Fitzroy Coal Mine Receiving Water Monitoring for Regulation – Efficiency Review and Gap Analysis

Project Report

Department of Environment and Science

Prepared for Fitzroy Partnership for River Health

November 2018

Prepared by

Dr Sonia Claus and Dr Ian Ramsay

Environmental Monitoring and Assessment Science, Science Division
Department of Environment and Science
EcoSciences Precinct
41 Boggo Road, Dutton Park, 4102
GPO Box 5078, Brisbane, QLD, 4001

November 2018

Table of Contents

Introduction

The Fitzroy Partnership for River Health (FPRH) prepares an annual report card that visually compares the health of waterways in the Fitzroy Basin. The sources of the data used for the report card are from Queensland Government monitoring programs and coal mining companies operating within the Basin. Coal mining companies have a requirement to undertake a Receiving Environment Monitoring Program (REMP) as a condition of their environmental approval and this is one of the key sources of information. From a regulatory perspective, the REMP provides a basis over time for evaluating whether the discharge limits or other conditions imposed upon an activity have been successful in maintaining or protecting receiving environment values.

The FPRH undertook a catchment-wide monitoring efficiency review in 2015/16 and identified the opportunity for individual REMPs to be replaced by a basin wide REMP. Subsequently, the FPRH developed a proposal for a Fitzroy Basin Integrated REMP (FPRH, 2017). This has been discussed with industry partners and has received general support. However, it is essential to obtain support from the regulator for the program to be successful. To achieve this, it has been identified that a review of company monitoring is needed, which specifically focusses on regulatory requirements.

Any REMP must be designed to meet the specified conditions of the environmental approval and should consider the Department's REMP Guideline (DEHP, 2014). This document states that "*the aim of a REMP is to monitor and assess the potential impacts of controlled or uncontrolled releases of wastewater and associated contaminants to the environment from a regulated activity. A REMP provides a basis for evaluating whether the discharge limits or other conditions imposed upon an activity have been successful in maintaining or protecting receiving environment values over time.*"

The aim of this project is to undertake a review of REMPs in the Fitzroy Basin. The specific focus of the review is on monitoring in the local receiving environment where mine-affected water is authorised to be released and the associated monitoring conditions in the Environmental Approvals (EAs). The review aims to identify: the regulatory requirements that could form the basis for a regionally coordinated "integrated" REMP; any information and data gaps; and potential efficiencies in the current monitoring, particularly in regard to indicators and locations.

The review focusses on existing data and information. The key information sources were:

- Current Environmental Authorities (EAs);
- Data and information currently stored in the Water Tracking and Electronic Reporting System (WaTERS);
- Available REMP reports for individual coal mining companies; and
- Data and information currently held by the FPRH.

The Fitzroy Basin boundaries used by the FPRH to report on river health in the Fitzroy Basin Report Card is shown in Figure 1. There are 11 sub-basins within the FPRH Fitzroy Basin including Callide, Comet, Connors, Fitzroy, Lower Dawson, Lower Isaac, Mackenzie, Nogoa, Theresa, Upper Dawson and Upper Isaac.

The Model Water Conditions for Coal Mines in the Fitzroy Basin (DEHP, 2017) (Model Mining Conditions) are provided in Appendix A and provides conditions which relate to wastewater releases, receiving environment monitoring and a REMP. Most coal mines in the Fitzroy Basin have conditions similar to these. There are three main components of monitoring requirements within coal mine EAs, namely:

- Monitoring within the mine site and mine water releases, which typically compare data to limits and triggers, i.e. Release Point (RP) monitoring.
- Monitoring upstream and downstream of the mine release site(s) during periods of mine water releases, also referred to as Receiving Environment (RE) monitoring. Triggers or limits are often applied to this monitoring for key indicators to ensure downstream water quality does not exceed levels authorised in the approval
- Monitoring of upstream, downstream and the broader receiving waters during periods of base and event flow, also referred to as Receiving Environment Monitoring Programs (REMPs). The purpose of

this monitoring is to assess the overall condition of the system downstream of mining operations. Water quality is compared to water quality objectives and relevant guidelines, rather than limits or triggers specified in the approval.

Figure 1. Fitzroy Basin and sub-basins used by the Fitzroy Partnership for River Health for the Fitzroy Basin Report Card.

This report summarises the findings of the review and includes information on facilities and release locations, receiving environment monitoring points, monitoring indicators and reporting requirements. The water quality monitoring data available in WaTERS is discussed along with recommendations around how current EA conditions might be amended. In addition to the report, a Power BI working file and spatial layer of metadata of existing monitoring has been developed. This is based mainly on information captured in WaTERS, from hard copy mining REMP reports and from coal mining EAs.

Spatial Layer and Metadata Information

For facilities identified with an authorised release to water within the FPRH Fitzroy Basin, the following information was collected, and a spatial layer was produced:

1. All identified monitoring points (release point, receiving environment monitoring point and REMP monitoring point) from WaTERS, current EAs and coal mine REMP documents.
2. At each monitoring point the following metadata was collected:
    - Site name (facility)
    - Client
    - Monitoring point type – release point (RP), receiving environment monitoring point (RE) and REMP monitoring point (REMP only)
    - Latitude, longitude
    - Type - release point (RP), upstream (US), downstream (DS)

- Description
- Stream
- Sub-basin
- Monitoring frequency – during release, stream event, baseflow
- Fitzroy Partnership site code
- WQ Indicators
- Biological indicators
- Sediment monitoring

3. Qld Government gauging station locations
4. Efficiency report proposed monitoring points – monitoring points identified in the Monitoring Efficiency Review (Flint *et al.* 2016).

An online ArcGIS spatial layer has been created and can be accessed via the link http://arcg.is/11X5Wn.

Facilities and Release Locations

There were 75 facilities identified within the Fitzroy Basin which have an authorised release to water (see Figure 2 and Table 1). The number of facilities in each sub-basin is provided in Table 2 and a full list of facilities is provided in Table 8 of Appendix B. Most of the facilities were mining activities, with 52 facilities being coal mines. Other activities that have authorised release to water in the Fitzroy Basin include sewage treatment plants, power stations, abattoirs and coal seam gas. Six of the facilities are yet to be commissioned and 59 of the facilities were found to have a REMP condition in their EA. 52 of these facilities submit data to WaTERS.

Table 1. Facility activity type and number in the Fitzroy Basin.

Facility type	Number of facilities
Coal Mine	52
STP	9
Metal Mine	3
Electricity generation	2
Meat processing	2
Petroleum	2
Rail Loadout	2
Explosives	1
Gemstone Mine	1
Mineral processing	1
Total	**75**

Table 2. Number of facilities in each sub-basin of the Fitzroy.

All Facilities

Sub-Basin	Number of facilities
Callide	4
Comet	6
Connors	3
Fitzroy	11
Lower Dawson	4
Mackenzie	13
Theresa	6
Upper Dawson	5
Upper Isaac	23
Total	**75**

Coal Mines

Sub-Basin	Number of facilities
Callide	1
Comet	4
Connors	3
Fitzroy	1
Lower Dawson	3
Mackenzie	12
Theresa	5
Upper Dawson	1
Upper Isaac	22
Total	**52**

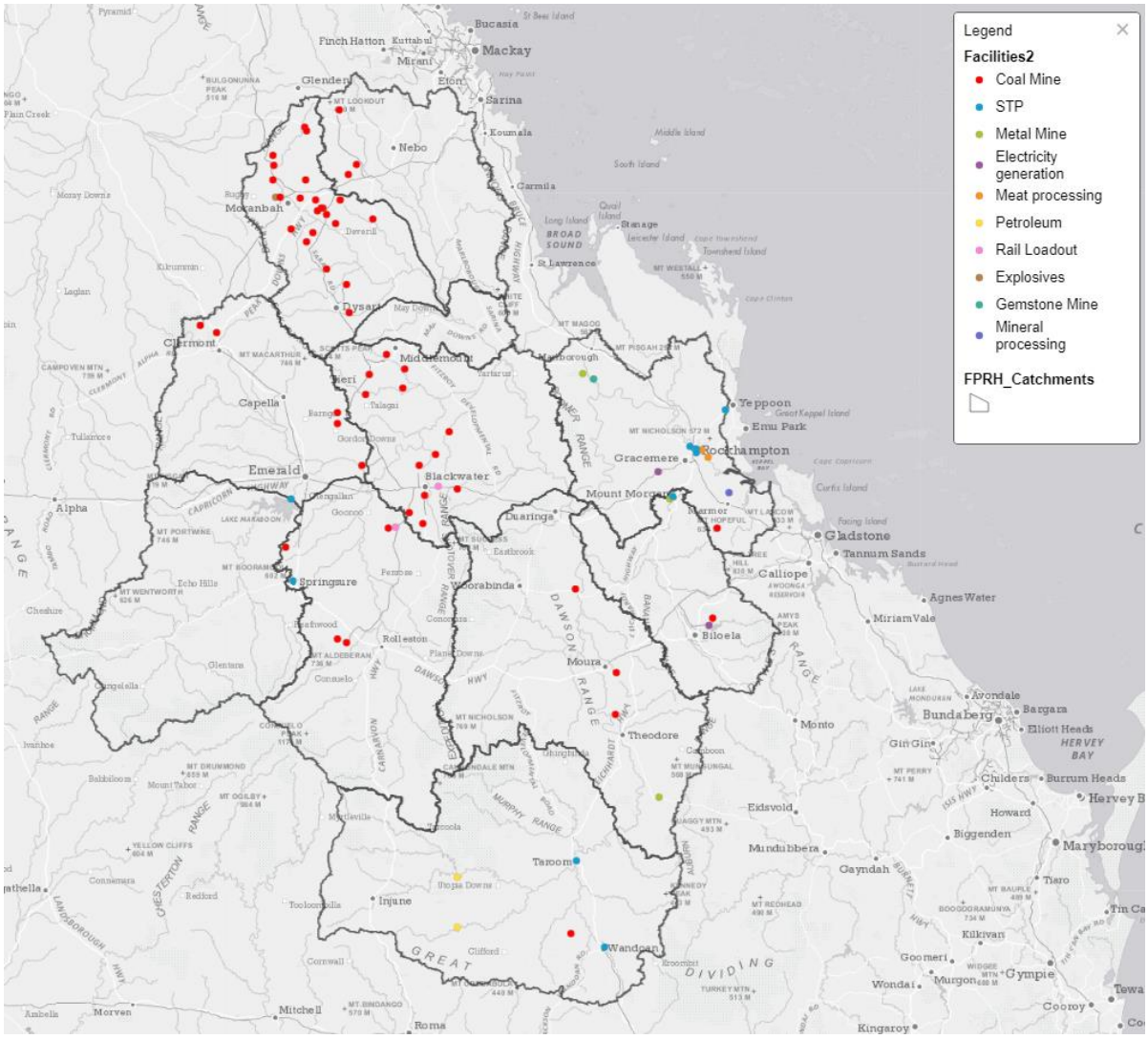

Figure 2. Location of facilities in the Fitzroy Basin with authorised release to water.

Based on the information collected for all activities, there are 300 release points (RPs) in the Fitzroy Basin. For the 52 coal mines, there are 124 release points (RPs) noting that release points (RP) have not been defined for mines which have not yet been commissioned and no sub-basin was assigned to those release points.

Receiving Environment Monitoring Points

Current Monitoring Points

For the 75 facilities identified from available information, there are 531 receiving environment monitoring points including 163 REMP only monitoring points. It should be noted that REMP reports were only obtained for coal mine facilities in which case the REMP only monitoring points is likely to be an under estimation. For the 52 coal mine facilities, there are 401 receiving environment monitoring points including 122 REMP only monitoring points (see Figure 3).

For all facilities, there are also client gauging stations that are used to monitor stream flow. For the 531 receiving environment monitoring points, 101 are a gauging station. For the coal mines, of the 401 receiving environment monitoring points, 86 are a gauging station (see Table 3). Note that these gauging stations can be separate to Qld Government flow gauging stations.

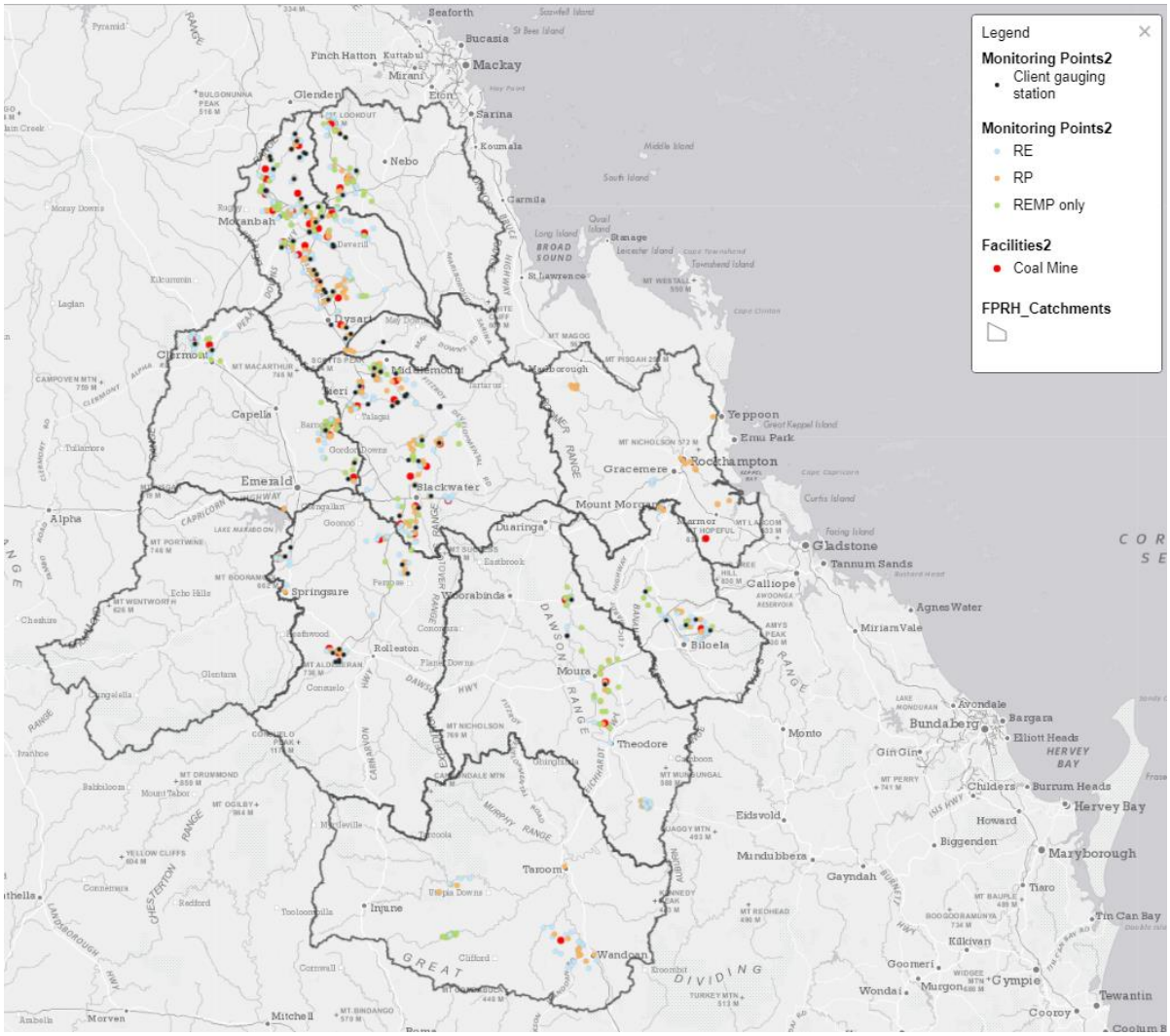

Figure 3. Location of coal mine facilities, release points (RP), receiving environment (RE), REMP only monitoring points and client gauging stations in the Fitzroy Basin.

Table 3. Number of receiving environment monitoring points and the number with gauging stations in each sub-basin for coal mine facilities in the Fitzroy Basin.

Sub Basin	Monitoring Points
Callide	32
Comet	24
Connors	38
Lower Dawson	24
Lower Isaac	1
Mackenzie	71
Theresa	49
Upper Isaac	162
Total	**401**

Sub Basin	Client Gauging station
Callide	5
Comet	8
Connors	4
Lower Dawson	3
Lower Isaac	1
Mackenzie	21
Theresa	6
Upper Isaac	38
Total	**86**

Duplication

To meet the requirements of the REMP condition in the Model Mining Conditions, an upstream and downstream monitoring point for each release point is usually required. As a result, there can be an overlap between receiving environment monitoring points that are monitored for different release points and for different facilities.

From this review it was identified that 42 potential duplicate monitoring points exist across the facilities identified with releases (see Table 9 in Appendix B). The *Monitoring Efficiency Review* (Flint et al. 2016) found that there were 22 areas of potential duplication within seven catchments. Given these locations are shared across companies and used for regulation, some mechanism would need to be developed to allow a sharing of monitoring effort and data for rationalisation to occur, for example using an independent third party. A further consolidation in the number of receiving environment monitoring points monitored by each facility may be possible, as there are groups of monitoring points across 14 watercourses which could be potentially combined (See Table 10 in Appendix B). However, further assessment of each of these receiving environment monitoring points would be required prior to considering rationalisation and then amendment of the relevant approvals.

Suggested Regional REMP Monitoring Points

The draft Integrated REMP (FPRH, 2017) suggested a number of monitoring points in each sub-basin. Based on the spatial information collected as part of this review, it is possible to suggest monitoring points for each sub-basin where coal mine facilities are operating which may be relevant to regional REMP monitoring (see Table 4 and Figure 4).

There was a preference to suggest monitoring points for regional REMP monitoring that have historical water quality data. The suggested regional REMP monitoring points in Table 4 include locations taken from the draft Integrated REMP Report (FPRH, 2017), the open gauging stations listed on the Queensland Government Water Monitoring Information Portal (https://water-monitoring.information.qld.gov.au/), company gauging stations and company receiving environment monitoring points.

Table 4. Suggested regional REMP monitoring points of potential relevance to coal mine regulation and impact assessment.

Monitoring Point Code	Description	Latitude	Longitude	Sub-Basin
\$130306B	Don River at Rannes Recorder	-24.0963	150.1146	Callide
\$130378A	Dee River at Dululu	-23.8492	150.2644	Callide
CALLCM-DMP1	Callide Dam	-24.3693	150.6143	Callide
\$130327A	Callide Creek at Goovigen	-24.1054	150.2866	Callide
\$130504B	Comet River at Comet Weir	-23.6125	148.5514	Comet
130509A	Carnarvon Creek at Rewan	-24.9775	148.3881	Comet
ROLLCM-DMP2	Meteor Creek	-24.4561	148.4471	Comet
\$130506A	Comet River at The Lake	-24.3115	148.6145	Comet
MINECM-DMP2	Sandhurst Creek at Gregory Highway gauging station	-23.8637	148.1253	Comet
\$130510A	Comet River at Springsure Creek Junction	-23.8563	148.5037	Comet
130403A	Connors River at Mount Bridget	-22.0357	149.1315	Connors
\$130404A	Connors River at Pink Lagoon	-22.3359	148.9485	Connors
130406A	Funnel Creek at Main Road	-21.7768	148.9268	Connors
HAILCM-DMP1	Bee Creek at Suttor Road gauging station	-21.5545	148.4567	Connors
SWALCM-SMP6	Bee Creek near Dipperu National Park	-21.9194	148.617	Connors
\$130003B	Fitzroy River at Riverslea	-23.5764	149.9378	Fitzroy
\$130005A	Fitzroy River at The Gap	-23.089	150.1071	Fitzroy
\$130317B	Dawson River at Woodleigh	-24.8321	149.975	Lower Dawson
\$130322A	Dawson River at Beckers	-24.0883	149.8219	Lower Dawson
\$130374A	Dawson River at Bindaree	-24.3566	149.8094	Lower Dawson
130401A	Isaac River at Yatton	-22.6566	149.1158	Lower Isaac
FPRH 1	Isaac River @ May Downs Road	-22.853	149.332	Lower Isaac
NORPCM-DMP3	Rolf Creek gauging station	-22.7127	148.6908	Lower Isaac
130105B	Mackenzie River at Coolmaringa	-23.2699	149.5096	Mackenzie

Monitoring Point Code	Description	Latitude	Longitude	Sub-Basin
$130106A	Mackenzie River at Bingegang	-23.0762	149.0331	Mackenzie
JELLCM-DMP3	Mackenzie River	-23.2432	148.9299	Mackenzie
YARRCM-DMP4	North Mile Creek at Fitzroy Development Road	-23.1621	149.1459	Mackenzie
$130210A	Theresa Creek at Valeria	-23.1856	147.8948	Theresa
$130219A	Nogoa River at Duck Ponds	-23.4816	148.4727	Theresa
CLERCM-SMP4	Sandy Creek at Clermont Connection Road	-22.8127	147.6419	Theresa
$130302A	Dawson River at Taroom	-25.6377	149.7896	Upper Dawson
$130324A	Dawson River at Utopia Downs	-25.7447	149.3299	Upper Dawson
$130344A	Juandah Creek at Windamere	-26.025	149.8831	Upper Dawson
130410A	Isaac River at Deverill	-22.1708	148.3842	Upper Isaac
130414A	Isaac River at Goonyella	-21.8555	147.9726	Upper Isaac
NORPCM-DMP2	Stephens Creek gauging station	-22.6284	148.4632	Upper Isaac
LVERCM-SMP3	Confluence of Isaac River and Phillips Creek	-22.3541	148.4917	Upper Isaac
$130209A	Nogoa River at Craigmore	-23.8849	147.7572	Upper Nogoa
FPRH 2	Nogoa River at Raymond	-24.2322	147.812	Upper Nogoa
FPRH 3	Nogoa River at Glenlee Road	-24.071	147.762	Upper Nogoa

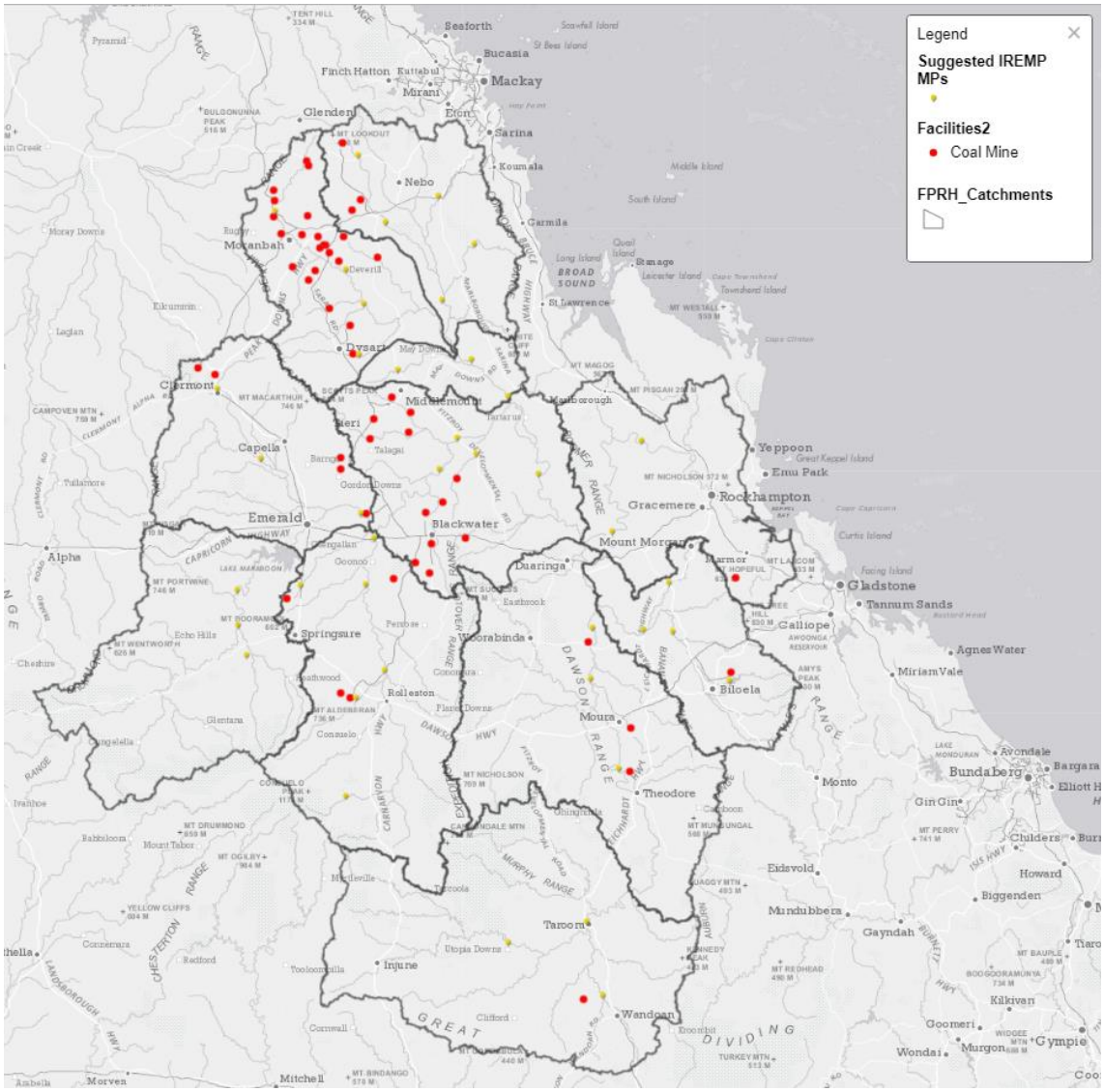

Figure 4. Location of suggested regional REMP monitoring points to support coal mine regulation and impact assessment.

Monitoring Indicators

Water quality and quantity

Under the Model Mining Conditions, the indicators that should be monitored at release points, and which have release limits, include electrical conductivity (EC), pH, turbidity, suspended solids (SS), and sulphate (see Table 2 of the Model Mining Conditions). These contaminants were determined to be the major contaminants of concern for release of mine-affected water in the Fitzroy Basin. Other indicators to be monitored end-of-pipe include metals, ammonia, nitrate, hydrocarbons, fluoride and sodium (see Table 3 in the Model Mining Conditions). These indicators were considered contaminants of potential concern and included trigger values, rather than limits, in the approvals as there was insufficient information at the time of writing the Model Mining Conditions to determine the actual level of risk involved.

Often all indicators in Table 2 and Table 3 of the Model Mining Conditions are monitored at release points. Given more information has been collected on these contaminants since the Model Mining Conditions were developed, it may be possible to determine if the levels of some of these indicators are low risk and do not need to be monitored any further. This would require case-by-case assessment.

Condition W19 of the Model Mining Conditions suggests that EC, pH, SS and sulphate should be monitored in the receiving environment. However, often all indicators within Table 3 of the Model Mining Conditions are monitored at these locations as part of REMP monitoring. It is likely that many of these indicators are not required at local receiving environment monitoring points, particularly if they are not being detected at levels of concern at these locations. Again, this would require case-by-case assessment.

For the EA and REMP review, it was found that there are many water quality indicators measured at release points and receiving environment monitoring points. The total number of indicators monitored across monitoring points for all facilities is 191, while 134 indicators are monitored across coal mine monitoring points (see Table 11 in Appendix A).

The least number of water quality indicators sampled at a monitoring point is one and the maximum is 80. There is also variability in the number of water quality indicators that are measured at different facilities. The number of water quality indicators that are measured for the different coal mines is provided in Table 5.

The most frequently monitored indicators for all facilities are EC, pH, sulphate and SS. The most common metals that are monitored are copper, aluminium, zinc and uranium. Hydrocarbons are also commonly monitored at coal mine monitoring points.

The five most commonly indicators monitored at coal mine release points are pH, EC, copper, chromium and zinc. The five most commonly monitored indicators at coal mine receiving environment monitoring points are EC, pH, sulphate, SS and copper.

Condition W11 of the Model Mining Conditions requires that the daily quantity of mine affected water that is released from each release point be measured and recorded. Instantaneous flow and daily volume was found to be monitored at 148 of the 202 coal mine release points. Instantaneous flow and daily volume was monitored at an additional 106 coal mine receiving environment monitoring points.

Table 5. Number of water quality indicators measured at each coal mine facility

Site	Number of WQ Indicators
Callide Coal Mine	83
Hail Creek Coal Mine	78
Oaky Creek Coal Mine	71
Foxleigh Coal Mine	66
Ensham Coal Mine	64
Baralaba North and Wonbindi Coal Mine	63
Dawson North And Central Coal Mine	63
Dawson South Coal Mine	63
Red Mountain Jount Venture CHPP	62
Middlemount Coal Mine	61
Carborough Downs Coal Mine	60
Peak Downs Coal Mine	58
Isaac Plains Coal Mine	57
Moorvale Coal Mine	57
Grosvenor Coal Mine	56
Lake Vermont Coal Mine	55
German Creek Coal Mine	54
South Walker Creek Coal Mine	54
Caval Ridge Coal Mine	53
Goonyella Riverside & Broadmeadow Coal Mines	53
Gregory Crinum Coal Mine	53
Moranbah North Coal Mine	53
Lake Lindsay Coal Mine	52
Minerva Coal Mine	52
Olive Downs Mine	52
Poitrel Coal Mine	52
Clermont Coal Mine	51
Daunia Coal Mine	51
Jellinbah Coal Mine	51
Yarrabee Coal Mine	51
Broadlea North Coal Mine	49
Coppabella Coal Mine	48
Meteor Downs South Coal Mine	48
Bluff Coal Mine	47
Comet Ridge Coal Mine	47
Codrilla Coal Mine	46
Eagle Downs Coal Mine	46
Kestrel Coal Mine	46
Minyango Mine	46
Norwich Park Coal Mine	46
Glencore	44
Saraji Coal Mine	40
Rolleston Coal Mine	37
North Goonyella Coal Mine	31
Cook Coal Mine	29
Burton Coal Mine	23
New Burton Coal Mine	23
Total	**134**

Biological

From this review, seven different types of biological indicators were identified, including macroinvertebrates, fish, habitat condition, riparian vegetation, macrocrustaceans, phytoplankton and zooplankton. For all facilities reviewed, biological indicators are measured at 267 monitoring points. For the coal mines, biological indicators are measured at 220 receiving environment monitoring points (see Table 6). Biological indicators are not currently collected in WaTERS but could potentially be included in the future.

Biological indicators of aquatic ecosystems can be effective in reflecting long-term disturbance in rivers. However, the response of biological communities to different types of stressors varies significantly and may not be suited to assessing individual point sources releases. There are additional challenges with biological monitoring within temporary or ephemeral streams.

Table 6. Biological indicators measured at coal mine receiving environment monitoring points in the Fitzroy Basin.

Biological Indicator	Number of Monitoring Points
Aquatic Vegetation	10
Fish	16
Habitat condition	181
Macrocrustaceans	5
Macroinvertebrates	195
Riparian Vegetation	26
Zooplankton	5
Total	**220**

Biological Indicator	Sub Basin	Number of Monitoring Points
Aquatic Vegetation	Upper Isaac	10
Fish	Callide	16
Habitat condition		4
Habitat condition	Callide	16
Habitat condition	Connors	19
Habitat condition	Lower Dawson	16
Habitat condition	Lower Isaac	1
Habitat condition	Mackenzie	23
Habitat condition	Theresa	26
Habitat condition	Upper Isaac	76
Macrocrustaceans	Mackenzie	5
Macroinvertebrates		4
Macroinvertebrates	Callide	16
Macroinvertebrates	Connors	19
Macroinvertebrates	Lower Dawson	23
Macroinvertebrates	Lower Isaac	1
Macroinvertebrates	Mackenzie	23
Macroinvertebrates	Theresa	26
Macroinvertebrates	Upper Isaac	83
Riparian Vegetation	Connors	9
Riparian Vegetation	Upper Isaac	17
Zooplankton	Mackenzie	5
Total		**220**

Macroinvertebrates (including macrocrustaceans and zooplankton)

Macroinvertebrates are often used to determine the aquatic ecosystem health of water ways. They are affected by the physical, chemical, and biological conditions of the waterway. They may also show the cumulative impacts of pollution and the impacts from habitat loss not detected by traditional water quality assessments (US EPA, 2012).

Most macroinvertebrate indicators are based on taxonomic properties of the macroinvertebrate community such as species richness, the fraction of Ephemeroptera, Plecoptera and Trichoptera taxa (% EPT) or the ratio of the number of observed (O) taxa to the taxa which would be expected (E) if the system was in a reference state (O/E) as in RIVPACS or AUSRIVAS. These taxonomy-based indicators generally do not respond to specific

stressors or toxicants and therefore they do not identify the source of the observed condition (Shafer, *et al.* 2011). The taxonomic composition of macroinvertebrate communities can also vary in time and space.

The response of macroinvertebrates to toxicants can vary. The effect to the macroinvertebrate communities may be short-term (acute) if the pollutant exists in the water at high enough concentrations. In most cases however, the effect of toxicants concentrations and point source discharges can vary and emphasis should be placed on long-term effects (chronic) (Water and Rivers Commission, 2001). Therefore, macroinvertebrates may be effective in identifying water quality trends (increasing or decreasing) over several years. However, the usefulness of macroinvertebrate assessments to determine impacts from short term pulse events, such as from point sources is questionable.

From a review of the coal mine REMP reports, additional challenges occur for macroinvertebrate sampling, as many streams are often not flowing at the time of sampling. The issues raised above are exacerbated when sampling in ephemeral or temporary streams.

Based on this review, there are opportunities to significantly reduce the number of locations at which macroinvertebrates are monitored, particularly in the near-field receiving environment to coal mines and in temporary streams.

Habitat Condition (including aquatic and riparian vegetation)

The use of habitat condition, aquatic vegetation and riparian vegetation assessments to determine impacts from short term pulse events from point sources is questionable. There is a need to determine the habitat condition as part of a macroinvertebrate assessment, as this can also influence the macroinvertebrate assemblages. However, habitat condition assessments on their own is not an appropriate indicator of point source impacts, unless the concentration of contaminants are high enough to alter the habitat and vegetation, which is unlikely to be the case. There is an opportunity to significantly reduce the number of monitoring points at which habitat condition is monitored, as it may only be necessary to monitor habitat condition at monitoring points where macroinvertebrates are monitored, and macroinvertebrate monitoring is likely to be reduced.

Fish

Fish provide an ideal assessment tool for a long-term, broad-scale monitoring program as they are easily identified, relatively abundant, valued by the general community and sensitive to a range of changes in river health. Impacts on fish communities are long lasting and the existing communities show the net effects of environmental factors over a period of years, effectively summarising the recent history of the stream (Murray-Darling Basin Commission, 2004).

Fish were monitored at 16 monitoring points in the Callide sub-basin. Therefore, fish monitoring is not done consistently across REMPs. Fish as an indicator is probably more suited for inclusion in the regional REMP than the near-field receiving environment monitoring. Therefore, there may be an opportunity to reduce the number of monitoring points at which fish are monitored.

Sediment Monitoring

Toxicants may be adsorbed to suspended particles in the water column and to sediments settled on the river bed. Therefore, sediments may become pollutant sinks but also a potential source of contamination as a result of changes in environmental conditions and/or anthropogenic disturbances. This means that sediments can be representative of pollutant trends over long periods, usually up to one year (Lundy et al 2017). However, the sediments can also be redistributed by physical processes, and contaminated sediments could be concentrated in depositional areas. Therefore, there are potential challenges tracing high toxicant concentrations in sediments to specific sources.

The selection of monitoring points where the concentration of contaminants in sediment is monitored should take into account potential sources and also the hydrodynamic factors and depositional areas. Sampling needs to be carefully undertaken to account for the heterogeneous nature of sediment. Currently, contaminant concentrations in sediment is monitored at 257 monitoring points for all facility types in the Fitzroy Basin and 197 monitoring points for coal mines facilities (see Table 7).

Table 7. Number of monitoring points where the contaminant concentrations in sediment is monitored.

All Monitoring Points

Sub Basin	Number of Monitoring Points
Callide	16
Comet	17
Connors	19
Lower Isaac	1
Mackenzie	49
Theresa	41
Upper Dawson	12
Upper Isaac	102
Total	**257**

Coal Mine RE Monitoring Points

Sub Basin	Number of Monitoring Points
Callide	16
Comet	9
Connors	19
Lower Isaac	1
Mackenzie	32
Theresa	33
Upper Isaac	87
Total	**197**

The intent of the National sediment guidelines is:

i. to identify sediments where contaminant concentrations are likely to result in adverse impacts on sediment ecological health;
ii. to make decisions about the potential remobilisation of contaminants into the water column and/or into aquatic food chains; and
iii. to identify and enable protection of uncontaminated sediments (Simpson et al. 2013).

Following the sediment guideline framework, the total concentrations of contaminants are compared to sediment quality guideline values. If the contaminant concentrations exceed the sediment quality guideline values, further investigations should be initiated to determine whether there is indeed an environmental risk associated with the exceedance.

There may be an opportunity to reduce the number of sediment monitoring points and frequency at which the concentration of contaminants in sediment is monitored given metals are not currently an identified issue for most coal mines in the Fitzroy Basin (see Water Quality Monitoring Data Section). The potential need for further investigation into the concentrations of contaminants in sediment should be included in the proposed regional REMP and EA reviews.

Suggested Indicators

Based on the major contaminants of concern at coal mines in the Fitzroy Basin, the key indicators are EC and turbidity. In some cases, it may also be appropriate to measure pH. Some grab samples of SS may be required to interpret turbidity for the purposes of assessing stream health and helping calibrate models. It is also important to measure stream flow at the same time as the key indicators. The key requirement here is that, these indicators need to be measured across times when the stream is flowing and not just during times of mine releases.

Other indicators listed in Table 3 of the Model Mining Conditions (e.g. metals, ammonia, nitrate, hydrocarbons, fluoride and sodium) should only be monitored if they are determined to be contaminants of concern for the activity. As an alternative, it is also suggested that monitoring of onsite storages that are related to the authorised release points be included in the EA conditions. It may be more appropriate to monitor indicators such as metals, ammonia, nitrate, fluoride and sodium within the onsite storages in the pre-wet, or quarterly, instead at the release or environment monitoring points during the release.

It is recommended that the focus of the regional REMP be on key contaminants of concern and stream flow for coal mines that require regulation and assessment. The primary indicator is EC, with the next priority indicators being turbidity/suspended solids and sulphate, although some other indicators such as pH, metals/metalloids, sodium, etc should also be considered.

There appears to be an opportunity to significant reduce the number of monitoring points at which macroinvertebrates, habitat condition and fish are monitored, particularly in the near-field receiving

environment of coal mines. Fish, macroinvertebrates, habitat condition as indicators are potentially more suited for inclusion in the regional REMP. However, their direct applicability to regulating and assessing the impact of coal mines is relatively limited and therefore the regional REMP should include only limited biological monitoring and where it is fit for purpose. There may also be opportunity to reduce the number of sediment (benthic) monitoring points and the related frequency at which contaminants in sediments are monitored, given contaminants such as metals are not an issue of known concern for most coal mines in the Fitzroy Basin.

Frequency of monitoring

The frequency of monitoring that is required under EA conditions vary with the type of indicator measured and the monitoring location. Condition W5 and W19 require that release and environment monitoring points are monitored **daily during release** for EC, pH, turbidity, SS and sulphate and **weekly during release** for other indicators. Condition W21 also states that the receiving environment must be monitored **periodically** (under natural flow conditions) and **while mine affected water is being discharged** from the site.

The frequency of sampling is variable across all monitoring points, with monitoring ranging from daily during release for release points to biannually for receiving environment monitoring points. Currently, the receiving environment points specified in approvals are often only monitored during release and not periodically under natural flow conditions as required under Condition W21.

In terms of water quality indicators monitored by the coal mining companies in the local receiving environment, it is recommended that this focuses on indicators that can be measured using real time senses rather than grab samples, where possible. Monitoring should be continuous with a minimum of hourly data being made available for periods of stream flow. The key requirement here is that these indicators are measured across the whole hydrograph and not just during times of mine releases. An example of EC monitoring occurring only during release is shown in Figure 5.

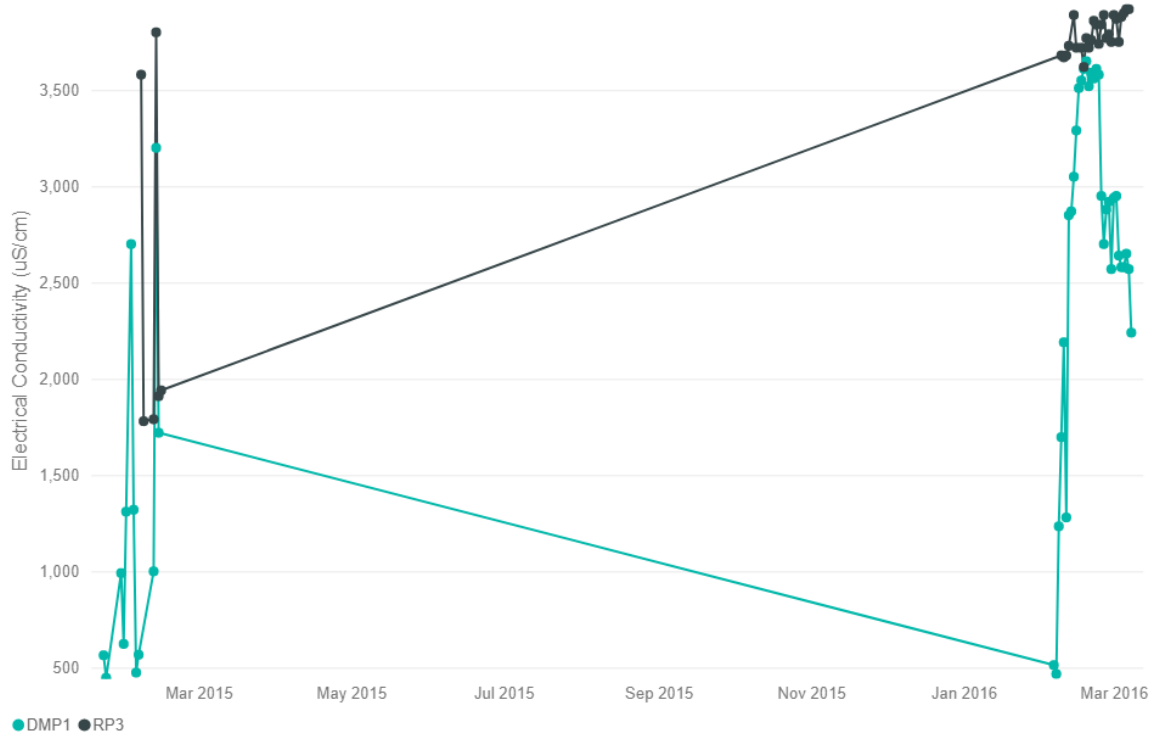

Figure 5. Electrical Conductivity measured at Hail Creek Coal Mine at release points (RP) and receiving environment downstream monitoring point (DMP).

The draft Integrated REMP (FPRH, 2017) suggests monitoring biannually in April and September and during baseflow conditions (dry season). This frequency is unlikely to be sufficient for monitoring of water quality indicators that are used to support regulation and report annually (see the Reporting requirements section below). Water quality data that is collected as part of the regional REMP would ideally be collected continuously for relevant indicators (e.g. EC and flow) and bi-monthly (6 times a year) for other indicators (e.g. metals, sulphate, suspended sediment, pH etc).

Reporting requirements

Condition W24 states that "*A **report** outlining the findings of the REMP, including all monitoring results and interpretations in accordance with conditions W21 and W22 must be **prepared annually** and made available on request to the administrating authority*.

This must include an assessment of background reference water quality, the condition of downstream water quality compared against water quality objectives, and the suitability of current discharge limits to protect downstream environmental values."

The regulatory objectives of a regional REMP that would replace the current REMPs, should focus primarily on the following:

- assessing whether end of pipe release criteria have been successful in protecting receiving environmental values downstream of the releases. More specifically, assessing whether salinity and other relevant indicators downstream of mine sites meet relevant water quality objectives;
- collecting water quality data upstream and downstream of releases to provide background reference water quality information to assist with assessing environmental values and water quality impacts downstream of mines, particularly during times of releases;
- integrating salinity and flow data from the regional REMP into the Fitzroy salinity model to assess the cumulative effect of mine water releases;
- where applicable, assessing if metals concentrations in sediment at sites downstream of mine discharge points exceed (i) upstream concentrations and (ii) guideline values; and
- assessing ecosystem health at key refuge waterholes in major sub-basins impacted by mine releases.

It is therefore recommended that the regional REMP reporting integrate local coal mine monitoring data and that collected by FPRH. This would include a local assessment based on the release points and near field monitoring data for each coal mine in relevant sub-basins with a comparison to the relevant water quality objectives, in addition to regional assessment of the ecosystem health of each sub-basin within the Fitzroy Basin based on available data from FPRH, industry and at Qld Government gauging stations. The regional ecosystem health assessment should also provide an indication of cumulative effects of regulated activities and indicate potential point sources that may have contributed to the poorer ecosystem health within the sub-basins, where identified.

Proponents will still need to notify the administrating authority of events and exceedances as per their approval and are likely to still be responsible for monitoring the near-field receiving environment based on EA conditions. However, they would not need to undertake annual assessments of the environment as required under current REMP conditions, as this would be done by the regional REMP.

Review of Water Quality Monitoring Data submitted by coal mines

Water quality monitoring data for the majority of coal mines within the Fitzroy Basin is currently provided to WaTERS. A cursory data assessment was undertaken to determine the effectiveness of this data in meeting approval requirements, in addition to the suitability of the data for assessing the risk of release of mine-affected water from the coal mine facilities. It was found that there was generally a lack of consistent data submitted by coal mine companies to WaTERS. Many companies submitted release data while a lesser number of companies provided receiving environment monitoring data. Only a third of companies provided data for REMPs. In general, there was also a lack of continuous flow and EC data submitted. As mentioned previously,

where it is provided, it is often not provided for the whole hydrograph. This may be because the minimum requirement for data provision in many EAs is generally daily and during release periods only.

Overall, the data clearly shows that EC is the key contaminant of concern for coal mines in the Fitzroy Basin, although the levels of EC vary significantly from site to site. Other water quality contaminants include sulphate and suspended solids/turbidity. Sulphate is generally correlated with EC whereas suspended solids in mine affected water is typically much less than receiving water during times of events. Metals and low pH have not been found to be a major issue with coal mine releases in the Fitzroy Basin. However, anecdotal evidence suggests that many companies do not filter samples in the field when sampling for dissolved metals, due to difficulties filtering turbid samples. This would mean that much of the dissolved metal data collected to-date may not be reliable. Nonetheless, there is a potential for streamlining of the contaminants measured in releases of mine affected water and in local receiving environment. In general, it may be possible to reduce this monitoring to focus mainly on continuous monitoring of EC, flow and turbidity. However, this would need to be assessed on a case-by-case basis using available data and information.

Amending EA conditions

Amendments to EA conditions is likely to be required for the successful implementation of a regional REMP. This would need to include amendments to the receiving environment monitoring point, REMP and reporting requirements. It is suggested that the EA conditions for coal mines participating in the regional REMP be amended to include the following:

- Add participation in a regional monitoring program to the REMP condition
- Streamline indicators monitored at release points and receiving environment monitoring points based on the major contaminants of concern at the facilities (e.g. EC, sulphate and turbidity)
- Include limits on the release points, and if limits are not possible on the release, include triggers on the receiving environment monitoring points for key indicators.
- Include the monitoring of onsite storages that have authorised release points for other indicators, such as metals, instead of during the releases. As a minimum, this needs to occur pre-wet but quarterly would be preferred.
- Include a requirement for water quality monitoring data collected by the coal mine facilities as part of their EA requirements at release points, receiving environment monitoring points and onsite storages with authorised release points be submitted to WaTERS.
- Include a requirement for continuous flow and EC to be collected at release points and local receiving environment points (minimum hourly). Monitoring of receiving environment should occur at all periods of stream flow.
- Amend the annual REMP reporting condition as outlined above.

Future work is required to assist companies amend EA conditions to include the above recommendations. A standard set of conditions could be developed with the Environmental Services and Regulation Division of DES to support this process.

Conclusions

For facilities that are authorised to release wastewater within the Fitzroy Basin, there is considerable variability in the number of receiving environment monitoring points, the indicators that are measured and the frequency of monitoring. The metadata for this monitoring has been captured and broad opportunities to reduce the number of receiving environment monitoring points and the indicators that are monitored by each facility has been identified.

Water quality monitoring data provided to WaTERS for key indicators is not complete and, in most cases, does not cover all periods of stream flow (i.e. focusses on periods of mine water release). It is suggested that all EA required water quality data collected by coal mines at release and receiving environment monitoring points be submitted to WaTERS. This is required for coal mines to meet regulatory requirements but also to support the development and implementation of a regional REMP report and the Fitzroy Basin Report Card produced each year. Additionally, any additional data collected by the FPRH should also be submitted to WaTERS so that the data is also available to support coal mine regulation.

Based on the findings of this review, amendments to EA conditions will be required for the successful implementation of a regional REMP. This would include amendments to approval conditions involving receiving environment monitoring points, indicators being measured at these points (and potentially at release points), the REMP and general reporting requirements.

Recommendations

Based on the review of the EAs that are authorised to release wastewater in the Fitzroy Basin and the associated release and receiving environment data, the following recommendations are made to assist with the development of a regional REMP for the Fitzroy Basin, which should meet regulatory requirements and also provide benefits to stakeholders:

- **The receiving environment monitoring points that are currently used by coal mining companies in the local vicinity of the releases, should in general, be maintained.** It is recommended that in the case that companies agree to take part in the regional REMP, these monitoring points are stipulated in the EA and monitoring be undertaken during all times of stream flow, not solely when releases are occurring.
- **In terms of water quality indicators monitored by the coal mining companies, it is recommended that this focus primarily on indicators that can be measured using real time sensors, rather than grab samples. The key indicators are EC and turbidity. It is also important to measure stream flow at the same time as the key indicators.** Monitoring should be continuous, and a minimum of hourly monitoring data should be made available for periods of release and stream flow. In some cases, it may also be appropriate to measure pH. Some grab samples of suspended solids may be required to interpret turbidity for the purposes of assessing stream health and helping to calibrate models. The key requirement here is that, these indicators need to be measured across times when the stream is flowing and not just during times of mine releases.
- **It is recommended that participating companies are not required to undertake any type of biological monitoring or annual reporting of receiving water quality condition at local receiving environment points.** This function is best undertaken as part of the regional REMP. The only proviso to this is where a company needs to undertake an investigation, which is considered a separate reporting process.
- **Further work is required to develop standardised conditions and the process involved to assist companies amending EAs.**
- **It is recommended that companies investigate streamlining their requirement to monitor contaminants end-of-pipe at release points** (as per Table 3 of most EAs). Many indicators in Table 3 may no longer be required. However, this would require a case-by-case risk assessment of release or onsite storage water quality data by companies as part of their EA amendment.

- **For other indicators, such as metals and other potential contaminants of concern, these should be included in the monitoring of onsite storages that have authorised release points instead of monitoring such indicators at release points during a release.** As a minimum, this needs to occur pre-wet, but quarterly would be ideal. This data will inform coal mine regulation but will not be part of the Integrated REMP reporting.
- **With respect to the regional REMP, it is recommended that the focus be on key indicators relevant to Fitzroy coal mine regulation and assessment.** The primary indicator is EC, in addition to turbidity/suspended solids and sulphate, although some other indicators such as pH, metals/metalloids, sodium, etc need to be considered. It is also important to measure stream flow at the same time as the key indicators. A secondary focus would be on indicators such as nutrients, chlorophyll a, and potentially other physico-chemical indicators. These indicators are more related to regional ecosystem health and do not specifically relate to coal mine regulation. However, such indicators could relate to other point source activities in the Fitzroy at some locations. Finally, the regional REMP could also be the vehicle for delivering biological monitoring including fish, macroinvertebrates and habitat condition if relevant. However, for the purposes of supporting regulation, major monitoring effort and financial investment is probably not warranted for biological monitoring in the regional REMP.
- **For the regional REMP, the frequency of monitoring should be sufficient to support regulation and report annually.** Water quality data that is collected as part of the regional REMP would ideally be collected continuously for relevant indicators, such as EC, turbidity and flow, and a minimum of bi-monthly (6 times a year) for other sampled indicators, such as metals, sulphate, suspended sediment, pH etc.
- **There is a significant potential for cost savings from reduced monitoring of indicators by companies at the release points and in receiving environment**, particularly biological and metals, reduced need for grab samples and reduced annual reporting. Some of this investment can go into the regional REMP while some will need to go into more reliably continuous monitoring of release points and local receiving environment for key indicators and stream flow. **Further cost assessment of current company expenditure and proposed regional REMP components is required to find the appropriate proportion and mix of monitoring for the regional REMP.**
- **The "integrated" REMP reporting should focus on both a local condition assessment of local receiving environment based principally on company data, as well as, a regional assessment based on the data collected as part of the regional REMP.** The focus of the regional data collection should be on sub-basins that currently have coal mine facilities authorised to release mine-affected water, as provided in this report.
- **A mechanism should be explored to allow for sharing of water quality data from local receiving environment monitoring points that are currently duplicated by different facilities.** This mechanism may require the monitoring to be undertaken by a third party to allow for cost and data sharing.
- It is recommended that there is a requirement for all water quality monitoring data collected by the coal mine facilities as part of their EA at release points, receiving environment monitoring points and onsite storages with authorised releases to **be submitted to WaTERS and at appropriate timing to allow the reporting by FRHP to be undertaken.**
- **It is recommended that the regulated activities that are authorised to release wastewater to the environment in the Fitzroy Basin, other than coal mines, be explored** as a possible second stage implementation for the regional REMP. An obvious first step would be in the Fitzroy River Estuary with a primary focus on nutrients, sewage treatment plants and abattoirs. For other point sources located in the freshwater catchment, a similar detailed review of current receiving environment water quality monitoring is recommended to determine the best mixture of local and regional monitoring required to meet regulatory requirements.

References

DEHP (2014). Receiving Environment Monitoring Program guideline - For use with Environmental Relevant Activities under the Environmental Protection Act (1994). Brisbane: Department of Environment and Heritage Protection (DEHP), Queensland Government. http://www.ehp.qld.gov.au/licences-permits/business-industry/pdf/receiving-environment-monitoring-program-em1260.pdf

DEHP (2017). Guideline - Resource activity – mining - Model water conditions for coal mines in the Fitzroy Basin (ESR/2015/1561, formerly EM288; Version 3). Department of Environment and Heritage Protection (DEHP), Queensland Government, Brisbane. https://www.ehp.qld.gov.au/assets/documents/regulation/rs-gl-water-conditions-mines-fitzroy.pdf

Fitzroy Partnership for River Health (FPRH). 2017. Fitzroy Basin Integrated Receiving Environment Monitoring Program. Revision F – Dec 2017. Prepared by CQG Consulting for the Fitzroy Partnership for River Health (Draft Integrated REMP)

Flint, Nicole, Rebbekah Hearn, Nathan Johnston, Andrew Irving, Luke Ukkola and Amie Anastasi. 2016. Monitoring Efficiency Review.

Lian Lundy, Luciana Alves, Michael Revitt and Dirk Wildeboer. 2017. Metal Water-Sediment Interactions and Impacts on an Urban Ecosystem. International Journal of Environmental Research and Public Health. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5551160/pdf/ijerph-14-00722.pdf

Murray-Darling Basin Commission. 2004. Sustainable Rivers Audit Pilot. Fish Theme Technical Report. May 2004.

Queensland Government Water Monitoring Information Portal. (https://water-monitoring.information.qld.gov.au/)

Simpson SL, Batley GB and Chariton AA. 2013. Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water.

US EPA. Chapter 4 Macroinvertebrates and habitat. In Water: Monitoring and Assessment https://archive.epa.gov/water/archive/web/html/vms40.html

Water and Rivers Commissions. 2001. Water facts. Water quality and macroinvertebrates. Waterwatch WA. http://www.atmosedu.com/ENVS109/WaterQualityandMacroinvertabrates.pdf

Appendix A – Model Mining Conditions

Model water conditions for coal mines in the Fitzroy basin (ESR/2015/1561). Version 3.01, Effective: 31 March 2013.

Release Points (RP)

Mine affected water release points represent a potential source of water contaminated by mining activity. Wastewater releases are covered under EA Conditions W1 – W16.

W5

The release of mine affected water to waters from the release points must be monitored at the locations specified in Table 1 for each quality characteristics and at the frequency specified in Table 2 and Table 3.

Table 1 – Mine affected water release points, sources and receiving waters

Table 2 – Mine affected water release limits (EC, pH, Turbidity, SS, Sulphate). Monitoring frequency - Daily during release (the first sample must be taken within two hours of commencement of release)

Table 3 – Release contaminant trigger investigation levels (metals, ammonia, nitrate, hydrocarbons, fluoride, sodium). Monitoring frequency - Commencement of release and thereafter weekly during release.

W11

The daily quantity of mine affected water released from each release point must be measured and recorded at the monitoring points in Table 1.

W13 & W14 - Notification of release

W15 & W16 – Notification of release event exceedance

Receiving environment (RE) monitoring

The intent here is that that each release point (RP) has both an upstream and downstream monitoring point associated with it. The location of flow monitoring points should also be considered in selecting upstream monitoring points.

W19

The quality of the receiving waters must be monitored at the locations specified in Table 8 for each quality characteristic and at the monitoring frequency stated in Table 7.

Schedule W, Table 7 – Receiving waters contaminant trigger levels (EC, pH, SS, Sulphate). Monitoring frequency – Daily during release.

Schedule W, Table 8 – Receiving water upstream background sites and downstream monitoring points.

W20

If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in Table 7 during a release event the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and:

1. where the downstream result is the same or a lower value than the upstream value for the quality characteristic then no action is to be taken; or
2. where the downstream results exceed the upstream results complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining:
    i) details of the investigations carried out; and
    ii) actions taken to prevent environmental harm.

REMP monitoring

W21

The environmental authority holder must develop and implement a REMP to monitor, identify and describe **any adverse impacts to surface water environmental values, quality and flows** due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment **periodically** (under natural flow conditions) and while **mine affected water is being discharged** from the site.

For the purposes of the REMP, the receiving environment is the waters of the XX and connected or surrounding waterways within XX (e.g. X km) downstream of the release. The REMP should encompass any **sensitive receiving waters or environmental values downstream** of the authorised mining activity that will potentially be directly affected by an authorised release of mine affected water.

W22

The REMP must:

a) assess the condition or state of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);
b) be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;
c) include monitoring from background reference sites (e.g. upstream or background) and downstream sites from the release (as a minimum, the locations specified in Table 8);
d) specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the Queensland Water Quality Guidelines 2006. This should include monitoring during periods of natural flow irrespective of mine or other discharges;
e) include monitoring and assessment of dissolved oxygen saturation, temperature and all water quality parameters listed in Table 2 and 3);
f) include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ 2000, BATLEY and/or the most recent version of AS5667.1 Guidance on Sampling of Bottom Sediments);
g) include, where appropriate, monitoring of macroinvertebrates in accordance with the AusRivas methodology;
h) apply procedures and/or guidelines from ANZECC and ARMCANZ 2000 and other relevant guideline documents;
i) describe sampling and analysis methods and quality assurance and control; and
j) incorporate stream flow and hydrological information in the interpretations of water quality and biological data.

W23

A REMP Design Document that addresses each criterion presented in conditions W21 and W22 must be prepared and submitted to the administering authority no later than 3 months after the date of issue of this environmental authority [include for new sites or expansion projects, remove for existing mine sites which already have REMP Design Documents. Due consideration must be given to any comments made by the administering authority on the REMP Design Document and subsequent implementation of the program.

W24

A **report** outlining the findings of the REMP, including all monitoring results and interpretations in accordance with conditions W21 and W22 must be **prepared annually** and made available on request to the administrating authority. This must include an assessment of background reference water quality, the condition of downstream water quality compared against water quality objectives, and the suitability of current discharge limits to protect downstream environmental values.

Appendix B – Additional facility, monitoring point and indicator information

Table 8. List of facilities in the Fitzroy Basin, including those that are in WaTERS and those that have a REMP condition.

	Facility Name	Site in WaTERS	REMP Condition	Commissioned
1	ARC Marlborough Chrysoprase/Cobalt/Nickel Mine		No	
2	Baralaba North and Wonbindi Coal Mine	Yes	Yes	
3	Blackwater Coal Mine	Yes	Yes	
4	Blair Athol Coal Mine	Yes	Yes	
5	Bluff Coal Mine		Yes	No
6	Boonal JV Rail Loadout	Yes	Yes	
7	Broadlea North Coal Project	Yes	Yes	
8	Burton Coal Mine	Yes	Yes	
9	Callide Coal Mine	Yes	Yes	
10	Callide Power Station		No	
11	Carborough Downs Coal Mine	Yes	Yes	
12	Caval Ridge Coal Mine	Yes	Yes	
13	Cheetham Salt Limited		No	
14	Clermont Coal Mine	Yes	Yes	
15	Codrilla Coal Mine		Yes	No
16	Comet Ridge Coal Mine		Yes	No
17	Cook Coal Mine	Yes	No	
18	Coppabella Coal Mine	Yes	Yes	
19	Cracow Gold Mine		Yes	
20	Curragh Coal Mine	Yes	Yes	
21	Daunia Coal Mine	Yes	Yes	
22	Dawson Central & North Coal Mine	Yes	Yes	
23	Dawson South Coal Mine	Yes	Yes	
24	Dyno Nobel Industrial & Mining Explosives Manufacturing Plant		No	
25	Eagle Downs Coal Mine		Yes	
26	Ensham Coal Mine	Yes	Yes	
27	Fairbairn Dam Sewage Treatment Plant		No	
28	Fairview Arcadia Coal Seam Gas Project Area	Yes	No	
29	Foxleigh Coal Mine	Yes	Yes	
30	German Creek Coal Mine	Yes	Yes	
31	Glencore Wandoan Coal Project		Yes	No
32	Goonyella Riverside & Broadmeadow Coal Mines	Yes	Yes	
33	Gregory Crinum Coal Mine	Yes	Yes	
34	Grosvenor Coal Mine	Yes	Yes	
35	Gumigil Chrysoprase Mine		No	
36	Hail Creek Coal Mine	Yes	Yes	
37	Isaac Plains Coal Mine	Yes	Yes	
38	Jellinbah Coal Mine	Yes	Yes	
39	Kestrel Coal Mine	Yes	Yes	
40	Lake Lindsay Coal Mine	Yes	Yes	
41	Lake Vermont Coal Project	Yes	Yes	
42	Meteor Downs South Coal Mine	Yes	Yes	
43	Middlemount Coal Mine	Yes	Yes	
44	Millenium Coal Mine	Yes	Yes	
45	Minerva Coal Mine	Yes	Yes	
46	Minyango Coal Mine		Yes	No
47	Moorvale Coal Mine	Yes	Yes	
48	Moranbah North Coal Mine	Yes	Yes	
49	Mount Morgan Sewage Treatment Plant		Yes	
50	Mount Morgan Silver Mine		No	
51	New Burton Coal Mine	Yes	Yes	
52	North Goonyella Coal Mine	Yes	Yes	
53	North Rockhampton Sewage Treatment Plant	Yes	Yes	
54	Norwich Park Coal Mine	Yes	Yes	

	Facility Name	Site in WaTERS	REMP Condition	Commissioned
55	Oaky Creek Coal Mine	Yes	Yes	
56	Olive Downs Coal Mine		Yes	No
57	Omya Limestone Mine		No	
58	Peak Downs Coal Mine	Yes	Yes	
59	Poitrel Coal Mine	Yes	Yes	
60	Red Mountain Coal Handling and Processing Plant	Yes	Yes	
61	Rolleston Coal Mine	Yes	Yes	
62	Saraji Coal Mine	Yes	Yes	
63	South Rockhampton Sewage Treatment Plant	Yes	Yes	
64	South Walker Creek Coal Mine	Yes	Yes	
65	Spring Gully Coal Seam Gas Project	Yes	Yes	
66	Springsure Sewage Treatment Plant		Yes	
67	Stanwell Power Station		Yes	
68	Swift Australia Meat Processing		No	
69	Taroom Sewage Treatment Plant	Yes	No	
70	Teys Australia Rockhampton Meat Processing	Yes	Yes	
71	Triumph Creek Rail Load-out Facility		Yes	No
72	Wandoan Sewage Treatment Plant		No	
73	West Rockhampton Sewage Treatment Plant	Yes	Yes	
74	Yarrabee Coal Mine	Yes	Yes	
75	Yeppoon West Sewage Treatment Plant		No	

Table 9. Potential duplicate monitoring locations used for different coal mine facilities and companies.

Coal Mine Facility	Company Name	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Blair Athol Coal Mine	Rio Tinto	DMP3	BLAICM-DMP3	RE	ds	-22.7497	147.5369	Bath Creek	Theresa
Clermont Coal Mine	Glencore	DMP5	CLERCM-DMP5	RE	ds	-22.7497	147.5369	Bath Creek	Theresa
Blair Athol Coal Mine	Rio Tinto	DMP2	BLAICM-DMP2	RE	ds	-22.7242	147.5481	Bath Creek	Theresa
Clermont Coal Mine	Glencore	DMP4	CLERCM-DMP4	RE	ds	-22.7242	147.5481	Bath Creek	Theresa
Blair Athol Coal Mine	Rio Tinto	DMP4	BLAICM-DMP4	RE	ds	-22.7197	147.538	Bath Creek	Theresa
Clermont Coal Mine	Glencore	DMP6	CLERCM-DMP6	RE	ds	-22.7197	147.538	Bath Creek	Theresa
Blair Athol Coal Mine	Rio Tinto	UMP2	BLAICM-UMP2	RE	us	-22.6882	147.5544	Bath Creek	Theresa
Clermont Coal Mine	Glencore	UMP4	CLERCM-UMP4	RE	us	-22.6882	147.5544	Bath Creek	Theresa
South Walker Creek Coal Mine	BMC	UMP2	SWALCM-UMP2	RE	us	-21.7428	148.526	Bee Creek	Connors
Hail Creek Coal Mine	Rio Tinto	DMP4	HAILCM-DMP4	RE	ds	-21.7427	148.5261	Bee Creek	Connors
Minyango Mine	Blackwater Coal	DMP1	MINYMM-DMP1	RE	ds	-23.6381	148.9016	Blackwater Creek	Mackenzie
Cook Coal Mine	Glencore	DMP1	COOKCM-DMP1	RE	ds	-23.6381	148.9016	Blackwater Creek	Mackenzie
Jellinbah Coal Mine	Jellinbah	UMP1	JELLCM-UMP1	RE	us	-23.4081	148.9145	Blackwater Creek	Mackenzie
Curragh Coal Mine	Wesfarmers	DMP1	CURRCM-DMP1	RE	ds	-23.4061	148.9158	Blackwater Creek	Mackenzie
Blair Athol Coal Mine	Rio Tinto	DMP1	BLAICM-DMP1	RE	ds	-22.7147	147.5214	Breaker Creek	Theresa
Clermont Coal Mine	Glencore	DMP3	CLERCM-DMP3	RE	ds	-22.7147	147.5214	Breaker Creek	Theresa
Blair Athol Coal Mine	Rio Tinto	UMP3	BLAICM-UMP3	RE	us	-22.6861	147.5113	Breaker Creek	Theresa
Clermont Coal Mine	Glencore	UMP5	CLERCM-UMP5	RE	us	-22.6861	147.5113	Breaker Creek	Theresa
Callide Coal Mine	Batchfire	SMP2	CALLCM-SMP2	REMP only	us	-24.3231	150.685	Callide Creek	Callide
Callide Coal Mine	Batchfire	UMP1	CALLCM-UMP1	RE	us	-24.3231	150.685	Callide Creek	Callide
Oaky Creek Coal Mine	Glencore	UMP3	OAKYCM-UMP3	RE	us	-23.0156	148.5767	Cattle Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP2	GERMCM-DMP2	RE	ds	-23.013	148.576	Cattle Creek	Mackenzie
Kestrel Coal Mine	Rio Tinto	UMP4	KESTCM-UMP4	RE	us	-23.2326	148.325	Crinum Creek	Theresa
Gregory Crinum Coal Mine	BMA	DMP3	GREGCM-DMP3	RE	ds	-23.2311	148.3238	Crinum Creek	Theresa
Kestrel Coal Mine	Rio Tinto	UMP3	KESTCM-UMP3	RE	us	-23.2075	148.3384	Crinum Creek	Theresa
Gregory Crinum Coal Mine	BMA	SMP3	GREGCM-SMP3	REMP only	ds	-23.2074	148.3387	Crinum Creek	Theresa
Gregory Crinum Coal Mine	BMA	SMP2	GREGCM-SMP2	REMP only	ds	-23.2073	148.339	Crinum Creek	Theresa
Gregory Crinum Coal Mine	BMA	UMP1	GREGCM-UMP1	RE	us	-23.1468	148.3705	Crinum Creek	Theresa
Gregory Crinum Coal Mine	BMA	SMP14	GREGCM-SMP14	REMP only	us	-23.144	148.3695	Crinum Creek	Theresa
Dawson North And Central Coal Mine	Anglo American	DMP1	DANCCM-DMP1	RE	ds	-24.3554	149.809	Dawson River	Lower Dawson
Dawson South Coal Mine	Anglo American	DMP2	DAWSCM-DMP2	RE	ds	-24.3554	149.809	Dawson River	Lower Dawson
Blair Athol Coal Mine	Rio Tinto	SMP1	BLAICM-SMP1	REMP only	us	-22.6938	147.6143	Gowrie Creek	Theresa
Clermont Coal Mine	Glencore	SMP2	CLERCM-SMP2	REMP only	us	-22.6932	147.6265	Gowrie Creek	Theresa

Coal Mine Facility	Company Name	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Caval Ridge Coal Mine	BMA	DMP1	CAVACM-DMP1	RE	ds	-22.3449	148.4838	Isaac River	Upper Isaac
Saraji Coal Mine	BMA	DMP7	SARACM-DMP7	RE	ds	-22.3449	148.4838	Isaac River	Upper Isaac
Peak Downs Coal Mine	BMA	DMP2	PEAKCM-DMP2	RE	ds	-22.3108	148.4779	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP2	CAVACM-DMP2	RE	ds	-22.3091	148.4779	Isaac River	Upper Isaac
Peak Downs Coal Mine	BMA	DMP4	PEAKCM-DMP4	RE	ds	-22.1709	148.3843	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP4	CAVACM-DMP4	RE	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	SMP1	DAUNCM-SMP1	REMP only	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Olive Downs Mine	Peabody Coppabella	DMP3	OLIDCM-DMP3	RE	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	DMP2	POITCM-DMP2	RE	ds	-22.1246	148.2963	Isaac River	Upper Isaac
Red Mountain Coal Mine	Peabody	DMP1	REDMCM-DMP1	RE	ds	-22.1246	148.2963	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	DMP2	DAUNCM-DMP2	RE	ds	-22.1184	148.2772	Isaac River	Upper Isaac
Olive Downs Mine	Peabody Coppabella	UMP2	OLIDCM-UMP2	RE	us	-22.1163	148.2777	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	UMP2	DAUNCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Red Mountain Coal Mine	Peabody	UMP2	REDMCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	UMP2	POITCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	SMP2	POITCM-SMP2	REMP only	us	-22.0499	148.1305	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	DMP3	CARBCM-DMP3	RE	ds	-22.0496	148.1306	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	DMP1	ISAACM-DMP1	RE	ds	-22.0496	148.1308	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	SMP1	ISAACM-SMP1	REMP only	us	-21.9647	148.0462	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP2	CARBCM-UMP2	RE	us	-21.9647	148.0459	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP2	GOONCM-SMP2	REMP only	ds	-21.8683	147.97	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	UMP1	MORNCM-UMP1	RE	us	-21.8681	147.9714	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP5	CARBCM-UMP5	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	UMP3	ISAACM-UMP3	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Millennium Coal Mine	Peabody	UMP2	MILLCM-UMP2	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	UMP2	MORNCM-UMP2	RE	us	-21.8555	147.9722	Isaac River	Upper Isaac
Burton Coal Mine	Peabody	UMP4	BURTCM-UMP4	RE	us	-21.5366	148.1519	Isaac River	Upper Isaac
New Burton Coal Mine	Peabody	UMP2	NWBTCM-UMP2	RE	us	-21.5366	148.1519	Isaac River	Upper Isaac
Jellinbah Coal Mine	Jellinbah	UMP2	JELLCM-UMP2	RE	us	-23.2638	148.9017	MacKenzie River	Mackenzie
Curragh Coal Mine	Wesfarmers	DMP2	CURRCM-DMP2	RE	ds	-23.2631	148.9014	MacKenzie River	Mackenzie
Foxleigh Coal Mine	Middlemount South	DMP5	FOXLCM-DMP5	RE	ds	-23.0762	149.0331	MacKenzie River	Mackenzie
German Creek Coal Mine	Anglo American	DMP6	GERMCM-DMP6	RE	ds	-23.0762	149.0331	MacKenzie River	Mackenzie
Curragh Coal Mine	Wesfarmers	DMP4	CURRCM-DMP4	RE	ds	-23.0737	149.0319	MacKenzie River	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP3	LLINCM-DMP3	RE	ds	-23.0717	149.0342	MacKenzie River	Mackenzie
Millennium Coal Mine	Peabody	DMP1	MILLCM-DMP1	RE	ds	-22.0352	148.2788	New Chum Creek	Upper Isaac

Coal Mine Facility	Company Name	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Poitrel Coal Mine	BMC	SMP4	POITCM-SMP4	REMP only	us	-22.0351	148.2789	New Chum Creek	Upper Isaac
Red Mountain Coal Mine	Peabody	UMP1	REDMCM-UMP1	RE	us	-22.0047	148.2269	New Chum Creek	Upper Isaac
Millennium Coal Mine	Peabody	UMP1	MILLCM-UMP1	RE	us	-22.0044	148.2264	New Chum Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	DMP1	CARBCM-DMP1	RE	ds	-22.0064	148.3128	North Creek	Upper Isaac
Moorvale Coal Mine	Peabody	UMP1	MOORCM-UMP1	RE	us	-22.0046	148.3141	North Creek	Upper Isaac
Olive Downs Mine	Peabody Coppabella	UMP1	OLIDCM-UMP1	RE	us	-22.0046	148.3141	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP1	CARBCM-UMP1	RE	us	-21.9441	148.297	North Creek	Upper Isaac
Poitrel Coal Mine	BMC	SMP1	POITCM-SMP1	REMP only	us	-21.9421	148.2979	North Creek	Upper Isaac
Oaky Creek Coal Mine	Glencore	DMP4	OAKYCM-DMP4	REMP only	ds	-23.0713	148.4763	Oaky Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	UMP1	LLINCM-UMP1	RE	us	-23.0701	148.7421	Oaky Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP5	GERMCM-DMP5	RE	ds	-23.0515	148.7738	Oaky Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP1	LLINCM-DMP1	RE	ds	-23.0515	148.7738	Oaky Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP7	GERMCM-DMP7	RE	ds	-23.057	148.888	Roper Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP5	LLINCM-DMP5	RE	ds	-23.057	148.888	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	DMP2	FOXLCM-DMP2	RE	ds	-23.057	148.8881	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	DMP1	FOXLCM-DMP1	RE	ds	-23.016	148.8198	Roper Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP4	GERMCM-DMP4	RE	ds	-23.016	148.819	Roper Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP2	LLINCM-DMP2	RE	ds	-23.016	148.819	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	DMP1	MIDDCM-DMP1	RE	ds	-22.8766	148.6718	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	UMP1	FOXLCM-UMP1	RE	us	-22.8762	148.6719	Roper Creek	Mackenzie
German Creek Coal Mine	Anglo American	UMP1	GERMCM-UMP1	RE	us	-22.876	148.6713	Roper Creek	Mackenzie
Cook Coal Mine	Glencore	UMP1	COOKCM-UMP1	RE	us	-23.7529	148.886	Taurus Creek	Mackenzie
Minyango Mine	Blackwater Coal	UMP1	MINYMM-UMP1	RE	us	-23.7529	148.886	Taurus Creek	Mackenzie
Triumph Creek Rail Load-out Facility	Unimin Australia	UMP1	TRIUIND-UMP1	RE	us	-23.802	148.7112	Triumph Creek	Comet
Comet Ridge Coal Mine	Acacia Coal	UMP2	CORICM-UMP2	RE	us	-23.8015	148.7109	Triumph Creek	Comet
Blair Athol Coal Mine	Rio Tinto	UMP1	BLAICM-UMP1	RE	us	-22.6673	147.5313	Washpool Creek	Theresa
Clermont Coal Mine	Glencore	UMP3	CLERCM-UMP3	RE	us	-22.6673	147.5313	Washpool Creek	Theresa

Table 10. Coal mine monitoring points located on the same waterway.

Coal Mine Facility	Company Names	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
New Burton Coal Mine	Peabody	DMP3	NWBTCM-DMP3	RE	ds	-21.6217	148.1281	Anna Creek	Upper Isaac
Burton Coal Mine	Peabody	DMP2	BURTCM-DMP2	RE	ds	-21.5949	148.152	Anna Creek	Upper Isaac
New Burton Coal Mine	Peabody	DMP4	NWBTCM-DMP4	RE	ds	-21.5877	148.1574	Anna Creek	Upper Isaac
Burton Coal Mine	Peabody	DMP3	BURTCM-DMP3	RE	ds	-21.5875	148.1574	Anna Creek	Upper Isaac
New Burton Coal Mine	Peabody	DMP1	NWBTCM-DMP1	RE	ds	-21.5781	148.1618	Anna Creek	Upper Isaac
New Burton Coal Mine	Peabody	UMP1	NWBTCM-UMP1	RE	us	-21.5751	148.1852	Anna Creek	Upper Isaac
Burton Coal Mine	Peabody	UMP3	BURTCM-UMP3	RE	us	-21.5751	148.1852	Anna Creek	Upper Isaac
Caval Ridge Coal Mine	BMA	SMP1	CAVACM-SMP1	REMP only	us	-22.1805	148.0697	Cherwell Creek	Upper Isaac
Caval Ridge Coal Mine	BMA	UMP1	CAVACM-UMP1	RE	us	-22.1784	148.0672	Cherwell Creek	Upper Isaac
Peak Downs Coal Mine	BMA	SMP4	PEAKCM-SMP4	REMP only	us	-22.1716	148.0696	Cherwell Creek	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP7	CAVACM-DMP7	RE	ds	-22.1538	148.0904	Cherwell Creek	Upper Isaac
Peak Downs Coal Mine	BMA	SMP2	PEAKCM-SMP2	REMP only	ds	-22.1453	148.0894	Cherwell Creek	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP8	CAVACM-DMP8	RE	ds	-22.1423	148.1426	Cherwell Creek	Upper Isaac
Moorvale Coal Mine	Peabody	SMP3	MOORCM-SMP3	REMP only	ds	-22.1109	148.5712	Delvin Creek	Upper Isaac
Moorvale Coal Mine	Peabody	DMP2	MOORCM-DMP2	RE	ds	-22.0047	148.3961	Delvin Creek	Upper Isaac
Codrilla Coal Mine	Peabody Coppabella	DMP1	CODRCM-DMP1	RE	ds	-22.1291	148.5926	Devlin Creek	Upper Isaac
Codrilla Coal Mine	Peabody Coppabella	DMP2	CODRCM-DMP2	RE	ds	-22.1102	148.5699	Devlin Creek	Upper Isaac
Codrilla Coal Mine	Peabody Coppabella	UMP1	CODRCM-UMP1	RE	us	-22.1029	148.5375	Devlin Creek	Upper Isaac
Codrilla Coal Mine	Peabody Coppabella	DMP3	CODRCM-DMP3	RE	ds	-22.0193	148.3983	Devlin Creek	Upper Isaac
Moorvale Coal Mine	Peabody	SMP5	MOORCM-SMP5	REMP only	ds	-21.9998	148.3925	Devlin Creek System	Upper Isaac
North Goonyella Coal Mine	Peabody	DMP2	NGOOCM-DMP2	RE	ds	-21.684	148.0016	Goonyella Creek	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP4	GOONCM-SMP4	REMP only	us	-21.6831	148.0101	Goonyella Creek	Upper Isaac
North Goonyella Coal Mine	Peabody	UMP3	NGOOCM-UMP3	RE	us	-21.6656	147.9946	Goonyella Creek	Upper Isaac
North Goonyella Coal Mine	Peabody	UMP2	NGOOCM-UMP2	RE	us	-21.647	147.9969	Goonyella Creek	Upper Isaac
Moorvale Coal Mine	Peabody	SMP4	MOORCM-SMP4	REMP only	ds	-21.8853	148.5666	Harrybrandt Creek	Connors
Coppabella Coal Mine	Peabody	UMP1	COPPCM-UMP1	RE	us	-21.8832	148.44	Harrybrandt Creek	Connors
Coppabella Coal Mine	Peabody	DMP3	COPPCM-DMP3	RE	ds	-21.8736	148.5209	Harrybrandt Creek	Connors
Saraji Coal Mine	BMA	DMP6	SARACM-DMP6	RE	ds	-22.4193	148.6988	Isaac River	Upper Isaac
Lake Vermont Coal Mine	Jellinbah	DMP1	LVERCM-DMP1	RE	ds	-22.3559	148.4941	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP1	CAVACM-DMP1	RE	ds	-22.3449	148.4838	Isaac River	Upper Isaac
Saraji Coal Mine	BMA	DMP7	SARACM-DMP7	RE	ds	-22.3449	148.4838	Isaac River	Upper Isaac
Peak Downs Coal Mine	BMA	DMP1	PEAKCM-DMP1	RE	ds	-22.3391	148.4729	Isaac River	Upper Isaac
Saraji Coal Mine	BMA	DMP1	SARACM-DMP1	RE	ds	-22.3362	148.4674	Isaac River	Upper Isaac

Coal Mine Facility	Company Names	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Peak Downs Coal Mine	BMA	DMP2	PEAKCM-DMP2	RE	ds	-22.3108	148.4779	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP2	CAVACM-DMP2	RE	ds	-22.3091	148.4779	Isaac River	Upper Isaac
Millennium Coal Mine	Peabody	DMP2	MILLCM-DMP2	RE	ds	-22.1742	148.3811	Isaac River	Upper Isaac
Lake Vermont Coal Mine	Jellinbah	UMP3	LVERCM-UMP3	RE	us	-22.1726	148.3822	Isaac River	Upper Isaac
Peak Downs Coal Mine	BMA	DMP4	PEAKCM-DMP4	RE	ds	-22.1709	148.3843	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP4	CAVACM-DMP4	RE	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	SMP1	DAUNCM-SMP1	REMP only	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Olive Downs Mine	Peabody Coppabella	DMP3	OLIDCM-DMP3	RE	ds	-22.1708	148.3842	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	SMP7	POITCM-SMP7	REMP only	ds	-22.1675	148.3822	Isaac River	Upper Isaac
Olive Downs Mine	Peabody Coppabella	DMP2	OLIDCM-DMP2	RE	ds	-22.1659	148.3802	Isaac River	Upper Isaac
Saraji Coal Mine	BMA	UMP5	SARACM-UMP5	RE	us	-22.1639	148.3784	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	DMP2	POITCM-DMP2	RE	ds	-22.1246	148.2963	Isaac River	Upper Isaac
Red Mountain Coal Mine	Peabody	DMP1	REDMCM-DMP1	RE	ds	-22.1246	148.2963	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	DMP2	DAUNCM-DMP2	RE	ds	-22.1184	148.2772	Isaac River	Upper Isaac
Olive Downs Mine	Peabody Coppabella	UMP2	OLIDCM-UMP2	RE	us	-22.1163	148.2777	Isaac River	Upper Isaac
Caval Ridge Coal Mine	BMA	DMP3	CAVACM-DMP3	RE	ds	-22.0922	148.2377	Isaac River	Upper Isaac
Daunia Coal Mine	BMA	UMP2	DAUNCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Red Mountain Coal Mine	Peabody	UMP2	REDMCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	UMP2	POITCM-UMP2	RE	us	-22.0921	148.2397	Isaac River	Upper Isaac
Peak Downs Coal Mine	BMA	DMP3	PEAKCM-DMP3	RE	ds	-22.0919	148.2376	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	SMP2	POITCM-SMP2	REMP only	us	-22.0499	148.1305	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	DMP3	CARBCM-DMP3	RE	ds	-22.0496	148.1306	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	DMP1	ISAACM-DMP1	RE	ds	-22.0496	148.1308	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP7	GROSCM-SMP7	REMP only	ds	-22.0109	148.1004	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP6	GROSCM-SMP6	REMP only	ds	-21.9983	148.0886	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP5	GROSCM-SMP5	REMP only	ds	-21.9914	148.0804	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	SMP1	ISAACM-SMP1	REMP only	us	-21.9647	148.0462	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP2	CARBCM-UMP2	RE	us	-21.9647	148.0459	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP4	GROSCM-SMP4	REMP only	ds	-21.9641	148.0459	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	DMP1	GROSCM-DMP1	RE	ds	-21.964	148.0453	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP3	GROSCM-SMP3	REMP only	ds	-21.9601	148.037	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP4	CARBCM-UMP4	RE	us	-21.9507	148.2138	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP2	GROSCM-SMP2	REMP only	ds	-21.9367	148.0179	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	DMP1	MORNCM-DMP1	RE	ds	-21.9222	148.0205	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	SMP1	GROSCM-SMP1	REMP only	ref	-21.9213	148.0194	Isaac River	Upper Isaac

Coal Mine Facility	Company Names	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Grosvenor Coal Mine	Anglo	UMP2	GROSCM-UMP2	RE	us	-21.9199	148.0167	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	DMP2	MORNCM-DMP2	RE	ds	-21.8809	147.984	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP2	GOONCM-SMP2	REMP only	ds	-21.8683	147.97	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	UMP1	MORNCM-UMP1	RE	us	-21.8681	147.9714	Isaac River	Upper Isaac
North Goonyella Coal Mine	Peabody	DMP3	NGOOCM-DMP3	RE	ds	-21.8567	147.9717	Isaac River	Upper Isaac
Grosvenor Coal Mine	Anglo	UMP1	GROSCM-UMP1	RE	us	-21.8555	147.9723	Isaac River	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP5	CARBCM-UMP5	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Isaac Plains Coal Mine	Stanmore	UMP3	ISAACM-UMP3	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Millennium Coal Mine	Peabody	UMP2	MILLCM-UMP2	RE	us	-21.8555	147.9726	Isaac River	Upper Isaac
Moranbah North Coal Mine	Anglo American	UMP2	MORNCM-UMP2	RE	us	-21.8555	147.9722	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	DMP1	GOONCM-DMP1	RE	ds	-21.8554	147.9732	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP3	GOONCM-SMP3	REMP only	ds	-21.854	147.9546	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP1	GOONCM-SMP1	REMP only	ds	-21.8018	147.9951	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	UMP2	GOONCM-UMP2	RE	us	-21.7841	148.0156	Isaac River	Upper Isaac
North Goonyella Coal Mine	Peabody	DMP1	NGOOCM-DMP1	RE	ds	-21.768	148.0016	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	UMP3	GOONCM-UMP3	RE	us	-21.7353	148.0166	Isaac River	Upper Isaac
North Goonyella Coal Mine	Peabody	UMP1	NGOOCM-UMP1	RE	us	-21.7308	148.0164	Isaac River	Upper Isaac
Goonyella R&BM Coal Mines	BMA	SMP9	GOONCM-SMP9	REMP only	us	-21.7162	148.0377	Isaac River	Upper Isaac
New Burton Coal Mine	Peabody	DMP2	NWBTCM-DMP2	RE	ds	-21.6228	148.1282	Isaac River	Upper Isaac
Burton Coal Mine	Peabody	SMP1	BURTCM-SMP1	RE	us	-21.6215	148.1297	Isaac River	Upper Isaac
New Burton Coal Mine	Peabody	DMP5	NWBTCM-DMP5	RE	ds	-21.5627	148.1417	Isaac River	Upper Isaac
New Burton Coal Mine	Peabody	UMP3	NWBTCM-UMP3	RE	us	-21.537	148.1517	Isaac River	Upper Isaac
Burton Coal Mine	Peabody	UMP4	BURTCM-UMP4	RE	us	-21.5366	148.1519	Isaac River	Upper Isaac
New Burton Coal Mine	Peabody	UMP2	NWBTCM-UMP2	RE	us	-21.5366	148.1519	Isaac River	Upper Isaac
Poitrel Coal Mine	BMC	DMP1	POITCM-DMP1	RE	ds	-22.1079	148.2702	New Chum Creek	Upper Isaac
Poitrel Coal Mine	BMC	SMP6	POITCM-SMP6	REMP only	ds	-22.0876	148.2636	New Chum Creek	Upper Isaac
Daunia Coal Mine	BMA	DMP1	DAUNCM-DMP1	RE	ds	-22.0528	148.2678	New Chum Creek	Upper Isaac
Poitrel Coal Mine	BMC	SMP5	POITCM-SMP5	REMP only	us	-22.0512	148.2727	New Chum Creek	Upper Isaac
Daunia Coal Mine	BMA	UMP1	DAUNCM-UMP1	RE	us	-22.0433	148.277	New Chum Creek	Upper Isaac
Poitrel Coal Mine	BMC	UMP1	POITCM-UMP1	RE	us	-22.0419	148.2781	New Chum Creek	Upper Isaac
Millennium Coal Mine	Peabody	DMP1	MILLCM-DMP1	RE	ds	-22.0352	148.2788	New Chum Creek	Upper Isaac
Poitrel Coal Mine	BMC	SMP4	POITCM-SMP4	REMP only	us	-22.0351	148.2789	New Chum Creek	Upper Isaac
Red Mountain Coal Mine	Peabody	UMP1	REDMCM-UMP1	RE	us	-22.0047	148.2269	New Chum Creek	Upper Isaac
Millennium Coal Mine	Peabody	UMP1	MILLCM-UMP1	RE	us	-22.0044	148.2264	New Chum Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	SMP5	CARBCM-SMP5	REMP only	ds	-21.9936	148.2305	New Chum Creek	Upper Isaac

Coal Mine Facility	Company Names	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Olive Downs Mine	Peabody Coppabella	RP1	OLIDCM-RP1	RP	RP	-22.0961	148.346	North Creek	Upper Isaac
Moorvale Coal Mine	Peabody	DMP1	MOORCM-DMP1	RE	ds	-22.0837	148.3585	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	DMP1	CARBCM-DMP1	RE	ds	-22.0064	148.3128	North Creek	Upper Isaac
Moorvale Coal Mine	Peabody	UMP1	MOORCM-UMP1	RE	us	-22.0046	148.3141	North Creek	Upper Isaac
Olive Downs Mine	Peabody Coppabella	UMP1	OLIDCM-UMP1	RE	us	-22.0046	148.3141	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	SMP2	CARBCM-SMP2	REMP only	ds	-22.0025	148.3065	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	SMP1	CARBCM-SMP1	REMP only	us	-21.9797	148.3102	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP3	CARBCM-UMP3	RE	us	-21.9467	148.295	North Creek	Upper Isaac
Carborough Downs Coal Mine	Fitzroy Resources Australia	UMP1	CARBCM-UMP1	RE	us	-21.9441	148.297	North Creek	Upper Isaac
Poitrel Coal Mine	BMC	SMP1	POITCM-SMP1	REMP only	us	-21.9421	148.2979	North Creek	Upper Isaac
Foxleigh Coal Mine	Middlemount South	UMP4	FOXLCM-UMP4	RE	us	-22.9218	148.6665	Parrot Creek	Mackenzie
German Creek Coal Mine	Anglo American	UMP4	GERMCM-UMP4	RE	us	-22.8987	148.626	Parrot Creek	Mackenzie
Eagle Downs Coal Mine	Bowen Central Coal	UMP1	EAGLCM-UMP1	RE	us	-22.2189	148.253	Ripplestone Creek	Upper Isaac
Eagle Downs Coal Mine	Bowen Central Coal	UMP2	EAGLCM-UMP2	RE	us	-22.214	148.216	Ripplestone Creek	Upper Isaac
Eagle Downs Coal Mine	Bowen Central Coal	DMP2	EAGLCM-DMP2	RE	ds	-22.2451	148.2421	Ripstone Creek	Upper Isaac
Eagle Downs Coal Mine	Bowen Central Coal	DMP1	EAGLCM-DMP1	RE	ds	-22.2444	148.2617	Ripstone Creek	Upper Isaac
Peak Downs Coal Mine	BMA	DMP5	PEAKCM-DMP5	RE	ds	-22.2424	148.2419	Ripstone Creek	Upper Isaac
Peak Downs Coal Mine	BMA	UMP3	PEAKCM-UMP3	RE	us	-22.226	148.1555	Ripstone Creek	Upper Isaac
German Creek Coal Mine	Anglo American	DMP7	GERMCM-DMP7	RE	ds	-23.057	148.888	Roper Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP5	LLINCM-DMP5	RE	ds	-23.057	148.888	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	DMP2	FOXLCM-DMP2	RE	ds	-23.057	148.8881	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	SMP2	FOXLCM-SMP2	REMP only	ds	-23.0162	148.8201	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	DMP1	FOXLCM-DMP1	RE	ds	-23.016	148.8198	Roper Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP4	GERMCM-DMP4	RE	ds	-23.016	148.819	Roper Creek	Mackenzie
Lake Lindsay Coal Mine	Anglo American	DMP2	LLINCM-DMP2	RE	ds	-23.016	148.819	Roper Creek	Mackenzie
German Creek Coal Mine	Anglo American	DMP3	GERMCM-DMP3	RE	ds	-22.95	148.878	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	SMP8	MIDDCM-SMP8	REMP only	ds	-22.8925	148.7087	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	DMP1	MIDDCM-DMP1	RE	ds	-22.8766	148.6718	Roper Creek	Mackenzie
Foxleigh Coal Mine	Middlemount South	UMP1	FOXLCM-UMP1	RE	us	-22.8762	148.6719	Roper Creek	Mackenzie
German Creek Coal Mine	Anglo American	UMP1	GERMCM-UMP1	RE	us	-22.876	148.6713	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	SMP4	MIDDCM-SMP4	REMP only	ds	-22.8748	148.6586	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	SMP5	MIDDCM-SMP5	REMP only	us	-22.8597	148.6348	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	SMP6	MIDDCM-SMP6	REMP only	us	-22.8597	148.6142	Roper Creek	Mackenzie
Middlemount Coal Mine	Middlemount/Ribfield	UMP1	MIDDCM-UMP1	RE	us	-22.8594	148.6324	Roper Creek	Mackenzie

Coal Mine Facility	Company Names	Monitoring Point Code	MP ID	Monitoring Point Type	Type	Latitude	Longitude	Stream Name	Sub-Basin
Isaac Plains Coal Mine	Stanmore	DMP3	ISAACM-DMP3	RE	ds	-21.977	148.1132	Smoky Creek or Smokey Creek	Upper Isaac
Isaac Plains Coal Mine	Stanmore	UMP1	ISAACM-UMP1	RE	us	-21.9631	148.1308	Smoky Creek or Smokey Creek	Upper Isaac
Broadlea North Coal Mine	Fitzroy Resources Australia	DMP1	BRONCM-DMP1	RE	ds	-21.9384	148.1648	Smoky Creek or Smokey Creek	Upper Isaac
Broadlea North Coal Mine	Fitzroy Resources Australia	SMP1	BRONCM-SMP1	REMP only	ds	-21.9111	148.1857	Smoky Creek or Smokey Creek	Upper Isaac
Broadlea North Coal Mine	Fitzroy Resources Australia	UMP1	BRONCM-UMP1	RE	us	-21.9021	148.1913	Smoky Creek or Smokey Creek	Upper Isaac

Table 11. List of all indicators identified for all facilities and coal mines with authorised releases to water.

Water Quality Indicator	Number of Monitoring Points (all facilities)	Number of Coal Mine Monitoring Points
Acidity	29	29
Aluminium	15	11
Aluminium - Dissolved	612	486
Aluminium - Total	571	460
Ammonia	83	83
Ammonia as N	526	387
Antimony	7	3
Antimony - Dissolved	40	29
Antimony - Total	42	29
Arsenic	4	
Arsenic - Dissolved	532	423
Arsenic - Total	478	384
B.O.D. 5	14	1
Barium - Dissolved	60	49
Barium - Total	65	51
Benzene	46	43
Benzo(a)anthracene	3	
Benzo(a)pyrene	3	
Benzo(b+j)fluoranthene	3	
Benzo(k)fluoranthene	3	
Beryllium	2	
Beryllium - Dissolved	26	26
Beryllium - Total	39	28
Bicarbonate	16	5
Bisphenol A	3	
Boron	3	
Boron - Dissolved	554	442
Boron - Total	511	403
Bromide - Total	3	
Bromochloroacetonitrile	1	
Bromodichloromethane	1	
Bromoform - Total	2	
BTEX	5	5
Cadmium	4	
Cadmium - Dissolved	546	435
Cadmium - Total	498	405
Calcium	65	46
Calcium Carbonate	7	3
Carbonate	16	5
Chloride	60	42
Chloride - Total	3	
Chlorine	7	7
Chlorine - Total	17	
Chloroform	1	
Chlorophyll a	48	34
Chromium	15	11
Chromium - Dissolved	579	484
Chromium - Total	561	468
Chromium (total) - Dissolved	14	
Chromium VI - Dissolved	13	
Chromium VI - Total	6	
Chrysene	3	
Cobalt	4	
Cobalt - Dissolved	527	418
Cobalt - Total	475	385
Copper	15	11

Water Quality Indicator	Number of Monitoring Points (all facilities)	Number of Coal Mine Monitoring Points
Copper - Dissolved	640	514
Copper - Total	592	484
Cyanide - Total	3	
Cyanide (HCN as CN)	33	
Cyanobacteria	11	
Cyanobacteria Biovolume	11	
D.O.	98	68
D.O. % Deficit	11	
D.O. % Saturation	237	190
Daily Reuse Volume	1	
Daily Volume	229	195
Dibenzo(a,h)anthracene	3	
Dibromochloromethane	1	
Dichloroacetonitrile	1	
Dissolved Organic Carbon	15	
Dissolved Solids - Total	100	61
E.Coli	1	
Electrical Conductivity	767	622
Enterococci	5	
Ethylbenzene	28	25
Faecal Coliforms	5	1
Filterable Reactive Phosphorus	55	40
Flow - Instantaneous	288	254
Fluoride	77	57
Fluoride - Total	440	347
Free Residual Chlorine	5	1
Gallium - Dissolved	35	24
Gallium - Total	35	24
Hardness	162	116
Hydrocarbon - Total	27	24
Hydrocarbons (>C10-C16)	46	46
Hydrocarbons (>C10-C16) minus Naphthalene	7	7
Hydrocarbons (>C10-C40)	95	95
Hydrocarbons (>C16-C34)	46	46
Hydrocarbons (>C34-C40)	46	46
Hydrocarbons (C10-C14)	82	81
Hydrocarbons (C10-C16)	8	8
Hydrocarbons (C10-C36)	555	470
Hydrocarbons (C10-C40)	8	8
Hydrocarbons (C15-C28)	77	76
Hydrocarbons (C16-C34)	8	8
Hydrocarbons (C29-C36)	77	76
Hydrocarbons (C34-C40)	8	8
Hydrocarbons (C6-C10)	80	80
Hydrocarbons (C6-C10) minus BTEX	14	14
Hydrocarbons (C6-C9)	554	468
Hydrogen Sulfide (as S)	15	
Hydroxide	16	5
Indeno(1,2,3-cd)pyrene	3	
Iodide	3	
Iron	4	
Iron - Dissolved	550	439
Iron - Total	535	429
Lead	4	
Lead - Dissolved	528	417
Lead - Total	493	400
Magnesium	65	46
Manganese	4	

Water Quality Indicator	Number of Monitoring Points (all facilities)	Number of Coal Mine Monitoring Points
Manganese - Dissolved	526	419
Manganese - Total	482	389
Mercury	4	
Mercury - Dissolved	537	426
Mercury - Total	495	402
Mercury (inorganic) - dissolved	3	3
Mercury (inorganic) - total	3	3
Meta & Para-Xylene	5	5
Meta-Xylene	20	20
Molybdenum	9	3
Molybdenum - Dissolved	557	452
Molybdenum - Total	524	416
Naphthalene	25	25
NDMA	1	
Nickel	13	11
Nickel - Dissolved	560	449
Nickel - Total	519	426
Nitrate	74	70
Nitrate as N	520	412
Nitrate as NO3	12	10
Nitrite	12	12
Nitrite as N	92	81
Nitrite as NO2	2	
Nitrogen - Dissolved	3	3
Nitrogen - Org. - Total	29	29
Nitrogen - Oxidised	67	64
Nitrogen - Total	126	95
Nitrogen - Total - Kjeldhal Method	42	42
Nonylphenol	3	
Nutrients	5	5
Oil & Grease	3	
Ortho-Ph - Total	24	24
Ortho-Xylene	25	25
Oxidation Reduction Potential	31	31
pH	772	614
Phosphorus - Dissolved	3	3
Phosphorus - Total	112	86
Polycyclic Aromatic Hydrocarbons	3	
Potassium	54	41
Radiation - Alpha - Total	3	
Radiation - Beta - Total	3	
River Height	4	4
Selenium	15	11
Selenium - Dissolved	579	453
Selenium - Total	528	420
Silica - Dissolved	11	
Silica - Total	11	
Silver - Dissolved	531	426
Silver - Total	488	396
Sodium	318	280
Sodium - Total	9	9
Sodium Adsorption Ratio	12	
Strontium - Dissolved	11	
Strontium - Total	14	
Sulphate	697	561
Sulphur	5	5
Sum of Anions	24	24
Sum of Cations	24	24

Water Quality Indicator	Number of Monitoring Points (all facilities)	Number of Coal Mine Monitoring Points
Suspended Solids	680	536
Temperature	292	234
Thermotolerant coliforms	1	
Toluene	28	25
Total Alkalinity	68	56
Total Organic Carbon	15	
Total Residual Oxidant (as Cl)	2	
Trihalomethanes	1	
Turbidity	520	435
Uranium	15	11
Uranium - Dissolved	597	492
Uranium - Total	568	463
Vanadium	4	
Vanadium - Dissolved	543	438
Vanadium - Total	526	418
Xylene - Total	8	5
Zinc	15	11
Zinc - Dissolved	612	485
Zinc - Total	577	469

Table 12. List of indicators used in the Fitzroy Basin report card and included in the draft Integrated REMP report.

Category	Indicator
Physical Chemical	Electrical Conductivity (low flow) (µS/cm)
	Electrical Conductivity (high flow) (µS/cm)
	Turbidity (NTU)
	pH
	Sulfate (mg/L)
Nutrients	Total Nitrogen (mg/L)
	Oxidised Nitrogen (mg/L)
	Total Phosphorus (mg/L)
	Reactive Phosphorus (mg/L)
Ecology	Macroinvertebrates
	Fish
Toxicants	Arsenic (µg/L)
	Aluminium (µg/L)
	Boron (µg/L)
	Cadmium (µg/L)
	Chromium (µg/L)
	Cobalt (µg/L)
	Copper (µg/L)
	Iron (µg/L)
	Lead (µg/L)
	Manganese (µg/L)
	Mercury (µg/L)
	Molybdenum (µg/L)
	Nickel (µg/L)
	Uranium (µg/L)
	Zinc (µg/L)
	Selenium (µg/L)
	Silver (µg/L)