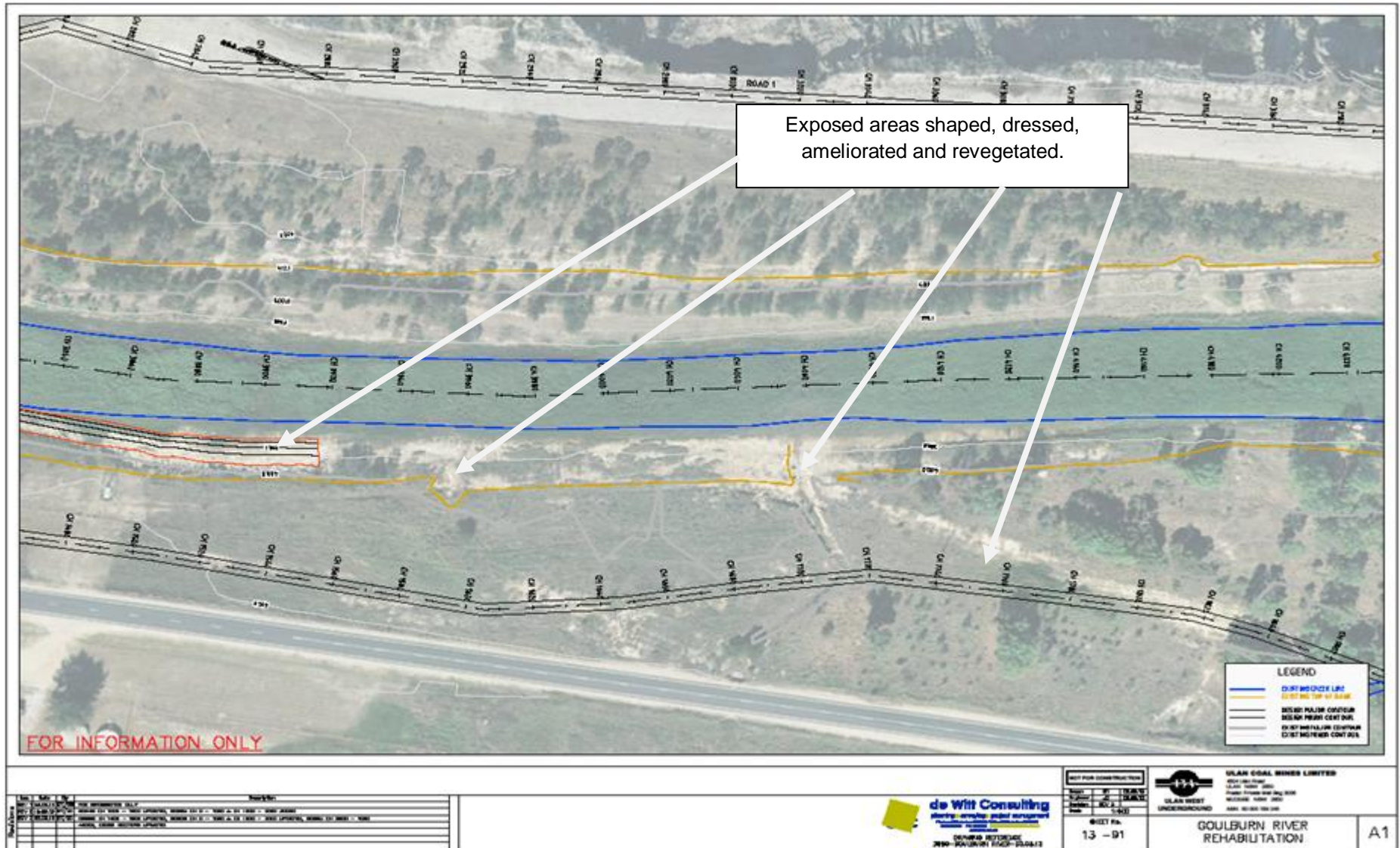


Figure 3.20 - Design Drawings for Remediation Area 6 (approximately) Ch 3880 to 4200 RHS & LHS

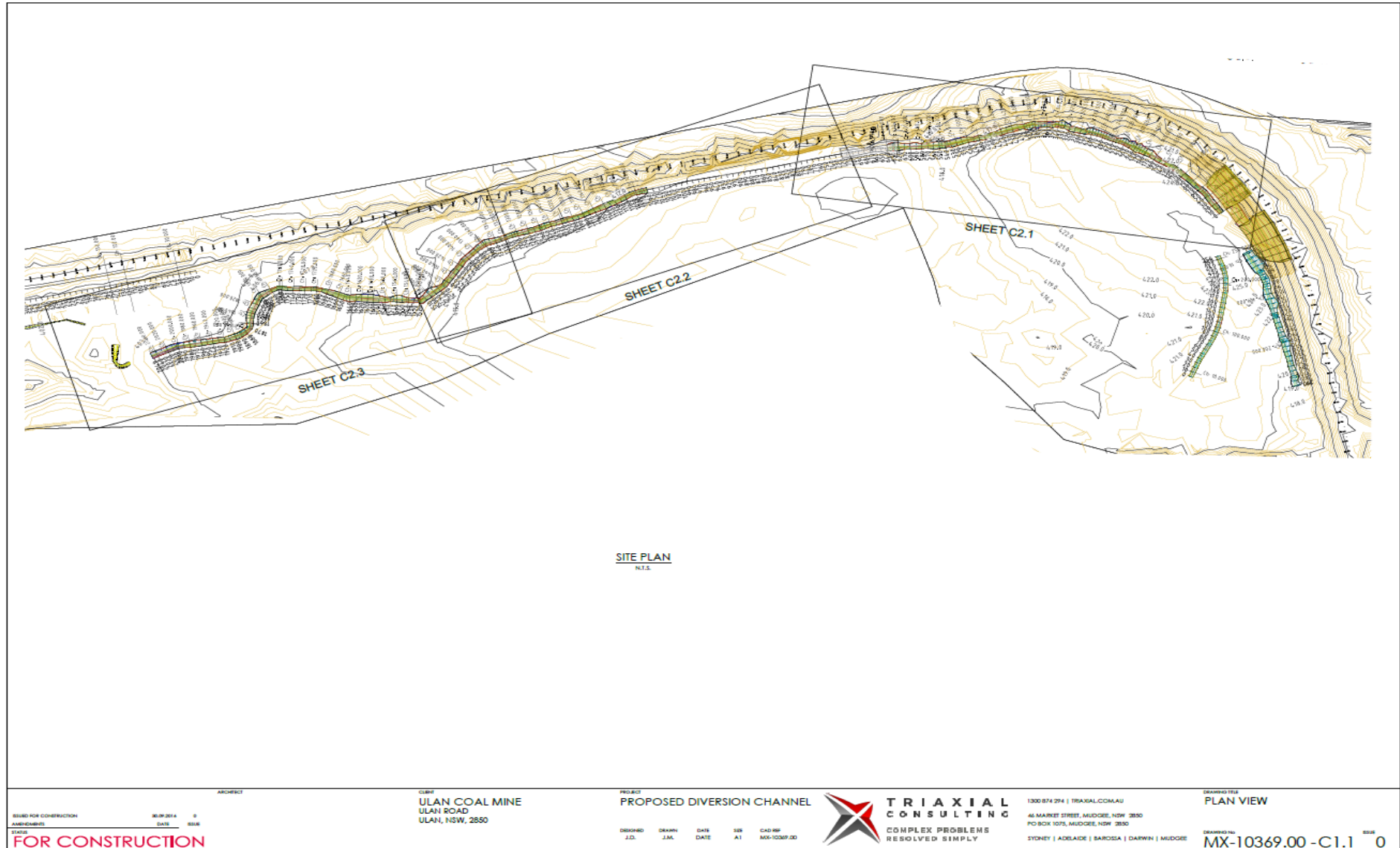


Figure 3.21 – Upstream drainage design

3.2 Detailed Design

3.2.1 Bank Erosion Management

Areas that are experiencing severe rill erosion do so predominately due to the erosive powers of raindrop impact, concentrated water flows from upstream catchments, the dispersive nature of the soils in situ and poor vegetation cover.

It is evident that batters greater than 1(V) to 2.7(H) are most at risk of erosion.

The design incorporates upstream water management and stabilisation of channel batters to manage bank erosion.

3.2.1.1 Upstream Water Management

The URS (2009) strategy identified the need for surface water controls along the Goulburn River Diversion to reduce the further deterioration of banks and slopes from overland water flow.

Poor road drainage and surface water flows are considered major contributors to severe rill erosion within the channel. To reduce further deterioration, an integrated site drainage system has been developed using standard erosion and sediment control techniques in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2D* (DECC, 2008) (the Blue Book).

The proposed integrated site drainage system will comprise the following components:

- implementation of surface water control drains to capture sheet flow, directing it away from the bank slope into formed discharge points and thereby reducing erosion potential of overland flow on bank slopes;
- construction of rock lined channels to convey road drainage from the existing culverts to the diversion;
- construction of appropriately designed discharge locations (referred to as chutes or drop structures) to collect upstream flows and convey them in a controlled manner to the channel bed, thereby reducing erosion and scour of bank slopes, and,
- utilise effective revegetation techniques to ensure stabilisation of disturbed areas and drainage lines (refer to **Section 3.3**).

A general overview of design considerations of these structures is outlined below.

Surface water controls will be constructed to manage and redirect overland flows into the diversion. The open-drains will be within 5 m from the top of the final river bank and typically 450 mm minimum depth with minimum grade of 1%.

Depending on the location and characterisation of soil material, the drains will be required to be stabilised with either grass or a rock-lining to minimise erosion.

To reduce the erosion potential in the culverts beside Ulan Road, rock lined channels will be constructed to convey the flow of water to constructed discharge points in the diversion. The channels will be designed to be shallow and wide in a trapezoidal shape in order to reduce peak flow velocity.

Surface water control works will be constructed to the 100 year ARI in accordance with Glencore ESCP standards.

3.2.1.2 Stabilisation of Disturbed Surfaces

Stabilisation of exposed surfaces to prevent soil erosion can be achieved with vegetation, paving, armouring or any other cover that protects the ground surface from erosive forces. It reduces the cover factor (C-factor) to an acceptable level & reduces soil erosion hazards by:

- absorbing the impact of raindrops;
- reducing volume and velocity of runoff;
- binding the soil with roots; and
- protecting the soil from the erosive effects of wind.

Vegetation is the preferred method where batters can be constructed to less than 1(V) to 2.7(H). Batters will be shaped to grade, ameliorated, dressed and revegetated. Although, since highly dispersible soils are present, it is unlikely that revegetation alone will provide sufficient stability. Eco Logical Australia (2014) recommend that site specific rehabilitation works and soil landscape reforming be planned and implemented for these areas, with revegetation implemented in conjunction with stabilisation works.

As part of the erosion control measures, all disturbed surfaces will be dressed with the most suitable method for immediate cover. Options include but are not limited to, mulches (straw or brush), wood chip, biodegradable blankets, and bitumen emulsion or compost blanket.

3.2.2 Base/Toe Erosion Management and In-Channel Remediation Works

Rock armouring is recommended for stabilising stream banks, providing in-stream channel stability and stabilisation of outlets or drop structures below concentrated flows.

Rock armour protects stream banks and discharge channels from erosive flow velocities.

The material will be sized in accordance with the results of the 100 year ARI flood hydraulic modelling and will be a well-graded mixture composed primarily of the larger rock sizes but with a sufficient mixture of other sizes to fill the progressively smaller voids between the rocks.

The Rock revetment will be constructed on a rock pad that will be placed approximately 500mm above the channel floor. This will mitigate risk of excavation to the channel floor.

Figure 3.22 provides a typical design for the application of rock armour.

3.2.2.1 Rock Armour Requirements

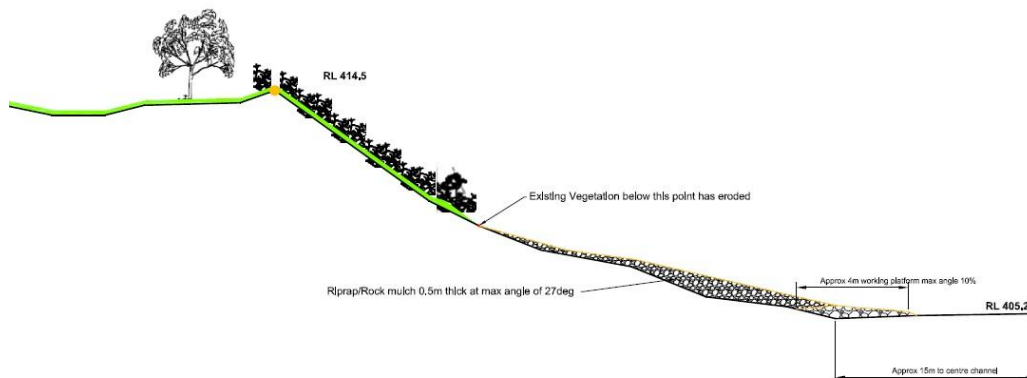
The results of the hydraulic modelling undertaken by URS Australia were used to calculate the required rock sizing suitable for the conditions along the channel. Generally it is recommended that a standard minimum medium diameter size (d_{50}) of 0.2 - 0.5m be used. A relatively small number of locations currently display isolated high velocities. At these locations larger rock is required with d_{50} sizes of 0.2 m to 0.6 m. Again it is noted that these velocities exist at the location of works only and that by the time flows exit the diversion they are at height and velocity parameters consistent with pre works conditions.

The calculation of rock size assumed a specific gravity of 2.6 and also applied a factor of safety of 1.5. The material used for rock armour will be hard, angular and of such quality that it will not disintegrate on exposure to water or weathering. It will be chemically stable, capable of withstanding freezing and thawing and suitable in other respects for the intended use. It will meet the relevant Australian Standards in terms of a wet dry variation of not more than 35%, an aggregate crushing strength of 25 megapascals (mPa) or more and a dry density of at least 2.1 tonnes/m³.

The design will require 18,000 m³. This equates to approximately 1,100 truck movements.

Rock will be sourced from the Bobadeen Quarry. UCML has approval to extract 100,000 tonnes per annum (tpa) of basalt from the quarry. Using the Quarry provides more control and will significantly reduce truck movements in comparison to commercial quarry sites. The material will be won and delivered to site over a two year period.

Figure 3.22 - Typical design for the placement of rock for treatment of bank erosion



3.2.3 In-Channel Works to Create Pools and Riffles

The issue of in-channel remediation works was addressed by the Expert Panel in March 2013. The Expert Panel recommended that the Goulburn River Diversion should be remediated in the context of its current use, that is, as a modified river diversion channel.

The Panel advised against trying to replicate pre construction conditions. The Expert Panel developed the remediation objectives on this basis. This advice is consistent with the recommendations of Brierley and Fryirs in their generic “River Styles” characterisations.

The Expert Panel was asked to comment on the issue of re-snagging. They recommended against the concept as there was no defined species of fish requiring reconstruction of habitat. Since then, a geomorphic assessment of the Goulburn River Diversion (Fluvial Systems – Chris Gippel 2013) has further supported this position by determining that there is little woody debris in representative sites above or below the river.

3.2.4 Channel Stability

As part of the design specification for each area of the diversion channel, the following measures will be considered in order to improve the channel; geomorphology and stability;

- provision of appropriate top of bank and bank slope drainage to reduce erosion of highly dispersive soils and control surface water;
- strategic re-shaping and re-contouring of the channel bank to reduce slope angles, control surface runoff, mitigate rill erosion and support revegetation on the slopes; and
- revegetation on slopes to improve surface cover;

Channel Stability will be assessed and monitored using a Landscape Functional Analysis (LFA) methodology known as Ephemeral Drainage Line Assessment (EDA) Indicators of Stability. **Refer to Section 4.1.4** for detail.

The typical scope for bank and channel stabilisation works to be undertaken for each respective Area is illustrated in



Figure 3.3 to Figure 3.22.

3.2.5 Managing the Soils In Situ

3.2.5.1 Soil Analysis

In order to understand the current soil chemistry that may be contributing to the existing erosion risk, UCML commissioned an investigation to develop a soils inventory that identified.

- the nature of soils present, mapped their location and provided advice on the erosion risk and rates and methodology for the application of the ameliorants that are required.
 - the nature of soils present and their suitability to sustain resilient vegetation growth.
- risks that exist in terms of inadvertently exposing undesirable material during construction.

A total of 25 pits were excavated and 38 samples collected and tested. Samples were taken to a depth of 1 to 2 metres pending on the variability. Eight samples were also taken directly from the batter/gully face.

All samples were logged, photographed and GPS locations recorded.

Laboratory analysis was undertaken for the purposes of general characterisation and the identification of specific soil attributes such as acidity, alkalinity, salinity and sodicity.

The soils were tested at the Soil Conservation Service Research Centre at Scone (SRC).

SRC is accredited by the National Association of Testing Authorities (NATA). NATA is the authority responsible for accreditation of laboratory services,

The specific tests were:

Physical properties

- Particle Size Analysis

Chemical Properties

- Cation Exchange Capacity (CEC)
- Acidity/alkalinity (ph)
- Salinity (EC)
- Total phosphorus
- Emerson Aggregate Test (EAT)
- Organic Carbon

3.2.5.2 Soil Management and Recommendations

Sites 1, 2, 3, 20 and 22 occur in topsoil stockpiles. Samples from these sites recorded low salinity and sodicity levels but slight to moderate acidity. Once treated with lime, these soils will be suitable for use as topdressing material for regraded diversion batters and other disturbed areas during rehabilitation works. Soils from these stockpile areas will require lime addition to raise pH levels at application rates of up to 5 tonnes/ha. Lime should be applied and incorporated immediately after soil respreading and prior to seeding. These soils will also benefit from organic amendment.

For each remediation area, soil analysis will be undertaken with the results of this analysis dictating the specifics of amelioration measures to be utilised.

3.2.5.3 Soil Amelioration

The majority of subsoil samples exhibit elevated exchangeable Na levels leading to sodicity or dispersiveness. Therefore gypsum will be routinely utilised during the Diversion rehabilitation works. Four random soil samples were tested for gypsum rate requirements. The testing revealed that minimum gypsum application rates are in the order of 5 and 7.5 tonnes/ha.

The addition of organic amendments also greatly assists in amelioration of sodic soils. Weak soil structure, commonly occurring throughout the study area, can be effectively managed by the addition of organic matter which increases soil aggregate stability and improves soil structure. The routine use of cover crops (for example, oats in autumn/winter and Japanese millet in spring/summer) and the strategic use of specialist revegetation techniques such as hydromulching and straw mulching will significantly assist with organic amendment of poorly structured, sodic soils encountered in the Study Area.

3.2.5.4 Soil Stripping, Handling and Stockpiling

The following topsoil handling techniques are recommended to prevent excessive soil deterioration:

- strip material to the depths of between 10 to 500cm as per test pit details.
- Stripped material should be stockpiled then mixed with recommended ameliorants and then spread directly onto re-graded diversion batters as soon as possible after striping (if construction sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling.

- if required, soil stockpiles will be left in as coarse condition as possible in order to promote infiltration and minimise erosion until vegetation is established. This will also prevent anaerobic zones forming.
- as a general rule, maximum stockpile heights will be 3 m. Clayey soils will be stored in lower stockpiles for shorter periods of time compared to sandier soils.
- if long-term stockpiling is required (i.e. greater than 12 months), they will be seeded and fertilised as soon as possible. An annual cover crop species that produce sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward will provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.
- prior to re-spreading stockpiled topsoil onto reshaped overburden (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.
- Where it is envisaged that weed infestation could be problematic seeding and tree planting should be postponed till germinated weeds can be sprayed
- topsoil will be spread to a minimum depth of 6 to 10 cm pending site testing of subsoils.

3.2.5.5 Soil Respreading and Seedbed Preparation

The following techniques will assist with optimum establishment and growth of vegetation:

- ameliorate soils to minimise limitations, as identified in **Section 3.2.5.3**. The main limitation for the study area’s reusable soil is weak soil structure, sodicity, low or high pH and low organic carbon levels. These limitations can be managed by the addition of organic matter as organic amendment increases soil aggregate stability and improves soil structure.
- where high salinity levels exist, consideration will be given to incorporating an intermediate soil layer between the regraded saline subsoil and the non-saline topsoil to minimise the upward migration of salts via capillary rise and reduce the risk of pasture roots contacting saline subsoils. The intermediate layer should be benign soil or spoil and be incorporated into the reconstructed profile at a minimum depth of 20 cm prior to topsoil application.
- where practical, topsoiled areas will be lightly contour ripped (after topsoil spreading) to create a ‘key’ between the soil and the underlying material. Ripping to be undertaken on the contour. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing.
- where practical, topsoiled areas will be scarified prior to, or during, seeding to reduce runoff and increase infiltration. This can be undertaken by contour tilling with a fine-tined plough or disc harrow.
- use of salt tolerant pasture species (for example, Tall Wheat Grass, Wimmera Ryegrass, Phalaris, Lucerne, Couch, Tall Fescue, Strawberry Clover, etc) on areas where the underlying subsoils are saline.

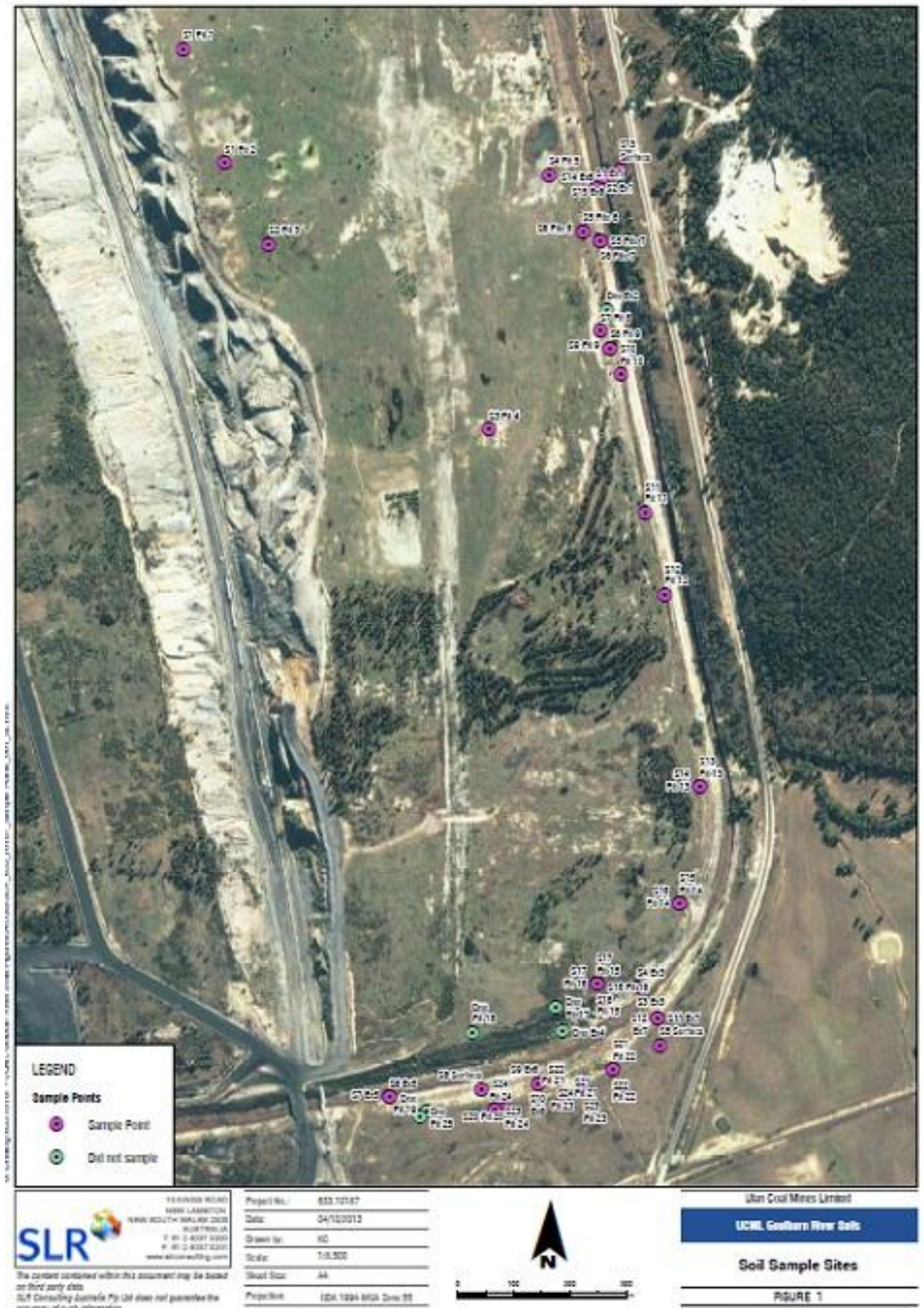


Figure 3.23 - Distribution of soil sample sites on the Goulburn River Diversion



Figure 3.24 - Soil sample sites indicating areas requiring lime ameliorants

3.2.6 Construction Management / Erosion Control Measures

The Erosion and Sediment Control Plan (ESCP) for the Goulburn River Diversion:

- Addresses the relevant conditions associated with Project Approval (PA 08_0184);
- Complies with Glencore's commitment to ESD principles; and
- Mitigates the impacts on water quality from erosion and sedimentation by
 - providing consistency with "the Blue Book".
 - identifying the risk activities that may cause erosion and generate sedimentation.
 - describing appropriate control measures.
 - describing the function, location and design criteria of works.
 - describing maintenance measures where appropriate.

The management principles have been derived from the *Managing Urban Stormwater; Soils and Construction Manual* (Landcom 2004) and include:

1. assessing soil and water implications for the development;
2. planning for ESC concurrently with engineering design and before earthworks begin;
3. minimising areas of disturbance and areas prone to erosion;
4. conserving topsoil;
5. controlling water flow;
6. rehabilitating soils as soon as possible; and
7. maintaining all works throughout, and after, the construction phase.

The construction scope for each area of the diversion will require detailed erosion and sediment control (ESC) plans for implementation prior to the commencement of any surface disturbance works.

The ESC plans may include (but not be limited to) the following:

- a map (to scale) of the site including topographical and other natural and man-made features;
- information on soil type and compaction requirements;
- rehabilitation requirements;
- information on ground cover;
- construction diagrams for erosion and sediment control features (including specific details of material requirements e.g. rock size, type of sediment filter);
- hydrocarbon control measures as a result of the use of earthmoving equipment within and adjacent to the diversion;
- methods and design calculations for control of runoff and flows in the diversion during construction periods and whilst vegetation is being established;
- design calculations for erosion and sediment control measures;
- monitoring and trigger levels;
- incidence response;
- wet weather contingency procedures.
- an activity schedule (to show implementation of erosion and sediment control features prior to commencement and throughout the duration of works);
- clearly identified legend to indicate the features of the plan;
- date plan was developed;
- name of person developing the plan;
- version number of the plan; and
- name of the plan to verify the location.

An inspection of ESC works will be conducted weekly and specifically after each rainfall event that provides for runoff. Current observations are that runoff occurs after events of 20 mm of rain in a 24-hour period.

A Ground Disturbance Permit (CAA HSEC PER 0004) will be required for all Goulburn River Diversion channel remediation activities. The Ground Disturbance Permit requires the development of a specific ESC Plan, which is then submitted to the Environment and Community Coordinator for approval prior to works commencing. No earthworks or excavations are to proceed on any area until the contractor has installed the measures detailed within the Ground Disturbance Permit for erosion and sediment control. Erosion and sediment control measures will be progressively amended where necessary to accommodate changed construction activities, landforms, drainage paths and other conditions.

The GRDRP ESC Plan will be resubmitted for approval. Modifications to the ESC Plan were made consistent with the changes to drainage identified in this plan and subsequent to comments provided in an Audit undertaken by EPA, DP&E and DRE.

3.3 Rehabilitation

3.3.1.1 Seed Collection and Propagation

A detailed seed collection program has been implemented 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.

The seed bank is available as a source of local providence seed for the project

3.3.1.2 Substrate Preparation

Surface preparation activities for revegetation of the diversion channel will commence as soon as possible following the completion of bank and channel stabilisation works. The type of general surface preparation activities will include:

- spoils, topsoils and substrate have been characterised prior to revegetation activities to determine the type and application rate for soil ameliorants that may be required.
- topsoils (or other suitable medium) will be spread across the areas to be rehabilitated to a predefined depth.
- ground preparation should be undertaken using tractor and ripper short rip lines spaced 5 m or more apart running at right angles to the streambed.
- in areas where machinery access is limited, manual planting of tube stock should be undertaken.

Refer to **Section 3.3.5** for greater detail.

3.3.1.3 Revegetation

The type of revegetation/management methodology may vary throughout the extent of the diversion channel as it will be dependent upon a number of factors including the degree of channel stability works, machinery access, channel design, soil type, aspect etc.

As part of the detailed design specification, a revegetation program is currently being established for each Area of the diversion channel. The general principles that will be factored into the revegetation design include the following:

- where practical, plantings and/or seeding programs within revegetation areas will be designed with structural and floristic diversity suitable to complement the benchmark vegetation communities;
- as a priority, revegetation will involve the use of local provenance seed that will either be utilised for direct seeding or for the propagation of tube stocks for planting. However, where adverse

seasonal conditions (i.e. drought) affect the availability of local provenance seed, supplementation with non-local provenance seed may be required.

- **Table 3.2** provides an indicative species selection guide;
- cover crops may be utilised as necessary to provide short term vegetative protection;
- revegetation areas are subject to a formal monitoring program (success/failure, as well as floristic monitoring, refer to 4.4) including a feedback loop to achieve continual improvement in the methodology and results;
- revegetation areas will be subject to a formal care and maintenance program that will be developed to include the control of weeds, replacement of failed plantings, bushfire protection; and
- measures will be installed to protect the integrity of revegetation areas.

Table 3.2 - Indicative Species List

| | Name | Common Name |
|-------------|------------------------------------|---|
| Large Trees | <i>Angophora floribunda</i> | Rough Barked Apple |
| | <i>Eucalyptus blakelyi</i> | Blakelys Red Gum |
| | <i>Eucalyptus crebra</i> | Narrow-leaved Ironbark |
| | <i>Eucalyptus moluccana</i> | Grey Box |
| | <i>Eucalyptus melliodora</i> | Yellow Box |
| Small Trees | <i>Callitris endlicherii</i> | Black Cypress-pine |
| | <i>Allocasuarina luehmannii</i> | Bulloak or Buloke |
| | <i>Acacia linearifolia</i> | Stringybark Wattle or Narrow- leaved Wattle. |
| | <i>Acacia implexa</i> | Lightwood |
| Shrubs | <i>Acacia spectabilis</i> | Mudgee Wattle |
| | <i>Acacia decora</i> | Western Silver Wattle or Showy Wattle |
| | <i>Acacia ausfeldii</i> | Ausfeld's Wattle or Whipstick Cinnamon Wattle |
| | <i>Acacia buxifolia</i> | Box-leaf Wattle |
| | <i>Allocasuarina diminuta</i> | None Known |
| | <i>Astroloma humifusum</i> | Native Cranberry or Cranberry Heath |
| | <i>Busaria spinosa</i> | Sweet Bursaria |
| | <i>Leptospermum polygalifolium</i> | Tantoon |
| | <i>Meluleuca thymifolia</i> | Thyme Honey-myrtle |
| | <i>Persoonia linearis</i> | Narrow-leaved Geebung |
| | <i>Styphelia triflora</i> | Common Pinheath or Five Corners |

| | Name | Common Name |
|----------------------------|-------------------------------|--|
| | <i>Callistemon rigidus</i> | Bottle brush |
| Grasses | <i>Arundinella nepalensis</i> | Reedgrass |
| | <i>Aristida vagans</i> | Three-awned spear grass |
| | <i>Aristida ramosa</i> | Purple Wiregrass |
| | <i>Dichelachne micrantha</i> | Short-haired Plume Grass |
| | <i>Cymbopogon refractus</i> | Barbed Wire Grass |
| | <i>Themeda triandra</i> | Kangaroo Grass |
| | <i>Bothriochloa macra</i> | Red-leg Grass, Red Grass, Redleg or Pitted Beard Grass |
| | <i>Austrodanthonia spp.</i> | Common Wallaby-grass, Ringed Wallaby-grass, and White-top |
| | <i>Sporobolus creber</i> | Slender Rat's Tail Grass |
| | <i>Cynodon dactylon</i> | Couch Grass, Bermuda Grass, Dog's Tooth Grass, Bahama grass or Devil's Grass |
| | <i>Microlaena stipoides</i> | Weeping Grass |
| | Sedges | <i>Cyperus spp.</i> |
| <i>Carex spp/</i> | | Sedge |
| <i>Gahnia aspera.</i> | | Rough Saw-sedge |
| <i>Lomandra longifolia</i> | | Spiny-head Mat-rush, Spiky-headed Mat-rush or Basket Grass |

3.4 Care and Maintenance

Actions used to assist in the rehabilitation of post-mining areas (including the diversion) and the management of habitat within these areas will include:

- fencing (where necessary) to prevent access to stock, vehicles or humans;
- signage to identify significant ecological features and protect rehabilitation, regeneration and revegetation areas;
- weed management;
- bushfire management;
- control of feral animals; and
- specific works as identified from the monitoring program (refer to **Section 4**) to provide that the remediation works continue along a trajectory to achieve the appropriate design (refer to **Section 3.1**). Such works may involve maintenance to erosion and sediment control structures and further earthmoving or revegetation works to address areas that may have failed.

4 Measurement and Evaluation

The following monitoring program is proposed to provide guidance on the achievement of the objectives of the GRDRP.

They are not intended to be compliance criteria but indicators for adaptive management and continual improvement.

This section is structured in two segments.

The first segment, **Section 4.1**, covers the surface water, stream health and channel stability components. It contains background data where relevant, describes monitoring and assessment methodologies and provides a management/contingency or TARP at **Table 4.5**.

The second segment at **Section 4.2** focuses on the rehabilitation/revegetation components of the project. It describes how these components will be monitored and assessed, mainly by using a Landscape Function Analysis methodology. This section also has a management/contingency table at **Section 4.4.2** to be used to track the implementation of specific actions and their progress toward desired outcomes.

The scope of the monitoring program that is specific to the GRDRP is outlined below.

4.1 Surface Water Flows, Stream Health and Channel Stability

4.1.1 Water Quality Baseline Data

The Ulan surface water monitoring program for the Goulburn River comprises both monthly and continuous monitoring both upstream and downstream of the diversion itself. **Figure 4.1** provides a spatial representation of the current surface water monitoring sites in relation to the diversion.

Baseline data is available from May 2006 and is sourced from continuous data loggers and event based sampling. Monitoring includes pH, electrical conductivity (EC) ($\mu\text{S}/\text{cm}$) and total suspended solids (TSS) (mg/L).

Minimum, 80th percentile and maximum values for the above mentioned parameters are tabulated in **Table 4.1**.

It should be noted that water quality results for SW02 (i.e. Goulburn River Downstream) since December 2007 include discharges from UCML in accordance with EPL 394.

Moolarben Coal Operations (Moolarben) has licensed discharge points reporting to the Goulburn River as identified in EPL 12932 (updated 11/09/2013). Moolarben may be discharging at times when construction works are in progress on the GRD.

Table 4.1 - Water Quality Monitoring for Goulburn River May 2006 to November 2010

| Water Quality Variable | Minimum | 80 th Percentile | Maximum |
|---|---------|-----------------------------|---------|
| Goulburn River Upstream (SW01) | | | |
| pH | 6.2 | 7.7 | 8.0 |
| Electrical Conductivity (EC) (µS/cm) | 38 | 680 | 1053 |
| Total Suspended Solids (TSS) (mg/L) | 9 | 111 | 176 |
| Goulburn River Downstream (SW02) (including discharges from UCML in accordance with EPL 394) | | | |
| pH | 6.4 | 7.9 | 8.1 |
| Electrical Conductivity (EC) (µS/cm) | 12 | 854 | 1235 |
| Total Suspended Solids (TSS) (mg/L) | 4 | 53 | 163 |

Water quality will continue to be monitored as per the Surface Water Monitoring Program.

In addition to this, event based sampling will be established at the tributaries entering the diversion.

SW01 and SW02 gauging stations will be upgraded to provide continuous monitoring for turbidity. Continuous monitoring commenced in the first quarter of 2014 and will continue until agreed otherwise.

4.1.2 Water Quality Trigger Levels

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* published by the Australian and New Zealand Environment Conservation Council (ANZECC) provide a framework for the assessment of water quality in fresh water environments.

The ANZECC (2000) guidelines recommend that trigger values be used as a yardstick against which to compare the results of water quality monitoring.

When monitoring results fall outside the trigger range there is a possible risk to environmental value and further action is required to investigate or address the cause.

The trigger values are not exceedance criteria but are used to initiate investigations into the cause of surface water quality as reported by the monitoring program.

ANZECC recommends developing site specific trigger values based on the 80th percentile of the base line monitoring data.

EPL 394 (UCML) and EPL 12932 (Moolarben Coal Operations) contains specific concentration limits for water that is discharged from the respective sites.

In addition to its statutory requirements, UCML has adopted interim trigger levels for the downstream gauging station of the GRD.

Water quality monitoring will continue to be undertaken in order to develop more appropriate site specific trigger levels. Until these specific levels are available, the ANZECC default triggers will be used.

Table 4.2 provides the trigger values identified in the Surface Water Monitoring Program.

Table 4.2 – Adopted Trigger Values for Key Water Quality Parameters

| Water Quality Variable | Goulburn River Upstream (SW01) | Goulburn River Downstream (SW02) | Watercourses flowing to and including Goulburn River ³ |
|------------------------|--------------------------------|----------------------------------|---|
| pH | 6.5 - 8.0 ¹ | 6.4 to 8.1 | 6.5 – 8.0 |
| EC (µS/cm) | 680 ² | 854 | 125 – 2200 |
| TSS (mg/L) | 111 ² | 53 | 50 ⁵ |

Note 1: ANZECC (2000) default trigger value range for low land east flowing coastal rivers in NSW

Note 2: 80th percentile based on historical data for the Goulburn River at SW01 upstream of the Ulan Mine Complex (refer to Table 3.3)

Note 3: Interim trigger values based on ANZECC (2000) default trigger values for low land east flowing coastal rivers in NSW. Site-specific trigger values will be developed as monitoring data becomes available.

Note 4: Interim trigger values based on ANZECC (2000) default trigger values for low land rivers in NSW. Site-specific trigger values will be developed as monitoring data becomes available.

Note 5: Interim trigger values based on Volume 1 of Managing Urban Stormwater: Soils and Construction (Landcom, 2004).

Note: Shaded cells are interim values, selected until site-specific levels can be determined.

Note: SW02 is downstream of the Ulan Mine Complex and as such water quality at this location can be influenced by other developments in the catchment outside of UCML influence.

In the event of exceedances of the above trigger levels, the management/contingency response as outlined in Section 4.1.5 “Management Contingency Response for Water Quality and River Health” will apply

| Water Quality Variable | Goulburn River Upstream (SW01) | | | Goulburn River Downstream (SW02) | | |
|------------------------|--------------------------------|-----|-------|----------------------------------|------|-------|
| | Min | Max | Avg | Min | Max | Avg |
| pH 2014 | 6.6 | 7.8 | 7.08 | 6.9 | 8.3 | 7.9 |
| pH 2015 | 6.5 | 7.1 | 6.9 | 7.1 | 8.3 | 7.8 |
| EC 2014 | 436 | 843 | 531.9 | 559 | 1248 | 805.4 |
| EC (µS/cm) | 230 | 849 | 494 | 457 | 974 | 776 |
| TSS (mg/L) 2014 | 2 | 32 | 8.14 | 2 | 27.6 | 6.71 |
| TSS (mg/L) | <1 | 84 | 14 | <1 | 7 | 2 |

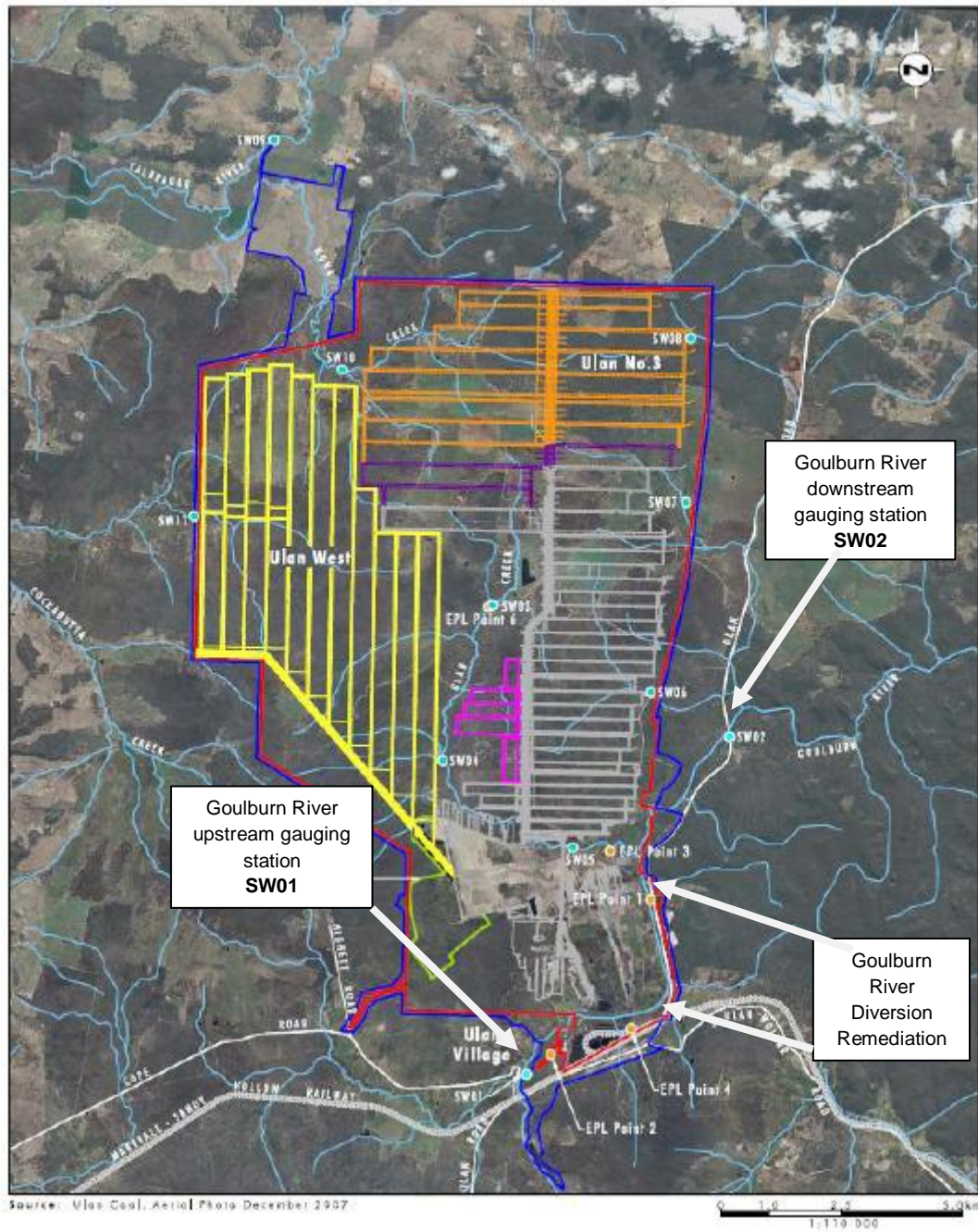


Figure 4.1 - Location of surface water monitoring sites

4.1.3 River Health Monitoring

An on-going monitoring program by UCML exists for the aquatic fauna. This has been sampled annually within the Goulburn River since 2003, along with the riparian habitat beside the river.

In addition to this several other watercourses in the general locality are monitored to provide benchmark information. **Figure 4.2** provides detail of sampling locations.

Two approaches were undertaken to determine the biodiversity values of the channelised section of Goulburn River ('the channel').

First, a comparison was made of the values of the various indices developed from the measured parameters at each site to determine where the aquatic ecosystem of the channel fits into the spectrum of values found throughout the area.

Secondly, an investigation was undertaken into the potential for the presence of Threatened Species (as listed under the *NSW Fisheries Management Act*, *NSW Threatened Species Conservation Act* and the EPBC Act).

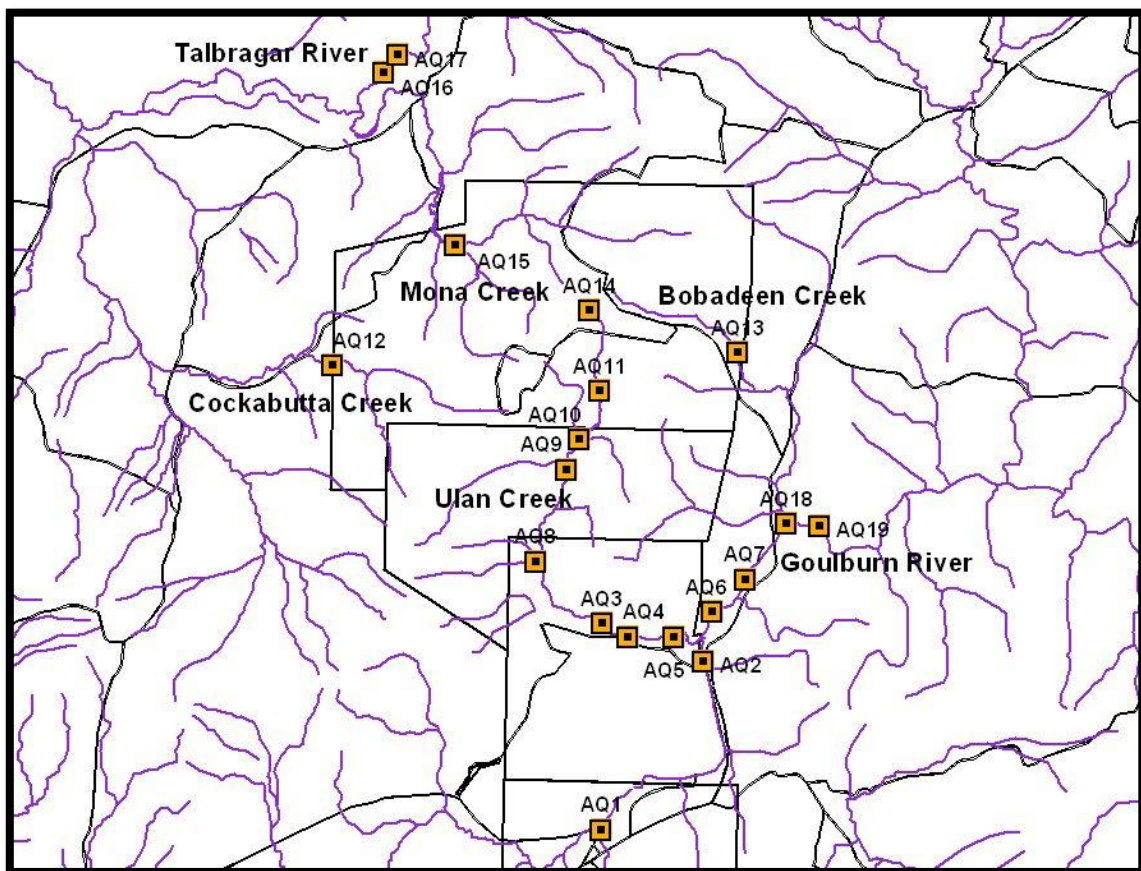


Figure 4.2 - Distribution of Aquatic Survey Sites

The current monitoring and surveying results conclude that:

- A comparative analysis of data about the aquatic ecosystems of water courses within and near Ulan Coal Mines shows that the channelised section of Goulburn River is similar in most respects to that found throughout the general area.
- Most indices were within the normal range of values for the area, except for riparian habitat and macro-invertebrate numbers.
- Macro-invertebrate fauna assemblages were typical of aquatic ecosystems in this part of the Upper Hunter and bird species associated with the riparian vegetation were mainly those associated with grassland and disturbed habitats.

- No Threatened Species or Endangered Populations and Ecological Communities have been found in the channel, upstream or downstream of the channel, and none would be expected due to the degraded nature of the habitats.
- Future rehabilitation strategies should concentrate on the riparian environment. It is expected that an increase in vegetation (trees and shrubs) along the channel will assist in diversifying the terrestrial fauna populations, particularly birds, as well as stabilising the banks and inhibiting overland flow from the mine into Goulburn River.
- Although reeds dominate the aquatic environment, they appear to provide a stable habitat for a range of macro-invertebrates, as well as a filter to sediment and pollutants within the channel.

This monitoring program, which is specific to the Goulburn River, will be conducted at the start and completion of any works taking place within the river and once annually.

The trigger level will be deemed to have been activated if a negative trend on the extent and condition of macro invertebrate communities is detected.

4.1.4 Channel Stability Monitoring

Channel stability will be monitored by the Landscape Functional Analysis Methodology known as Ephemeral Drainage Line (EDA) Indicators of Stability.

This rapid assessment methodology uses eight indicators to provide information for considering ephemeral drainage lines in a restored landscape. It provides an understanding of stream condition in terms of becoming stabilised and healthy or alternately, still actively eroding.

Two indicators consider the runoff from the immediate overland flow catchment while six indicators assess the functional role of the vegetation within the channel and the shape and erodibility of the channel walls and floor. The intent of the eight indicators is as follows:

1. **Slope Steepness.** The slope of the overland catchment adjoining the drainage line affects the potential energy of runoff flowing into the drainage channel.
2. **Slope Surface.** The amount of vegetation cover and coarse litter on the slope of the overland catchment reflects its capacity to cause erosion and contribute sediment to the drainage line.
3. **Channel wall vegetation.** Assesses the drainage lines capacity to resist erosive forces and provides an indication on how long it has, or has not, been stable.
4. **Channel floor vegetation.** As above, reflects the channel floors capacity to resist erosion.
5. **Cross Sectional Shape.** Cross sectional shape gives an indication of whether a drainage line is stabilising or continuing to erode. Typically steep walls with sharp edges are still actively eroding and channels with walls less than 65 degrees with rounded edges are in the process of stabilising.
6. **Longitudinal Shape** measures how the drainage line interacts with the adjacent floodplain by characterising a continuum that ranges from deeply incised gullies to a “chain of ponds” scenario. Drainage lines that are connected to the adjoining floodplain allow flows to break their banks and dissipate energy.
7. **Channel wall erodibility.** This indicator reflects the channels susceptibility to erosion from overland flows and high energy flows within the channel.
8. **Channel floor erodibility.** The size and cohesion of material on the channel floor reflects its potential for erosion. Rocks and stones protect the channel floor and dissipate energy from flows while particle sizes smaller than those on the wall require less energy to become mobile sediments.

Field testing of these indicators, and their underlying intent, on the existing remediation areas of the diversion proved useful. It was however identified that due to the highly modified nature of the diversion, and in comparison with the ephemeral streams that exist in the surrounding catchments that not all indicators will apply.

Therefore the EDA monitoring sites have been developed in consultation with a suitably trained professional to mitigate the risk of omitting indicators and inadvertently influencing the weighting of scores, **Table 4.3** below provides a description of how the abovementioned indicators contribute to an overall scoring assessment.

Table 4.3 - Ephemeral Drainage Line (EDA) Indicators of Stability

| EDA Category | Indicator | Score | Description |
|----------------------------|-----------------------------|-------|---|
| Runoff from Overland flows | Steepness of slope | 1 | Greater than 30 degrees enabling high flow velocities into drainage line over batters. |
| | | 2 | 10 to 20 degrees enabling moderate to high flow velocities into drainage line over batters. |
| | | 3 | 5 to 10 degrees enabling moderate flow velocities into drainage line over batters. |
| | | 4 | Less than 5 degrees generating moderate to low flow velocities into drainage line over batters. |
| | | 5 | Almost flat, laterally extensive and generating low flow velocities into drainage line over batters |
| | Surface of slopes | 1 | Bare slopes with side arm channels, very high inflow rates, copious sediments |
| | | 2 | Bare slopes, laterally extensive, high inflow rates and moderate sediment. |
| | | 3 | Sparsely covered slopes with bare bank lip, moderate flow rate some highly focused inflow with low sediment |
| | | 4 | Densely covered slopes, low and diffuse inflows, very low sediment visible. |
| | | 5 | Very densely covered slopes with litter and coarse debris, very low and diffused inflows and no observable sediment. |
| Channel Vegetation | Vegetation of channel walls | 1 | Little or no vegetation |
| | | 2 | Vegetation present is mainly ephemeral allowing sediment to pass. |
| | | 3 | Dense perennial cover with obvious sediment control |
| | Vegetation of channel floor | 1 | Little or no vegetation. Flow rates too high to permit growth. |
| | | 2 | Any present vegetation is annual or short lived. Partial burial of plants from recently deposited sediment. |
| | | 3 | Dense perennial plant cover similar to bank vegetation or characteristic of wetland species. No observable burying of plants from sedimentation. |
| Drainage Line Shape | Cross Sectional Shape | 1 | Drainage line walls are almost vertical. Depth typically greater than width. Signs of active erosion include side wall caving, mass wasting and tunnelling. Fine sediments have been washed away from the base of the wall. |
| | | 2 | Drainage line walls are almost vertical however erosion is less severe. Depth and width approximately equal, slight undercutting of walls and some sediment deposits are visible along drainage line walls. |
| | | 3 | Drainage line wall angles are moderate with both bank and bed edges typically rounded and stabilising. Width greater than depth. Some deposits of sediments at base of wall. |
| | | 4 | Drainage line wall angles are low to |

| EDA Category | Indicator | Score | Description |
|---------------------|--------------------|-------|---|
| | | | moderate and clearly stabilising. Width greater than depth. Some low small sediments may exist at base of side walls. |
| | | 5 | Drainage side walls are gently sloping and strongly vegetated. Width much greater than depth. Drainage line has obviously been stable for a considerable period of time. Indications of spontaneous restoration. |
| | Longitudinal Shape | 1 | Drainage line incised into channel floor. Existing sediments are within scour holes and are deposited along the channel. Flow sustainability is linear. |
| | | 2 | Drainage line channel is flat and continuous with deposits of loose sediments and signs of slow and recent sediment movement along the channel. Flow is noticeable sinuous. |
| | | 3 | Drainage channel is flat but with a cohesive, fine textured "soil" like floor. Minimal signs of sediment movement. Meandering bed shape with point bars. |
| | | 4 | Drainage line well vegetated between non cascading chain of ponds. Cohesive fine sediment/organic matter floors. No signs of sediment movement. Typically this type of channel floor is closely connected to its floodplain and gentle overbank deposition may occur. |
| Channel erodibility | Wall erodibility | 1 | Dispersive materials are exposed for more than 1 metre of drainage wall height. |
| | | 2 | Materials that slake readily are exposed for 0.3 to 1 metre of drainage wall height. |
| | | 3 | Materials that slake readily are exposed for 0.3 metre of drainage wall height |
| | | 4 | No unsuitable materials are exposed on drainage line walls. |
| | Floor erodibility | 1 | Materials on the drainage floor have a particle size and density similar to or smaller than materials in the wall. For example fine silt or sand deposits are on the floor and coarser gravels exist in the walls. |
| | | 2 | Materials on the drainage floor have a larger particle size and are denser than materials in the wall. For example gravel deposits are on the floor and coarser sands exist in the walls. |
| | | 3 | Materials on the drainage floor are much larger in particle size than materials in the wall. For example the floor is armoured with stones and rocks and the wall has coarse sands. |

A percentage index (assessment score divided by maximum total) is developed for each assessment site. They are then compared to the five stability classes as describes in **Table 4.4** below. Scores are recalculated periodically and the remediation works are assessed to track their progress towards a stable state (70% to 80%).

Table 4.4 - Categories of Channel Stability Indexes

| Index (%) | Classification | Stability Interpretation |
|--------------|-------------------------|--|
| 80 or more | Very Stable | Drainage line is likely to be in a durable and resilient state and able to withstand major storm events. Minimal event based monitoring is required. |
| 70 to 80 | Stable | Drainage line is stable but need to assess the eight indicators on the least healthy zone type to assess whether the channel is tracking towards, or away from, a more or less stable condition. If stream condition is declining, the indicators help identify the appropriate remediation actions. |
| 60 to 69 | Potentially stabilising | Potentially stabilising from an actively eroding or unstable state. Monitoring is required to determine if, or what, remedial actions are required. |
| 50 to 59 | Unstable | Channel is actively eroding and remedial action is required. Indicators will provide guidance on the remedial actions required. |
| Less than 50 | Very Unstable | Very actively eroding and unstable. Immediate action is required. Indicators will provide guidance on the remedial actions. |

4.1.5 Summary of Management Contingency Response for Water Quality, River Health

A summary of the management contingency response for water quality and river health can be summarised in **Table 4.5** below.

Table 4.5 - Management Contingency Response for Water Quality and River Health

| Ecological Response | Performance Indicator | Measure | Frequency | Response | | | |
|---------------------|--|---------|--|--|----------------|----------------------|------|
| Water Quality | Total suspended Solids | 53 mg/L | Continuous | The trigger is deemed to have been activated with a reading above 53 mg/L. | | | |
| | | | Continuous Monitoring Locations | | | | |
| | | | <table border="1"> <thead> <tr> <th>Location Codes</th> <th>Monitoring Locations</th> </tr> </thead> <tbody> <tr> <td>SW01</td> <td>Goulburn River Upstream (EPL Point 33)</td> </tr> <tr> <td>SW02</td> <td>Goulburn River Downstream (EPL Point 18)</td> </tr> </tbody> </table> | | Location Codes | Monitoring Locations | SW01 |
| Location Codes | Monitoring Locations | | | | | | |
| SW01 | Goulburn River Upstream (EPL Point 33) | | | | | | |
| SW02 | Goulburn River Downstream (EPL Point 18) | | | | | | |
| | | | | Investigate the source of contamination. | | | |
| | | | | If contamination is from the GRD, undertake remedial action, record actions and report in accordance with the Environmental Management System (EMS). | | | |

| Ecological Response | Performance Indicator | Measure | Frequency | Response |
|---------------------|--------------------------------|-----------------------|--|--|
| River Health | Macro invertebrate populations | Trends in populations | Prior to working within river, completion of work within river and annually. | The trigger is deemed to have been activated by negatively trending results. i.e. annual population taxa decreasing in numbers |
| | | | | Investigate the source of contamination. |
| | | | | If contamination is from the GRD, undertake remedial action, record actions and report in accordance with the Environmental Management System (EMS). |
| Channel Stability | EDA Stability indicators | EDA indicator Score | Post construction at each remediation area then annually with monitoring undertaken within the same demarcated monitoring sites. | Determine each indicator score and assess against Table 4.3 for appropriate action. |

4.2 Rehabilitation and Revegetation Methodology Records

The details of each rehabilitation and revegetation campaign will be recorded so that they are available for later interpretation of monitoring results. This will allow the continual improvement of rehabilitation and revegetation standards on site. Amongst the key parameters to be recorded are landform and drainage design details, substrate characterisation, site preparation techniques (e.g. topsoil and source, time of sowing, soil ameliorants used, etc.), revegetation methodologies (e.g. rate and type of fertiliser, cover crop and rate, seed viability, etc.), weather conditions, photographic records and initial follow-up care and maintenance works.

4.3 Rehabilitation Inspection

During the remediation phase, works and their erosion and sediment controls will be inspected and recorded by the Project Manager, or delegate, on at least a weekly basis, or after a runoff event, to ensure that required controls are in place and operating effectively. Current observations indicate that runoff generally occurs after events of 30 mm of rain in a 24-hr period.

As a minimum, the Goulburn River Diversion Remediation will be inspected within one month of the completion of rehabilitation works or following storm events to assess whether erosion and sediment controls remain competent and if revegetation has been compromised. This will be undertaken by the Environment and Community Coordinator (or delegate). Following the initial establishment period, rehabilitation inspections will be continued on a bi-annual basis to assess soil conditions, erosion, drainage and sediment control structures, germination rates, plant health and weed infestation.

Outcomes of the inspection process will be documented and any reasonable and feasible management actions will be implemented as soon as practical. Where necessary, rehabilitation and revegetation procedures will be amended accordingly with the aim of continually improving standards.

4.4 Long Term Rehabilitation and Revegetation Monitoring Program

The objective of this monitoring is to evaluate the progress of rehabilitation and regeneration works towards fulfilling the objectives and criteria as outlined in **Section 4.4**. Monitoring will be continued until it can be demonstrated that rehabilitation and regeneration have satisfied the criteria outlined in **Section 1, Table 2.1** or **Final Project Closure Criteria** as mentioned in **Section 6**. Information from the long term monitoring will also be used to refine closure criteria and modify rehabilitation and regeneration procedures as required.

Initially it is envisaged that the long term monitoring will be undertaken annually, however, where results are showing rehabilitation is progressing along the required trajectory, the frequency of monitoring may be reduced (i.e. 2 yearly) in consultation with DP&E and EPA.

4.4.1 Rehabilitation and Revegetation Monitoring Methodology

The method listed below uses a combination of methodologies such as Landscape Function Analysis (LFA), accredited soils analysis and an assessment of ecosystem characteristics.

4.4.1.1 Landscape Function Analysis (LFA)

LFA is a methodology used to assess key indicators of ecosystem function including landscape organisation and soil surface condition. It is a measure of how well the landscape retains and uses vital resources. It was developed by CSIRO scientists Tongway (1994) and Hindley (1995, 1996 & 2004).

Landscape organisation is measured by patches and interpatches taken from gradient orientated transects.

A patch is an area within an ecosystem where resources such as soil and litter tend to accumulate. Interpatches are bare areas where resources tend to be mobilised and transported off site. Landscape Organisation Indices are calculated by the length of the patches divided by the length of the transect. It provides an index or percentage of the transect that is occupied by functional patches.

Soil surface condition is the measure of soil quality and uses simple indicators including;

- **Rain splash protection.** The degree surface cover mitigates the effect of raindrop impact on soil surface
- **Perennial vegetation cover.** The basal cover of grasses and the canopy cover of trees and shrubs. It assesses the contribution of below ground biomass of perennial vegetation in contributing to nutrient recycling and infiltration.
- **Litter cover.** The amount, origin and degree of decomposition relates to carbon, nitrogen and other elements stored in the surface soil layers and is acquired by the decomposition processes.
- **Cryptogam cover.** Assess algae, fungi, lichens, mosses and liverworts. Is an indication of soil stability and elevated levels of available nutrients in surface layers of soils. They are known to exchange minerals and water with vascular plants for carbohydrates.
- **Crust brokenness.** Assesses the extent to which the soil surface is broken leaving loosely attached soil material available for erosion.
- **Soil erosion type and severity.** Erosion classes include rills (less than 300 mm) and gully erosion (more than 300 mm) being channels caused by flowing water, Terracettes (walls up to 10 cm high and aligned with the local contour), sheet erosion (the progressive removal of very thin layers of soil across extensive areas), scalding (massive loss of the A horizon in texture contrasting soils exposing the A2 or B horizon. Typically hard and having low infiltration rates) and Pedestalling (the removal of soil by erosion to a depth exposing butts of surviving plants in a column of soil over the exposed A2 or B horizon).

- **Deposited material.** Asses the nature and amount of alluvium transported to and deposited on a site. Indicates the availability of material to be transported from up slopes and implies some instability.
- **Soil surface roughness.** Assess the surface roughness for its capacity to capture and retain mobile resources such as water, propagules, topsoil and organic matter. High surface roughness slows overland flows permitting longer time for infiltration and may comprise a safe site for lodgement of propagules and litter.
- **Surface resistance to disturbance.** Assess the ease with which soil can be disturbed to yield material suitable for wind and water erosion.
- **Slake test.** Assess the stability of soil fragments to rapid wetting.
- **Soil surface texture.** Assess the texture of soil and relates this to permeability.

These features are compiled and calculated into three indices of soil quality:

1. Stability (resistance to accelerated erosion).
2. Infiltration (the rate soil absorbs water).
3. Nutrient Cycling (the way plant litter and roots decompose and become available for use by other plants).

Each of the three indices is allocated a percentage rank based on a graded score of their individual indicators.

This score is then measured over time to determine if the remediation works are trending towards the analogue sites as expected.

Analysis of the individual indicators and their respective scores can reflect which particular components of soil condition are performing well and which ones require additional monitoring and assistance.

Figure 4.3 outlines the indicators and their contribution to the three indices mentioned above.

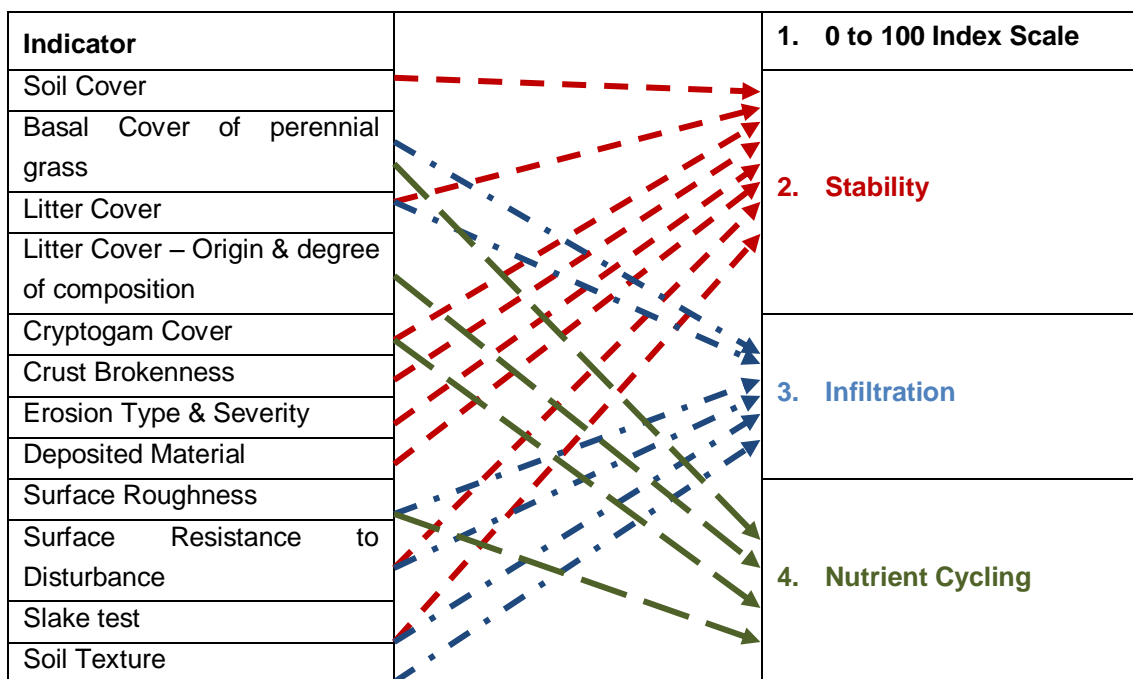


Figure 4.3 - Soil Surface analysis and their contribution to LFA Indices

4.4.1.2 Structural Diversity, Floristics and other Biodiversity Attributes

In addition to LFA, various biodiversity components will also be monitored to assess the change in plants and groups of plants through the various succession phases. More importantly, this assessment provides critical information for change management and the implementation of actions required for the continual improvement of project outcomes.

The rapid ecological assessment framework required to provide this information was developed by the CSIRO for assessing habitat quality across a range of vegetation types in the southern NSW Murray Darling Basin (Gibbons 2002) and the Biometric model used for property planning (Gibbons et al 2008).

The assessment framework provides quantitative data that measures changes in;

- Vegetation Structure and habitat characteristics (including groundcover diversity and abundance and cryptogams).
- Understory density and growth (including establishment of shrubs, direct seeding, and tube stock planting).
- Over story characteristics including tree density, health and survival rates.

Permanent transects and photo points are established to record changes in these attributes over time.

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 (formerly known as the Annual Environmental Management Report (AEMR)).

4.4.2 Monitoring Changes Subsequent to Pilot Review

4.4.2.1 Survey Sites and Methods

Two analogue sites were chosen with one located upstream and the other downstream of the remediation works. At both sites a Land Function Analysis (LFA) and an Ephemeral Drainage Line Assessment (EDA) were undertaken forming baseline monitoring data.

Due to the short length of the banks within the remediation area, three shorter LFA transects were installed to sample a sufficient length of transect rather than using a 50m transect which is generally used in LFA assessments. No LFA assessments have been undertaken within the remediation area. These assessments will commence once the remediation works are complete.

Within the remediation area, six EDAs were undertaken along 800m of channel banks that have been previously remediated. During the process of selecting sites for EDAs, general observations were made of the condition of remediation works, noting in particular the groundcover establishment success, failure of any earthworks and rock drains, success of riparian tree planting and signs of sheet, rill and gully erosion on slopes.

4.4.2.2 Landscape Function Analysis (LFA)

As 2016 was the first year for LFA monitoring to be completed within the Goulburn River Remediation works this monitoring forms baseline monitoring, therefore no comparison can be made between analogue sites and the works undertaken in the remediation area. Whether the Diversion Remediation site is improving or declining in terms of retaining and utilising resources cannot be determined until future measures are made. To permit comparison it is recommended that future LFA surveys are undertaken.

4.4.2.3 Ephemeral Drainage Line Assessment (EDA)

The results of the EDA show that at the analogue sites, channel stability is rated as Very Stable, while within the remediation area channel stability ranges from Stable to Active. However, a rating of Active occurred at only one of the six sites surveyed in the remediation area.

At this stage it is unknown whether the stability of the channel within the remediation area is improving or otherwise as the monitoring undertaken formed the first year of baseline monitoring.

Both the LFA and EDA transects run downslope. This can fail to pick up erosion that is occurring outside of the immediate transect area. Consistent with the recommendation of Erskine and Fletcher (2014), for monitoring erosion there should be transects running across the contour. This should provide information on whether there is an increase or decrease in number and width of sheet erosion, rills and gullies.

4.4.2.4 Visual Observation – Stability

The walkover of the Diversion Remediation works showed there are several breaches of the soil conservation earthworks. These are not large and could be repaired with very small machinery, or manually. The small areas of sheet erosion in the phase 1 area of the remediation works may be adequately addressed through the use of turf or spreading topsoil and seed.

The overall impression through examination of images taken previously of the area, is that the stability of the site has improved significantly from 2014 to 2016.

4.4.2.5 Visual Observation – Biodiversity

The achievement of soil stability was the priority for works to occur in the remediation area (ELA, 2014). Following this, greater attention can be given to enhancing biodiversity values of the area.

During the first phase of work in late 2014, *Eucalyptus blakelyi* (Blakely's Red Gum) was planted at the base of the rock revetment, but above of the normal flow of the stream. These trees have survived well, but their slow growth rates mean that this area should continue to be monitored to determine progress and seek to establish a cause of this slower growth. It could be that it will be some time before the trees overcome competition from nearby creek rushes (*Phragmites australis*). Alternatively, there could be issues with the substrate in which the plants are growing. It is recommended that a trial is undertaken with planting of further Blakely's Red Gum further upslope in the toe of the rock revetment. Additionally, other native plant species that are tolerant of wet growing conditions (waterlogging) should be trialled, such as (*melaleuca thymifolia*).

The use of large woody debris at the top of the banks would assist in the reintroduction of a range of fauna. Similarly, woody debris at the top of the rock revetment would give perching/roosting spots for a range of birds that forage in the riparian environment.

4.4.2.6 Appropriateness of Analogue Site

The Goulburn River Diversion is 20m to 30m deep, steep sided (>25% slope) channel cut into sedimentary Permian strata. Within the Goulburn River catchment there is no equivalent land feature of a stream in Permian sediments cutting such a deep and steep sided course. There appears to be no analogue to the Goulburn River Diversion to be a benchmark or guide to achieving stability.

The two analogues that have been chosen are different from the Diversion Remediation area in very important ways: the slope lengths are much shorter; and secondly the slope angles are much lower.

The concept that analogues be used for adaptive management and continual improvement rather than forming compliance criteria is endorsed (UCML, 2016). Analogues for top of bank areas (reasonably level areas away from steep banks) are more easily found in the area local to the remediation area. Possible analogues are an existing floristic monitoring site of Blakely's Red gum grassy/shrubby woodland adjacent to the Goulburn River to the north of where the works will finish; and within a Grey Box-Blakely's Red Gum-Narrow Leaved Ironbark community that exists within the Ulan Road corridor approximately 700m to the south of the Diversion Remediation works.

4.4.2.7 Australian Coal Association Research Program (ACARP)

The Mine Water and Environment Research (MiWER) Centre at Edith Cowan University (ECU) is a multi-disciplinary and internationally-recognised research provider for the assessment and management of mine water issues including pit lakes, river diversions, discharge assessment, and mine closure.

ECU began to undertake an ACARP within UCML in 2016 to develop a closure criteria for river diversions as an alternative to reference sites. The work schedule for the project is outlined in **Table 4.6** below. The ACARP is currently on going with final reporting expected to be completed by early 2018.

Table 4.6 ACARP Schedule

| | 2016 | | | | | | | | | | | | 2017 | | | | | | | | | | | |
|-------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| River Monitoring | | | | | | | | | | | | | | | | | | | | | | | | |
| Site selection | | | | | | | | | | | | | | | | | | | | | | | | |
| Finalise methods | | | | | | | | | | | | | | | | | | | | | | | | |
| Field monitoring | | | | | | | | | | | | | | | | | | | | | | | | |
| Chemical analyses | | | | | | | | | | | | | | | | | | | | | | | | |
| DNA extraction | | | | | | | | | | | | | | | | | | | | | | | | |
| DNA sequencing (UWA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Fine-scale Study | | | | | | | | | | | | | | | | | | | | | | | | |
| Site selection | | | | | | | | | | | | | | | | | | | | | | | | |
| Finalise methods | | | | | | | | | | | | | | | | | | | | | | | | |
| Field monitoring | | | | | | | | | | | | | | | | | | | | | | | | |
| Chemical analyses | | | | | | | | | | | | | | | | | | | | | | | | |
| DNA extraction | | | | | | | | | | | | | | | | | | | | | | | | |
| DNA sequencing (UWA) | | | | | | | | | | | | | | | | | | | | | | | | |

4.4.3 Summary of Management Contingency Response for Rehabilitation and Revegetation

The following table integrates the above-mentioned monitoring methodology into the Example Rehabilitation Table as per the NSW Trade and Investment Guideline ESG3: Mining Operations Plan (MOP) Guidelines, July 2013.

Certain aspects of this table may vary slightly based on consultation with suitably qualified professionals during refinement of the recommended monitoring strategy.

The monitoring methodology relies on the establishment of analogue sites to define the monitoring trend parameters. UCML has identified possible analogue sites above and below the channel diversion that reflect the anticipated final outcome. These will be developed in consultation with suitably qualified professionals and reported in a specific section of the annual rehabilitation report, as part of the Annual Environmental Review submitted to agencies in March each year.

The following Table provides advice on how UCML will monitor the site and determine if the rehabilitation is tracking towards a desired outcome, or if intervention is required. The table is not intended to be performance criteria however, to provide consistency, some of the parameters will flow through to the Project Closure criteria in **Section 6**.

It is also necessary to emphasise that performance indicators and measures should reflect the objective of remediating the diversion to a point of mitigating off site impacts rather than establishing a pre-construction outcome.

| Objective | Primary Measure | Performance Indicators | Management Contingency Response | Frequency |
|---|---|--|---|---|
| Landform | | | | |
| Final landform reflective of design criteria | Slope of final landform as determined by detailed engineering design and hydraulic modelling. | Landform of disturbed areas is generally compatible with the final design criteria for the GRD 1:2.7 (V:H) | Undertake survey to confirm cross sectional area. Undertake geotechnical assessment to determine stability. | At completion of each area |
| Channel Stability | Surface water control works in place to mitigate the effects of any run on water from the surrounding catchment | Type and severity of erosion | Monitor the LFA Drainage Line Assessment indicators and apply the recommended remediation actions as per Table 4.3 . | Annual |
| | Vegetation established channel walls and floor to promote resistance to the erosive effects of overland and channel flows. | Presence and type of vegetation | | Annual |
| | Rock revetment works constructed to limit the exposure of dispersive material to the erosive forces of channel flow. | Level of unprotected dispersive sub soils either present or not present. | | Annual |
| Rock Armour constructed to be resilient to modelled channel flows | Rock Armour complies with Australian Standards | <ul style="list-style-type: none"> AS41332.1.1 Dry Density (2.1 t/m³) AS41334.2.1 Aggregate Crushing Strength ((25mPa) AS 1141,22 Wet/Dry strength Variation | Rock criteria to be tested periodically through construction for compliance. | 1 test per 5,000m ³ of stockpiles. |
| Growth Medium | | | | |
| Landform is functional and performing as designed. | Based on key physical, biological and chemical characteristics, the LFA stability index provides an indication of the site stability. | LFA Stability index score trending towards analogue benchmark sites | Investigate the cause for the parameter to be trending outside the levels recorded in analogue sites. | Annual |
| | Based on key physical, biological and chemical characteristics the | LFA Infiltration index score that is trending towards analogue | Investigate the impact that the variation of the respective | Annual |

| Objective | Primary Measure | Performance Indicators | Management Contingency Response | Frequency |
|---|---|--|---|--------------|
| | LFA infiltration index provides an indication of the sites capacity to absorb water. | benchmark sites. | parameter is having on resilient vegetation growth and implement remediation action as recommended by a suitable qualified professional. | Annual |
| | Based on key biophysical and chemical characteristics the LFA nutrient recycling index provides an indication of the sites ability to recycle nutrient. | LFA Nutrient Recycling index score that is trending towards analogue benchmark sites | | |
| Microbial characterisation of growth medium. | As decomposers, soil microbial communities provide critical ecosystem processes. They are an important element for successful land rehabilitation because of their role in nutrient cycling, plant establishment and soil formation | Resilience of populations of bacteria, actinomycetes and fungi Measured by the stability of numbers from wet to dry conditions and trending towards analogue sites. | In the event of a negative trend, investigate with a suitable qualified professional and implement expert advice. Likely to be application of soil ameliorants or nutrients to assist microbial activity. | Annual |
| Soil properties of areas disturbed in the process of re-profiling batters and construction of rock revetment are managed to mitigate dispersion acidity impacts and over compaction of soils. | Acidity and Alkalinity chemical tests | pH is within ranges of the analogue benchmark sites, typically pH 5.6 to 7.3 | Lime applied as per recommended rates from the Soil Analysis report. Monitor soils. If required apply ameliorants recommended by soil testing and/or professional agronomic advice. | Annual |
| | Slaking Test and Emerson Aggregate Test | Dispersion is within typical ranges of the analogue benchmark sites. | Gypsum applied as per recommended rates from the Soil Analysis report Monitor dispersion parameters throughout the construction period. | Annual |
| | Topsoil easily penetrable with small sharp object with little force required | Good take up of ground covers and grasses | Compost to be added to topsoil at a rate of 200t per Ha | During works |

| Objective | Primary Measure | Performance Indicators | Management Contingency Response | Frequency |
|-------------------------------|--|---|--|-------------------------------|
| Eco System Development | | | | |
| Improve ecological function | Vegetation contains a diversity of shrubs and juvenile trees species that is endemic to the local community. | Structure and floristics of monitoring sites trending towards analogue sites. | Monitor the establishment and survival rates of local endemic trees and shrubs and instigate replanting as part of routine maintenance as required. | Annual |
| | Vegetation contains a density of species trending to that of the local remnant vegetation. | Stem densities of monitoring sites trending towards analogue sites. | | Annual |
| | Perennial groundcover is sufficient mitigate erosion. | 70% or better perennial plant grass cover. | Actions to improve perennial ground cover may include providing soil ameliorants or conditioners to address nutrient balance, limiting competition from weeds and total grazing pressure and replanting if required. | Annual |
| | Number logs or wooden structures in remediated areas (river batters exempt) | 5 or more hollow logs per Ha | Hollow logs to be placed around rehabilitated benches after topsoil placement | Once per site after placement |

4.5 Corrective Actions

Where a failure of erosion and sediment control structures or remediation works has occurred, or an inspection identifies a non-compliance with this plan, the incident/non-compliance will be handled in accordance with the SWGWRP (ULN SD PLN 0057). Actions will be entered into CMO to monitor completion and the effectiveness of the action.

4.6 Reporting

4.6.1 Environmental Incidents

In accordance with Condition 6, Schedule 5 of the Project Approval, within 7 days of detecting an exceedances or identifying an incident, UCML will report the exceedances to the DP&E and the EPA. The report will include the following details:

- the date, time and nature of the exceedances/incident;
- identify the likely cause of the exceedances/incident;
- description of the response action that has been undertaken to date; and
- description of the proposed measures to address the exceedances/incident.

Reportable incident notifications to EPA must be made **immediately** by telephoning the Environment Line service on **131 555** and in accordance with **Section 3.5.9.1** of the EMS. The Environment and Community Manager (or delegate) will provide written details of the incident to the Secretary and to EPA within 7 days of the date on which the incident occurred.

In accordance with *CAA HSEC STD 0006 6.0 Incident*, UCML have developed ULN SD PRO 0018 Hazard & Incident Management procedure to:

- manage hazards and incidents to minimise damage to people, environment, community and other assets; and
- identify factors that contributed to incidents through an investigation process and to learn from those events and prevent reoccurrence.

The details and final investigation results from all environmental incidents must be recorded on *CAA HSEC FRM 0020 Incident Reporting & Investigation Booklet* and provided to Environment and Community Manager for review. All environmental incidents are to be recorded in CMO and reported annually in the Annual Review report.

For more information on incident reporting, refer to Section 3 of the EMS (ULN SD PLN 0050).

4.6.2 Internal Reporting

The Environment and Community Manager is responsible for preparing information for internal communication and reporting as per Section 4.3 of the UCML EMS (ULN SD PLN 0050).

Information regarding the GRDRP (as required) will also be provided to Glencore Coal Assets Australia (GCAA) in accordance with Section 4.3 of the UCML EMS (ULN SD PLN 0050) for Monthly Environment and Community Status Report.

Incidents from any remediation works resulting in water pollution or non-conformances with legislative requirements will be reported internally in accordance with the UCML EMS (ULN SD PLN 0050) and EPL 394 reporting requirements.

4.6.3 External Reporting

A summary of the performance of the GRDRP will be provided in the Annual Review in accordance with the Project Approval conditions. The Annual Review report will also document community complaints and incidents relating to the performance, the effectiveness of the erosion and sediment controls, the effectiveness of engineered structures, maintenance and/or failure of the UCML water management system and any identified issues.

Additionally, in accordance with Condition 7, Schedule 5 of the Project Approval, UCML will regularly report environmental monitoring results on its website (www.ulancoal.com.au).

4.6.4 Community Complaints

Community complaints management includes receipt of complaints, investigation, implementation of appropriate remedial action, and feedback to the complainant as well as communication to site management or personnel and notification to external bodies, such as the EPA, where necessary.

Community complaints received by the Ulan Mine Complex are managed in accordance with the Social Involvement Plan (SIP) (ULN SD PLN 0015). UCML have developed *ULN SD PRO 0001 Complaints Procedure* to assist in recording complaints, complaint investigation and follow up actions. This procedure has been established to record all complaints received by UCML and provides the company with an important measure, which assists in the overall assessment of sustainable development (SD) performance. The Community, Land and Property Coordinator is responsible for complaints management.

UCML maintain a 24 hour, 7 day a week community and employee information telephone line **1800 647 630** and email address ulancommunity@glencore.com.au to:

- manage complaints received by UCML that may be a result of mining and/or associated activities conducted within land owned or managed by UCML;
- provide access to open cut blasting information for interested stakeholders; and
- provide access and incident information to employees during emergency situations.

In accordance with Condition 10, Schedule 5 of the Project Approval, access to the Ulan Mine Complex's Community Complaints Register is via the UCML internet site at www.ulancoal.com.au for the purposes of external review and transparency. Details of all community complaints are also reported in UCML's Annual Review report.

Further information on complaints management can be found in Section 3 of the EMS (ULN SD PLN 0050).

5 Review and Improvement

Ongoing monitoring and review on the performance and implementation of this GRDRP will be undertaken in accordance with *CAA HSEC PCL 0020 11.01 Environmental Compliance Management* and Section 5 of the EMS.

The Environment and Community Manager (or delegate) will review this GRDRP and supporting plans and resubmit to DP&E at least every three years or earlier if required. Any changes made to the GRDRP as a result of the review will be made in consultation with EPA, DRE, MWRC and DPI Water. A copy of the revised GRDRP will be supplied to the Secretary of DP&E for approval. The GRDRP will reflect changes in environmental requirements, technology and operational procedures. Updated versions of the approved GRDRP will be made publicly available on UCML's website at www.ulancoal.com.au

On an annual basis and after submission of the Annual Review, UCML shall review, and if necessary revise, the strategies, plans, and programs required under Project Approval 08_0184 to the satisfaction of the Secretary within 3 months of:

- a. the submission of an annual review under Condition 3 (Schedule 5);
- b. the submission of an incident report under Condition 6 (Schedule 5);
- c. the submission of an audit report under Condition 8 (Schedule 5); and
- d. any modification to the conditions of this approval, (unless the conditions require otherwise).

The performance of the GRDRP in achieving the objectives and targets shall be reviewed at least quarterly, which includes the environment & community component of the SD Annual Plan. The review will be completed by the Environment and Community Manager and reported to the Operations Manager. This review shall enable the identification of non-conformances and the formulation corrective action where targets are not being met in accordance with the UCML EMS (ULN SD PLN 0050).

6 Project Closure Criteria

The GRDRP is consistent with Condition 55 of PA 08_0184 which requires UCML to rehabilitate the site to the satisfaction of the NSW Department of Industry.

This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EA.

This criteria requires UCML to:

1. Improve overall aesthetic appearance.
2. Improve surface drainage controls and vegetation establishment.
3. Increase geomorphic features and ecological integrity where feasible.
4. Implement appropriate erosion control.
5. Strive for a positive improvement on water quality existing in the diversion.
6. Community and government acceptance of proposed works.

As mentioned in **Section 1.4.2 Conceptual Framework for Achieving Project Success** UCML has established a number of processes to guide the project and allow for adaptive management and continual improvement through the life of the project

The GRD Project Closure criteria have been developed by integrating the requirements of:

- PA 08_0184 and the Environmental Assessment for Continued Operations.
- The GRDRP objectives derived from an Expert Panel process in March 2013 and consistent with the river rehabilitation planning framework developed by the Land and Water Australia R&D Corporation and the CRC for Catchment Hydrology, and

DRE Mining Operations Plan (MOP) Guidelines Section 5.4 “Performance measures, Performance Indicators and Relinquishment Criteria.” & Section 7.4 “Relinquishment Phase achieved during MOP period.”

| Rehabilitation Phase | E.A & P.A 08_0184 criteria | GRDRP Project Objective | Performance Measure | Performance Indicator | Completion Criteria | Monitoring Sites | Justification |
|-------------------------|------------------------------|--------------------------------------|---|---|--|---------------------------|---|
| Landform Establishment. | Increase geomorphic features | Maintain Safe Hydraulic Performance. | Flood tolerance levels, channel flow heights and channel; flow velocities. | Modelled channel flow heights and velocities | Hydraulic modelling determines that parameters are the same as or better than current. | GRD Channel | URS Hydraulic Modelling 2013. |
| | | | Ephemeral Drainage Line Stability Assessment (EDA) | 8 EDA stability classification indicators (refer to Section 4.1.4) | EDA Index Score trending towards 70% or above. | All areas except Area 4 * | Landscape Function Analysis Ephemeral Drainage Line Indicators of Stability (Tongway and Hindley). |
| | | Constructability | Works constructed to project design. Rock armour to Australian Standards specifications. | <ul style="list-style-type: none"> Batter profiles and cross sectional areas as per design Material Type competent and sized to requirement as per specifications. | Geotechnical Assessment confirms construction as per design criteria. | 2, 3 & 5. | <ul style="list-style-type: none"> Engineering design as per GRDRP. URS Hydraulic Modelling to 100 year ARI. Australian Standards for Rock Armour. |

Note: Area 4 is not monitored by EDA Stability Indicators. This reach, known as the “canyon”, currently does not exhibit signs of instability. Also its box cut nature through bedrock, does not lend itself to the EDA indicators.

| Rehabilitation Phase | EA & PA 08_0184 criteria | GRDRP Project Objective | Performance Measure | Performance Indicator | Completion Criteria | Monitoring Sites | Justification |
|---|--|---|--|--|--|------------------|---|
| Growth Medium | Implement adequate erosion control | Improve and / or maintain water quality | Surface water controls mitigate erosion caused to channel batters from overland flows. | Surface Water Controls in place and built to 100 ARI design. Type and severity of erosion | Final engineer assessment determines that the appropriate design criteria have been met. | Entire GRD | <ul style="list-style-type: none"> Glencore Water Management Plan. Glencore ESCP. URS Goulburn River Diversion Remediation Strategy 2009 (revised 2013) EDA channel bank stability. |
| | | | Soil Condition | Soil acidity of growth medium | pH 5 to 8 | Topsoil sites | <ul style="list-style-type: none"> Goulburn River Diversion Soil Inventory SLR Consultancy 2013. NATA accredited Soils Analysis. |
| | | | | Soil Dispersion of disturbed sites | Emerson's Aggregate Test rating of moderate or better | Disturbed Areas | |
| | | | | Topsoil depth on Disturbed areas | Minimum average of 60 to 100 mm | Disturbed Areas | |
| | | | | LFA Soil Indices Refer to Section 4.4.1.1 | Suitably qualified professional determines that soils are healthy and trending to analogue site. | Entire GRD | CSIRO Landscape Function Analysis Tongway and Hindley). |
| Soil Microbe populations of coprotrophic, oligotrophic bacteria and actinomycetes fungi and yeast | Soil Monitoring determines that populations are resilient to local conditions. | Entire GRD | Microbial Management Systems – GRD Condition Report. | | | | |

| Rehabilitation Phase | EA & PA 08_0184 criteria | GRDRP Project Objective | Performance Measure | Performance Indicator | Completion Criteria | Monitoring Sites | Justification |
|-------------------------|---|-----------------------------|--------------------------|--|--|------------------|--|
| Ecosystem Establishment | Improve Vegetation establishment | Improve ecological function | Vegetation Establishment | Tree Density | Recognised assessment methodology (LFA, EFA) or tool (eg Biometric Tool, Biodiversity Investment Tool) agreed to by UCML and DRE determines plantings are trending towards analogue sites. | Entire GRD | Eco Logical Goulburn River Diversion vegetation assessment August 2014 |
| | | | | Tree Diversity | | | |
| | | | Groundcover | Percentage perennial groundcover. | 70% or better groundcover. | Disturbed sites | Managing Urban Runoff – Soil and Construction (“the Blue Book”) |
| Recruitment | Recognised assessment methodology (LFA, EFA) determines that groundcover recruitment and succession is trending towards analogue sites. | Disturbed sites | | CSIRO Ecological Function Analysis Tongway and Hindley). | | | |

7 Accountabilities

| Role | Accountabilities for this document |
|------------------------|--|
| Major Projects Manager | <ul style="list-style-type: none"> • Oversee implementation and delivery of the Plan. • Approve appropriate resources for the effective implementation of the plan. • Ensure the effective implementation of this plan to ensure the remediation is consistent with the Mining Operations Plan and Conceptual Mine Closure Plan. • Ensure any potential or actual environmental issue is reported in accordance with legal requirements and the corporate standard. • Authorise internal and external reporting requirements of this plan. • Approve subsequent revisions of this plan. • Ensure all personnel involved during the remediation works of the Goulburn River Diversion are aware of their corporate, environmental and community obligations. • Ensure ongoing consultation with relevant government departments is undertaken to determine completion criteria. |

| Role | Accountabilities for this document |
|-----------------------------------|---|
| Environment and Community Manager | <ul style="list-style-type: none"> • Provide that sufficient resources are allocated for the implementation of this Plan. • Ensure that the results of monitoring are evaluated and reported to senior management and to relevant personnel for consideration as part of ongoing mine planning. • Proactively engage government and community as required. • Review and approve external reports prior to final approval by the Operations or General Manager. • Ensure ongoing consultation with relevant government departments is undertaken to determine completion criteria. • Review the GRDRP objectives and criteria. • Ensure all erosion and sediment control plans (ESCP) are developed for each Area of the diversion are prepared in accordance with the ESCP (ULN SD PLN 0025). • Ensure all erosion and sediment control measures are in place in accordance with their respective ESCP and Ground Disturbance Permit. • Ensure that care and maintenance measures to assist in the rehabilitation of the Goulburn River Diversion are undertaken. • Contact point for community complaints in accordance with ULN SD PLN 0001 - Complaints Procedure. • Ensure effective management of all community complaints. |

| Role | Accountabilities for this document |
|--|--|
| <p>Environment & Community Coordinator</p> | <ul style="list-style-type: none"> • Manage and maintain the water monitoring programs in accordance with this Plan. • Ensure the monitoring equipment is operated in accordance with relevant industry standards and protocols. • Ensure that all working records are effectively maintained on site in accordance with the EMS. • Coordinate the collation and evaluation of monitoring data. • Update the monitoring data on the UCML internet site. • Regularly report environmental performance to the ECM. • Prepare internal and external reports for review by EMC. • Conduct periodic environmental inspections in accordance with the EMS. • Conduct periodic inspection of UCML's buffer lands to identify any water management issues. • Ensure any potential or actual water management issues, including incidents and non-conformances, are reported to the ECM. • Coordinate incident investigation processes including associated reporting requirements, in accordance with the EMS. • Provide visible and proactive leadership in relation to surface water management and erosion and sediment control. • Participate in the ongoing review of this Plan. • Ensure inspections of the remediation works are undertaken within 1 month of the completion of each Area of the diversion and/or after each storm event. • Monitor and evaluate the rehabilitation effectiveness for each Area. • Proactively engage government and community as required. |

| Role | Accountabilities for this document |
|-----------------|--|
| Project Manager | <p>Supervisors and Task Coordinators;</p> <ul style="list-style-type: none"> • Ensure that works are constructed to the appropriate design standards. • Ensure that adequate resources are budgeted for the implementation of the plan. • Ensure adequate resources are budgeted for an in relation to water monitoring or erosion and sediment control for their task/project. • Implement and manage changes to UCML's Goulburn River Remediation management system through UCML's Change Management process. • Ensure any work requiring ground disturbance is approved prior to disturbance in accordance with EMS (where relevant). • Monitor that team members and contractors carry out work appropriate to the work health and safety standards on site. • Monitor that team members and contractors carry out work appropriate monitoring and maintenance tasks. • Ensure and potential and actual water management issues are controlled, or otherwise isolated. • Ensure and potential and actual water management issues, including environmental incidents, are reported to the ECM. • Conduct environmental inspections, including monitoring of erosion and sediment control structures, prior to and following high rainfall events. • Provide input to management on the adequacy and effectiveness of this plan. • Complete maintenance, repair or replacement of erosion and sediment control structures as identified through field inspections in accordance with UCML's ESCP and Ground Disturbance Permits. • Provide visible and proactive leadership in relation to surface water management and erosion and sediment control. • Ensure personnel working at the operation are aware of any water monitoring obligations for their task/project. • Ensure all erosion and sediment controls are in place in accordance with ESCPs. |

| Role | Accountabilities for this document |
|-----------------------------|---|
| All Employees & Contractors | <ul style="list-style-type: none"> • Ensure the effective implementation of this plan with respect to their work area. • Ensure any potential or actual water management issues, including environmental incidents, are reported to the project manager, supervisor or task coordinator. • Seek approval from the project manager, supervisor or task coordinator prior to making changes to the water management system. • Construct diversion remediation works in accordance with agreed Work Authorisations and Safe Work Method Statements (Remediation Contractor). • Construct erosion and sediment controls in accordance with agreed ESCPs (Remediation Contractor). • Undertake rehabilitation of the Goulburn River Diversion in accordance with this Plan (Remediation Contractor). |

8 Document Information

Relevant legislation, standards and other reference information must be regularly reviewed and monitored for updates and should be included in the site management system. Related documents and reference information in this section provides the linkage and source to develop and maintain site compliance information.

8.1 Related Documents

Related documents, listed in **Table 8.1** below, are internal documents directly related to or referenced from this document.

Table 8.1– Related documents

| Number | Title |
|--------|--|
| UCML | <ul style="list-style-type: none"> • Environmental Management Strategy (EMS) (ULN SD PLN 0050); • Water Management Plan (WMP) (ULN SD PLN 0017); • Erosion and Sediment Control Plan (ESCP) (ULN SD PLN 0025); • Goulburn River Diversion Erosion and Sediment Control Plan (ESCP) (ULN SD PLN 0130); • Surface Water Monitoring Program (SWMP) (ULN SD PLN 0055); • Groundwater Monitoring Program (GWMP) (ULN SD PLN 056); • Surface Water and Groundwater Response Plan (SWGWRP) (ULN SD PLN 0057); • Integrated Mining Operations Plan (MOP) 2010 to 2017; • Biodiversity Management Plan (ULN SD PLN 0026); and • Conceptual Mine Closure Plan (ULN SD PLN 0084). |

8.2 Definitions

Table 8.2 lists all terms used in this document and their definitions.

Table 8.2 - Definitions

| Term | Definition |
|-----------|---|
| ACARP | Australian Coal Association Research Program |
| ANZECC | Australia and New Zealand Environment and Conservation Council |
| ARI | Average Recurrence Interval. The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration |
| BE | Bobadeen East Offset Area |
| Blue Book | Managing Urban Stormwater: Soils and Construction, Volumes 1 and 2 (Landcom 2004 and DECC 2008) |
| BOA | Bobadeen Offset Area |

| Term | Definition |
|-------------|---|
| DPI (Water) | Department of Primary Industries (Water) |
| DP&E | Department of Planning and Environment |
| EA | Environmental Assessment |
| EC | Electrical Conductivity |
| EDA | Ephemeral Drainage Assessment. |
| EMS | Environmental Management Strategy |
| EP&A Act | <i>Environmental Planning and Assessment Act 1979 (NSW)</i> |
| EPA | Environment Protection Authority |
| ESC(P) | Erosion and Sediment Control (Plan) |
| GRDRP | Goulburn River Diversion Remediation Plan |
| (G)CAA | (Glencore) Coal Assets Australia |
| GWMP | Groundwater Monitoring Program |
| LFA | Landscape Function Analysis |
| LGA | Local Government Area |
| metres AHD | Metres Australian Height Datum |
| MWRC | Mid-Western Regional Council |
| Mtpa | Million tonnes per annum |
| PA | Project Approval |
| POEO Act | <i>Protection of the Environment Operations Act 1997</i> |
| SWGWRP | Surface Water and Groundwater Response Plan |
| SWMP | Surface Water Monitoring Program |
| TSS | Total Suspended Solids |
| UCML | Ulan Coal Mines Limited |
| V:H | Vertical : Horizontal |
| WMP | Water Management Plan |

8.3 Reference Information

Reference information, listed in **Table 8.3** below, is information that is directly related to the development of this document or referenced from within this document.

Table 8.3 – Reference information

| Reference | Title |
|--------------------------------|--|
| Legislation | <ul style="list-style-type: none"> • <i>Protection of the Environment Operations Act 1997</i> • <i>Water Management Act 2000</i> • <i>Water Act 1912</i> • <i>Environmental Planning and Assessment Act 1979</i> |
| Glencore Coal Assets Australia | <ul style="list-style-type: none"> • CAA HSEC STD 0011 11.0 Environment • CAA HSEC PCL 0020 11.01 Environmental Compliance Management • CAA HSEC STD 0012 12.0 Change • CAA HSEC PCL 0005 11.20 Statutory Approval Management • CAA HSEC PRO 0007 11.01 Environmental Data Collection and Reporting • CAA HSEC STD 0006 6.0 Incident • CAA HSEC PRO 0012 Incident Reporting and Investigation • CAA HSEC FRM 0020 Incident Report and Investigation Booklet • CAA HSEC PRO 0010 11.16 Completion Criteria and Rehabilitation Monitoring • CAA HSEC STD 0003 3.0 Documents and Records • |
| UCML | <ul style="list-style-type: none"> • Social Involvement Plan (ULN SD PLN 0015) • Complaints Procedure (ULN SD PRO 0001) • Environmental Management Strategy (ULN SD PLN 0050) • Water Management Plan (ULN SD PLN 0017) • Surface Water Monitoring Program (ULN SD PLN 0055) • Groundwater Monitoring Program (ULN SD PLN 0056) • Surface Water and Groundwater Response Plan (ULN SD PLN 0057) • Biodiversity Management Plan (ULN SD PLN 0026) • Integrated Mining Operations Plan 2010 to 2017 • Conceptual Mine Closure Plan and Rehabilitation Liability Assessment (ULN SD EXT 0072) |
| External | <ul style="list-style-type: none"> • ACARP “Maintenance of Geomorphic Processes in Bowen Basin River Diversions” (ACARP guidelines) • ANZECC/ARMCANZ, 2000. National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality. • Austin, M. P., Cawsey, E. M., Baker, B. L., Yialeloglou, M. M., Grice, D. J. and Briggs, S. V. (2000) Predicted Vegetation Cover in the Central Lachlan Region. Final report of the Natural Heritage Trust Project AA 1368.97. CSIRO Wildlife and Ecology, Canberra. |

| Reference | Title |
|-----------|--|
| | <ul style="list-style-type: none"> • Braun-Blanquet, J. (1927) Pflanzensozioogie. Springer, Vienna. • Department of Environment and Climate Change (DECC), 2008. Managing Urban Stormwater – Soils and Construction, Volume 2A – Installation of Services. • Department of Environment and Climate Change (DECC), 2008. Managing Urban Stormwater – Soils and Construction, 2C – Unsealed Roads. • Department of Environment and Climate Change (DECC), 2008. Managing Urban Stormwater – Soils and Construction, 2D – Main Road Construction. • Department of Environment and Climate Change (DECC), 2008. Managing Urban Stormwater – Soils and Construction, Volume 2E – Mines and Quarries. • Department of Water and Energy, 2007. <i>River Hydrology and Energy Relationships - Design Notes for the Mining Industry.</i> • IE Aust, 1987. Australian Rainfall and Runoff (AR&R). • Eco Logical Australia Pty Limited, 2014. <i>Goulburn River Diversion Rehabilitation Works – Vegetation Assessment and Revegetation Recommendations.</i> Prepared for Ulan Coal Mines Limited. • Landcom, 2004. Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition. • Umwelt (Australia) Pty Limited, 2009. <i>Ulan Coal – Continued Operations Environmental Assessment.</i> Prepared for Ulan Coal Mines Limited. • Umwelt (Australia) Pty Limited, 2011. <i>Ulan Coal Continued Operations North 1 Underground Mining Area, Minor Modification to Ulan No.3 & Ulan West Mine Plans & Proposed Concrete Batching Plant.</i> • Umwelt (Australia) Pty Limited, May 2012. <i>Environmental Assessment Modification to Ulan Coal Continued Operations, Ulan West Mine Plan (Approved Panels 1 – 4) and Construction Blasting</i> • URS, 2009. <i>Goulburn River Diversion - Long Term Stability Strategy,</i> prepared for Ulan Coal Mines Limited. • URS, 2015. <i>Goulburn River Diversion remediation Works – Construction Verification – Pilot Project,</i> prepared for Ulan Coal Mines Limited. |

8.4 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 in **Table 8.4** below.

Table 8.4 – Change information

| Version | Date | Review team (consultation) | Change Summary |
|---------|--------------------------------|--|--|
| 1 | 31 March 2011 | Jamie Lees, Cheryl Henriques, Matt Newton (Umwelt), Susan Shield, (Umwelt) | Review of Erosion & Sediment Control Plan following Project Approval 08_0184 being granted by the DoP&I. |
| 2 | 19 July 2011 | Matt Newton (Umwelt), Susan Shield (Umwelt), Cheryl Henriques, Jamie Lees | Incorporate comments from DP&E review |
| 2.1 | 21 July 2011 | Eliza LeBrocq | Formatting - No content changes |
| 2.2 | 21 July 2011 | Eliza LeBrocq | Formatting - No content changes |
| 2.3 | 21 July 2011 | Eliza LeBrocq | Formatting - No content changes |
| 3 | 15 June 2012 | Susan Shield (Umwelt), Robyn Stoney, Ian Flood, Rachel Murray | Update of plan required by Annual Review, Court Orders, approval of MOD 1 and MOD2, and EPL 394 variation. |
| 4 | 28 th June 2013 | Rod Reinhard Robyn Stoney Chris Glennon Cathal O'Leary | Draft GRDRP updated from the original GRDRP. |
| 5 | 11 th October 2013 | Rod Reinhard Robyn Stoney Chris Glennon | Updated from draft GRDRP |
| 6 | 28 th February 2016 | Steven Hawkins Robyn Stoney Angela van der Kroft | Revised draft, capturing the results and learnings from the Pilot Project conducted in 2014-15. |
| 6.1 | 30 th June 2016 | Steven Hawkins Robyn Stoney Angela van der Kroft | <p>Draft submitted for DP&E Approval.</p> <p>Review of pilot project and subsequent annual review:</p> <p>Incorporates recommendations of the Vegetation Assessment and Revegetation Report Ecological Australia (2014), specifically large rooted species such as shrubs and trees are avoided on the bank batter slopes</p> <p>Species used in the seed mix expanded to include <i>Callistemon rigidus</i></p> <p>In Area 3b drop structure moved 100 metres East to coincide with lowest point in the bank and the water flow path</p> <p>Removing drop structure at chainage 1700, merging drain in area 2 to area 4</p> |

| | | | |
|------|---------------|---|--|
| | | | <p>and continuing the drain towards East Pit. It will be possible to channel water flow toward the East Pit during construction works and to divert flow to the Goulburn River once the revegetation is effective in the minimisation of sediment (Figure 3.23)</p> <p>Area 5 and 6 construction of a levee bank to provide flood protection to the East Pit area in a 1% Annual Exceedance Probability event</p> <p>Modification of aquatic monitoring program, now, prior and post construction works in the river and annually</p> <p>Basalt testing regime reduced from 4 to 6 tests every 4000m³ to 1 in 5000m³ due to consistency of samples</p> <p>Area 5 right hand side between chainage 3060 to 3260 undergoing engineering review to minimise interventions which could be harmful in this area</p> <p>Revision to schedule. An additional 6 months was included in the pilot project review phase, at the advice of the URS Supervising Engineer, to allow time for settling of the work and exposure to a range of weather conditions. An additional four months are included in 2018, post completion of the work for review and repairs if required. The project completion will be sooner than the final work proposed in the Environmental Assessment (2009) which was to finish in year 9 of the project (2019) and is therefore consistent with the project as approved</p> |
| 6.11 | February 2017 | Steven Hawkins Robyn Stoney Jessica Southgate | <p>Draft submitted for DP&E approval.</p> <p>Update incorporates Goulburn River Rehabilitation Assessment undertaken by Eco Logical Australia (ELA, 2017), specifically baseline monitoring results for LFA and EDA.</p> <p>Area 3b Ch1480 – 1840 RHS complete.</p> |

Appendix A - Approvals

Copy of approvals in relation to the draft Goulburn River Diversion Remediation Plan



Charlie Allen
General Manager
Ulan Coal
Private Mail Bag 3006
Mudgee NSW 2850

Contact: Ben Harrison
Phone: 02 6575 3402
Fax: 02 6575 3515
Email: benjamin.harrison@planning.nsw.gov.au
Our ref: MP 08_0184

Dear Charlie

Ulan Coal – Approval of Goulburn River Diversion Remediation Erosion and Sediment Control Plan

Reference is made to the Goulburn River Diversion Remediation Erosion and Sediment Control Plan submitted for the Department's consideration on 19 May 2014.

The Department has reviewed the plan and considers it generally adequate for the pilot project phase of the Goulburn River Diversion Remediation. Subsequently, the Acting Secretary has approved the plan.

The Department expects that the plan will be reviewed following the pilot project and if revised, resubmitted for approval prior to proceeding with the continued remediation program.

For further information, please contact me on 6575 3402 or by email to benjamin.harrison@planning.nsw.gov.au.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'S. Brooks'.

Scott Brooks
Team Leader Compliance
19-6-2014
As nominee of the Secretary



Development Assessment Systems & Approvals
Mining Projects

Contact: Sara Wilson
Phone: 9228 6583
Fax: 9228 6466
Email: sara.wilson@planning.nsw.gov.au

Mr Dan Clifford
General Manager
Ulan Coal Mines Ltd
Private Mail Bag 3006
MUDGEE NSW 2850

Dear Mr Clifford

**Ulan Continued Operations Project (MP 08_0184)
Goulburn River Diversion Remediation Plan**

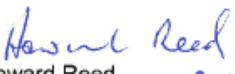
I refer to the revised Goulburn River Diversion Remediation Plan (GRDRP) (Version 5.1) dated November 2013, which has been prepared in accordance with Schedule 3 Condition 36 of the Ulan Coal Mine Limited (UCML) Project Approval (08_0184) for the Ulan Continued Operations Project.

The Department has reviewed the GRDRP and considers it adequate. Accordingly the Director-General has approved the plan.

The Department notes the requirement under Schedule 5 Condition 10 to make copies of all approved plans, programs and strategies publicly available.

If you require any more information, please call Sara Wilson on 9228 6583.

Yours sincerely


Howard Reed 3.12.13
Manager
Mining Projects
As the Director-General's nominee

Department of Planning & Infrastructure
22-33 Bridge Street Sydney NSW 2000 | GPO Box 39 Sydney NSW 2001 | T 02 9228 6111 | F 02 9228 6455 |
www.planning.nsw.gov.au

Appendix B – Correspondence

Copy of correspondence in relation to the draft Goulburn River Diversion Remediation Plan



Development Assessment Systems & Approvals
Mining Projects

Phone: (02) 9228 6583
Fax: (02) 9228 6466
Email: sara.wilson@planning.nsw.gov.au
Room 305
23-33 Bridge Street
GPO Box 39
SYDNEY NSW 2001

Robyn Stoney
Environment & Community Manager
Ulan Coal Mines Limited
Private Mail Bag 3006
MUDGEE NSW 2850

Our ref: S04/01722

Dear Ms Stoney

Ulan Coal Continued Operations Project Draft Goulburn River Diversion Remediation Plan

The Department has reviewed the draft Goulburn River Diversion Remediation Plan Version 5.1 (GRDRP) submitted in accordance with Condition 36 of Schedule 3 of the Ulan Coal Continued Operations Project Approval (08_0184).

The Department is satisfied with Ulan Coal Mine Limited's (UCML) broad objectives for remediating the Goulburn River Diversion, and the general content and structure of the draft GRDRP. However, the Department believes that the final GRDRP should be improved by addressing the following comments.

Staging of the Remediation Works

The proposed remediation program (Section 3.1) indicates that Area 3(a) will be a pilot area to allow all design options to be trialled before commencement of broader remediation and revegetation operations. The Department agrees that this approach will contribute to the successful implementation of the plan as it will allow UCML to test the constructability and rehabilitation/revegetation methodologies and observe operator capabilities.

However, it is not clear how the timing of the pilot area works will fit in with the overall timing of the broader works. The GRDRP indicates the entire works will be completed in a continuous program covering a 12 month period. The Department questions how testing associated with the pilot area and verification of appropriate methodologies can be satisfactorily done and the broader works then fully implemented within this timeframe.

A column should be added to Table 3.1 to indicate the proposed overall timing and staging of the pilot and broader remedial works.

In-channel Remediation Works

The GRDRP contains very little information in relation to the proposed in-channel remediation works. During the joint agency workshop held on 10 April 2013, UCML representatives discussed options to remove some of the excess sediment built-up in the channel and install structures to create pools and facilitate improved aquatic fauna habitat.

The text and figures of the GRDRP (see Figures 3.3 to 3.22) do not indicate that any in-channel remedial works are proposed. The Department requests either full consideration or else justification for the exclusion of this component of the remediation works.

Erosion & Sediment Control Plan

The Department supports UCML's intention to prepare an Erosion & Sediment Control Plan (ESCP) specific to the Goulburn River Diversion, as well as detailed ESCPs sub-plans for each of the seven remediation areas.

The Department requires that the overarching ESCP for the diversion is prepared to the satisfaction of the Director-General and approved prior to the implementation of remedial works.

Monitoring

The GRDRP (Section 4.1) indicates that the following monitoring will be undertaken during the remedial works:

- water quality monitoring upstream and downstream of the diversion in accordance with the mine's Surface Water Monitoring Program;
- event based water quality monitoring;
- channel stability monitoring; and
- ongoing aquatic fauna monitoring.

However, the GRDRP provides very little information on the detailed nature, location or timing of the proposed monitoring, or criteria/trigger levels that would initiate corrective actions. The GRDRP should be expanded to include this information.

Closure/Completion Criteria

The GRDRP (Section 6) provides general and high level criteria proposed to assess future success in achieving the objectives of the remediation and revegetation works. The Department requires that these criteria are further articulated to provide tangible and measureable indicators to ensure satisfactory achievement of the objectives.

UCML is required to update the draft GRDRP to address the above matters, as well as the issues raised by other agencies, and submit the final report by 11 October 2013.

Please feel free to call Sara Wilson on (02) 9228 6583 if you have any enquiries in relation to this matter.

Yours sincerely

Howard Reed
Manager, Mining



Contact: Michael Young
Phone: 02 6360 5346
File ref: OUT13/19198

Robyn Stoney
Environment & Community Manager
Ulan Coal Mines Limited
PMB 3006
Mudgee NSW 2850

Dear Robyn,

**Ulan Coal Mine: CCL741, MPL315, ML1341, ML 1365, ML1366, ML1467, ML1468,
ML1511, ML1554, ML1656
Goulburn River Diversion Remediation Plan (GRDRP)**

Thank you for providing a draft copy of the plan for review by the Division of Resources & Energy (DRE) of NSW Trade and Investment. The document has been reviewed with the following comments made to assist you in bringing it to a standard where the GRDRP could be endorsed by DRE.

The Department is supportive of UCML's broad objectives of improving the Goulburn River diversion's performance in terms of river dynamics, water quality, ecological function and visual amenity. However the document would be improved, and potentially the outcome more certain if greater clarity was provided in terms of the plans objectives, completion criteria (i.e. how UCML will know and how Government will know when these objectives have been achieved), and finally how the measurement will be undertaken: i.e. monitoring methodology.

These comments are primarily directed at the riparian ecological aspects of the plan. The *Maintain and/or improve ecological function objective* (Table 1.2) is confusing when viewed against the overall objective of improving the diversion. If the *maintain* objective was accepted, with no improvement in ecological function, then other objectives are unlikely to be met (e.g. the Improve water quality objective). The objective should simply be restated as *Improve Ecological Function*.

The ecological function of the existing diversion needs to be bench-marked against an analogue section of the river, with the remediation plan's objectives referenced to that.

With the objectives properly articulated, the plan then needs to be clear on what indicators will be used to measure achievement of the objectives. In Table 1.2 the *Criteria/indicators* with respect to ecological function are really just criteria and as important as it is to establish these, it is also important to be clear on what measures will be used (i.e. the indicators) and what the acceptable values would be. The chosen indicators will be governed to a large extent on the monitoring methodologies chosen. However, the draft

NSW Trade & Investment, Division of Resources & Energy, Mineral Resources
Locked Bag 21 Orange 2800
Tel: (02) 6360 5333 www.trade.nsw.gov.au ABN: 72 189 919 072

plan provides little information on what monitoring methodologies would be applied. It is important that the GRDRP provides this information in the final draft. It is also important to state that the success or failure of revegetation works has been shown to be governed, to a large extent, by soil parameters and as such these should also be identified and included in the monitoring programme.

As discussed in our meeting with you and Chris Glennon on 12th June, when the final draft of the GRDRP is submitted would you please ensure that a copy of this letter and any correspondence from other agencies are included as appendices. Reference to where matters raised in the correspondence have been addressed in the GRDRP should also be provided.

It is understood that the GRDRP requires the approval of the Department of Planning as a requirement of Project Approval PA 08-0184. As the Goulburn River diversion is a mining related disturbance within Consolidated Coal Mining Lease No 741 and portions of the security bond held by DRE are in respect of remediation commitments made in the *Ulan Coal Continued Operations Environmental Assessment*, the GRDRP also requires DRE approval under Condition 3 & 7 of CCL741 prior to implementation.

If you have any questions or need to discuss this matters further you are welcome to ring me on 02 6360 5346.

Yours Sincerely



Michael Young
Manager and Principal Inspector, Environment – Central NSW
18th July 2013



Your reference :
Our reference : LIC06/381-15 & DOC13/31514
Contact : Ms Sheridan Ledger; (02) 6332 7608

General Manager
Ulan Coal Mine
Private Mail Bag 3006
MUDGEE NSW 2850

Attention: Robyn Stoney

7 August 2013

Dear Mr Clifford

I refer to Ulan Coal Mine's (Ulan) 'Goulburn River Diversion Remediation Plan' (the Plan) received by the Environment Protection Authority (EPA) on 7 July 2013.

The EPA was aware in 2012 that Ulan had been considering revising the 'Goulburn River Diversion Remediation Strategy 2009' following investigations into the constructability of the original plan which found it posed an environmental risk, particularly in relation to erosion and sedimentation of the Goulburn River. The EPA supported this position and therefore supports the preparation and implementation of a revised strategy. Having reviewed the Plan, the EPA considers that it generally concurs with the principles and intent of the objectives and criteria which have now been developed. The EPA requests that the matters discussed below be addressed in any final Plan submitted to the Department of Planning and Infrastructure.

As has been indicated throughout the Plan, erosion and sediment control remain as the primary risk, both during and post construction activities. The use of a pilot area is considered pivotal to determine erosion and sediment control risk for the project's entirety and should be utilised to inform, where required, amendments to the Plan and a revised erosion and sediment control plan post the completion of the pilot area. Additionally, a site inspection of the pilot area by relevant government agencies should be conducted prior to the commencement of the remainder of the remediation areas.

In relation to the erosion and sediment control, water quality monitoring, incident response and wet weather contingency procedures should be clearly defined in the erosion and sediment control plan. It is the EPA's preference that up and downstream continuous turbidity monitoring should be installed on the Goulburn River prior to the pilot area works being conducted. The period that such monitoring is conducted should be determined in consultation with the EPA. Erosion and sediment controls should be inspected following defined rainfall events in addition to the weekly inspections by the project manager as proposed. Further, these defined rainfall events should also trigger an inspection once works have been completed.

Should you have any further enquiries in relation to this matter please contact Ms Sheridan Ledger at the EPA Central West Office (Bathurst) by telephoning (02) 6332 7608.

Yours sincerely


DARRYL CLIFT
Head Central West Unit
Environment Protection Authority

PO Box 1388 Bathurst NSW 2795
Level 2, 203 - 209 Russell Street Bathurst NSW 2795
Tel: (02) 6332 7600 Fax: (02) 6332 7630
ABN 43 692 285 758
www.epa.nsw.gov.au



Department of
Primary Industries
Office of Water

Ms Robyn Stoney
Environment and Community Manager
Ulan Complex
PMB 3006
Mudgee NSW 2850

Contact Hemantha De Silva
Phone 02 49042525
Fax 02 49042503
Email Hemantha.Desilva@water.nsw.gov.au
Our ref ER20268

Dear Ms Stoney

Re: Ulan Coal Goulburn River Diversion Remediation Plan

The NSW Office of Water (Office of Water) appreciates the opportunity to review the Ulan Coal Goulburn River Diversion Remediation Plan (GRDRP). A summary of comments on the plan are listed below and detailed comments are provided in Attachment A.

- a. Excavation of channelized fill material within diversion cut base is not considered appropriate as part of the GRDRP, and is not considered further, or recommended.
- b. The locations for slope cutting and battering appear consistent with the priority areas identified in discussion between the NSW Office of Water and UCML. Monitoring and performance reporting is critical to achieving a beneficial outcome from this work.
- c. Installation of large rock or other works into the channel bed may induce scour and release of sediment which is currently stored in the channel base and should not be employed unless an additional assessment identifies opportunities and need for redesigning in-channel structures and management of bed controls or flow redirection structures.
- d. It is recommended that improved soil management, and use of ameliorants and other management measures are employed to promote revegetation opportunities in the diversion cutting and rebattered slopes where feasible. Revegetation within the channel should not be conducted until any option for introducing variability in channel form and increasing in-channel roughness is adopted.
- e. Reconstruction of drainage drop structures is supported, and recommended to be of similar nature and sizing to revetment works where aligned at the toe of rebattered bank. Installation of scour and/or flow re-direction and roughness elements to increase channel morphology diversity is not recommended to the remediation of the diversion

NSW Office of Water| www.water.nsw.gov.au

Should you have any queries in relation to above comments, please contact Hemantha De Silva, Senior Water Regulation Officer at the Office of Water's Newcastle Office on telephone number 02 4904 2525.

Yours sincerely



Mitchell Isaacs
Manager Strategic Stakeholder Liaison
9 August 2013

Ulan Coal Goulburn River Diversion Remediation Plan

Background

The remediation of the diversion of the Goulburn River around the closed eastern open cut pit of the Xstrata Ulan Coal Mine Ltd (UCML) requires consideration of the value of the river in its current condition upstream and downstream of the diversion alignment, as compared to its current condition in the diversion cutting. It also require weighting the risks associated with any option presented, to minimise the risks to upstream and downstream reaches against any improvement in geomorphic condition and ecosystem value in the existing reach.

The Goulburn River forms four reach-scale RiverStyle categories within a five kilometre distance of the UCML. These RiverStyles were determined using the process formulated by Brierley and Fryirs¹, and adopted as the geomorphic categorisation in New South Wales by the NSW Office of Water. Upstream of the UCML site, the Goulburn River (Moolarben Creek) graduates from an intact valley fill to a cut and fill river style of moderate condition and strategic value, due to the high value and fragile river setting upstream. This River Style is bounded at its downstream point by the Moolarben Creek Dam, which is owned by UCML.

The Goulburn River diversion reach is located at the outcrop of the Ulan Seam. Photographs taken of the location prior to the channelization of the Goulburn River reveal extensive sheet and gully erosion, with minimal vegetation cover. The river appeared to be in very poor condition, and minimal effort to control erosion and degradation of the river was apparent.

Downstream of the diversion, the Goulburn River is confined by outcrops of Triassic/Jurassic sandstone, and forms into a bedrock controlled river with minor floodplain packets to the entry to the Corner Gorge downstream of The Drip valley wall cliff. Due to the high value given to The Drip and the Corner Gorge, and its high geomorphic condition, the Goulburn River reach from the Ulan Creek confluence to the Corner Gorge inlet is categorised as being of conservation recovery value, with intact vegetation assemblages, minimal existing erosion and minor sediment slugs being transmitted through the reach (one being evident at the Ulan Road crossing).

Major geomorphic controls on the river reaches include the Moolarben Creek Dam and the Ulan Road crossing immediately upstream of the Goulburn River diversion, and a series of bedrock outcrops which occur downstream of the Ulan Creek confluence with the Goulburn River, which is located 500 m downstream of the diversion outlet to the existing river course.

Potential consequences of proposed remedial options

a. Excavation of channelized fill material within diversion cut base

The channelisation of the Goulburn River has dramatically changed river style, condition, fragility to further disturbance and recovery potential. It would be effectively impossible to return the Goulburn River to a pre-disturbance condition, and it would be inadvisable to attempt it. As described by Brierley and Fryirs², change in river form and behaviour to an entirely different category should be seen as irreversible. Any remedial actions within an irreversibly changed river system should then

¹ Brierley G, Fryirs K (2005) *Geomorphology and River Management*. Blackwell Publishing Sydney.

² *Ibid* p. 298

try to maximise the beneficial behaviour of the river in its new setting, rather than attempt the impossible task of returning it to a previous category.

Remedial works which involve excavation may lead to extension of bed incision upstream, which may undercut the Ulan Road crossing, and may lead to bed level drop at the Ulan Road bridge, and possibly to the Moolarben Creek Dam. Location and nature of controls on bed level and constraints on headward erosion have not been assessed as part of the diversion approval or the remediation strategy. Although bedrock exposure may control headward migration of incision resulting from the remediation works, there is some likelihood such controls may not be effective to the depth of any headward migrating headcut(s). As a precaution, it is recommended excavation into the bed fill materials in the diversion channel should not occur, until the location and nature of headward controls are confirmed.

Downstream effects resulting from excavation disturbance in the Goulburn River diversion include excessive sediment release and deposition into the course of the Goulburn River, pore clogging and impacts on benthic and hyporheic fauna, turbidity and loss of light penetration through the water column, possible release of captured metals and other contaminants associated with the Ulan Seam and contact strata to the seam.

The primary identified benefit to any excavation works installed in the channel would be to enhance fish passage along the excavated reach of the Goulburn River. UCML has stated this is not considered a high priority area for action, as fish species and numbers are considered low, and installing fish passage structures would be difficult and disproportionate to the benefit accrued. This option is not considered as part of the GRDRP, and is not considered further.

b. Cut of eroding upper slopes and battering channel cut to lower grade

A primary issue for the integrity of the Goulburn River diversion is the ongoing erosion and slope destabilisation of the gorge cut. This is a problem identified a number of years previously, as it relates to the sodic and dispersive subsoils and loose regolithic materials located in the upper half of the cut for the diversion. Discussions with UCML identified ongoing instability concentrated at three locations:

- Drop discharge points for table drains from the eastern open cut backfill area along the left bank of the diversion cutting,
- Upper section (exposed regolith and subsoils) of the cutting at the Area 2 and 3b (the angle bend from west-east to south-north orientation of the diverted river)
- Re-entry point of watercourses reporting over cut slopes and/or gorge cliff (principally Bora Creek)

These areas are identified in the remediation plan as priority action points. It is important to reduce runoff slopes along the exposed upper section of the cutting, and to minimise the volume of run-on reporting on to the exposed slopes. Batter slope angles are recommended to be reduced to less than slopes for exposed spoil dumps; ie <10%, compared to a current slope angle of >30%.

The locations for slope cutting and battering appear consistent with the priority areas identified in discussion between the NSW Office of Water and UCML. Monitoring and performance reporting is critical to achieving a beneficial outcome from this work.

c. Installation of rock works at toe of embankment

Rock armouring of river channels has been identified with lowering of fish refuge and habitat for benthic and other macro invertebrate species. However, the virtual entirety of the Goulburn River channelization has been excavated through weak regolith or strong country rock to form an artificial gorge setting. The river channel is effectively armoured at the toe and the lower half of the

gorge cut. There appears minimal additional impact to installing further rock along areas of concentrated flow entry to the channel.

Rock works may be valuable where cutting upper rock and regolithic slopes is required. The extent, impinging dump area and volume and sizing of materials to reinforce the lower slopes and any roughness elements installed on the batter slope length requires clarification prior to installation. Further detail on the tractive stress limits for foreseeable flood events transmitted through the diversion post-rehabilitation is required as part of detailed design of the revetment reinforcement plan.

It is a standard and usually recommended rehabilitation measure that large sized rock materials, log spans or log jams may be used to form artificial roughness elements and mimic, to even a small extent, the diversity of channel width and flow within the overall cutting. This may be considered should rock revetment require further reinforcement at the toe of re-arranged slopes to the diversion cutting. This should be considered in the detailed design. However, installation of large rock or other works into the channel bed may induce scour and release of sediment which is currently stored in the channel base, which is being stabilised by extensive beds of *Phragmites australis* and blackberry and other weeds. Care should be undertaken to only install any such works in conjunction with installation of other bed controls. UCML has indicated such controls may not be stable, given the channel configuration (especially width) and the volume of unconsolidated material currently in the extensive channel base.

Therefore, this option should not be employed unless an additional assessment identifies opportunities and need for redesigning in-channel structures and management of bed controls or flow redirection structures.

d. Use of soil conditioners and ameliorants prior to revegetation for batter slopes

Revegetation is a critical performance element to successful remediation of the diversion cutting. The nature of exposed soils in the upper region of the diversion cutting appears very poor and may be difficult to revegetate without treatment. It is noted UCML has successfully employed a range of ameliorants to spoil dump remediation and revegetation. Similar techniques could and should be employed in the diversion cutting.

It is recommended that improved soil management, and use of ameliorants and other management measures are employed to promote revegetation opportunities in the diversion.

e. Channelisation and reformation of drop structures to drain runoff from the backfilled eastern open cut to report to the diversion cutting.

This has been a standard measure used in the Goulburn River diversion since construction. It is noted some failure of drainage has occurred, presumably as a result of tunnelling/piping failure through the base of the drains. Re-entry drainage to the diversion has been a particularly significant problem, with several previous re-entry points failing over time.

The primary note to this issue is the design and management of drainage re-entry to the diversion may require ongoing management and reconstruction if the design does not cater for significant drainage volumes reporting during severe storm events and/or extended wet periods. Further, the installation of rip rap ramps for re-entry drainage may not be suitable where not incorporated into the revetment works to be installed to the toe of the cutting.

The specific measures appear reasonable, as outlined in the above discussion points. The locations for the remedial works requires some further investigation, which would be developed as the detailed design phase for the remediation programme is undertaken.

Introducing some level of variability in-channel may have some benefits. It may also have consequences, particularly where scour occurs around control structures. However, as noted above, the risks and consequences of disturbance to stored sediment in the diversion channel are too great to recommend without further studies and redesign of flow alignment or roughness structures.

Reconstruction of drainage drop structures is supported, and recommended to be of similar nature and sizing to revetment works where aligned at the toe of re-battered bank. Installation of scour and/or flow re-direction and roughness elements to increase channel morphology diversity is not recommended to the remediation of the diversion.

End Attachment A



V13/480
OUT13/19977
25 July 2013
Chris Glennon
Xstrata Coal
4505 Ulan Road
MUDGEE NSW 2850

Dear Chris,

Re: Draft Goulburn River Diversion Remediation Plan

Thank you for providing *Fisheries NSW* the opportunity to comment on this remediation plan.

Fisheries NSW are responsible for ensuring that fish stocks are conserved and that there is "no net loss" of key fish habitats upon which they depend. To achieve this, the Department ensures that developments comply with the requirements of the *Fisheries Management Act 1994* (namely the aquatic habitat protection and threatened species conservation provisions in Parts 7 and 7A of the Act respectively) and the associated *Fisheries Management Act 1994* and the *Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)*.

Fisheries NSW are satisfied with the proposed remedial works outlined within the remediation plan, however consideration should also be given to the possibility of in-stream rehabilitation works which improve the aquatic habitat available such as snagging and/or planting aquatic vegetation species.

In relation to required approvals/permits, a permit may be required for any proposed *dredging and reclamation* works in accordance with sections 198-203 of the *Fisheries Management Act 1994* (the Act). Such works include, but are not limited to, the construction of the temporary channel floor crossing at chainage 3200, as referred to in Figure 3.19 of the plan.

If you have any queries do not hesitate to call me on 6763 1255 or 0429 908 856.

Yours sincerely

A handwritten signature in black ink that reads 'D. Ward'.

David Ward
Fisheries Conservation Manager (Greater Darling)

FISHERIES CONSERVATION & AQUACULTURE BRANCH
TAMWORTH AGRICULTURAL INSTITUTE
4 Marsden Park Road
CALALA NSW 2340

www.industry.nsw.gov.au

Tel: 02 6763 1255
Fax: 02 6763 1265

Appendix C – Reports

URS construction report Pilot area Eco Logical Vegetation Assessment



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001_2 Pilot Project V



Goulburn River
Diversion Flora_v3 F.