Ulan Coal Mine - Aquatic Monitoring

Spring 2016

Prepared for
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Project Manager	Rachel Murray 02 4302 1231 Unit 1, Level 1, 79 Market Street, Mudgee NSW 2850
Prepared by	Lindsey Frost, Jessica Southgate
Reviewed by	Rachel Murray, Peter Hancock
Approved by	Daniel Magdi
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Contents

List of figures

List of tables

Abbreviations

Abbreviation	Description
ANZECC	Australian and New Zealand Environment and Conservation Council
BIS	Bobadeen Irrigation Scheme
DoE	Department of the Environment & Energy
DP&E	Department of Planning & Environment
ELA	Eco Logical Australia
GCAA	Glencore Coal Assets Australia
LGA	Local Government Area
MOD1	Modification 1
MOD2	Modification 2
MOD3	Modification 3
MWRC	Mid-Western Regional Council
OMP	Offset Management Program
PA	Project Approval
RARC	Rapid Appraisal of Riparian Condition

RCE	Riparian, Channel and Environmental inventory
SWMP	Surface Water Management Program
UCML	Ulan Coal Mines Limited

Executive summary

This Aquatic Monitoring Report was prepared by Eco Logical Australia (ELA) on behalf of Ulan Coal Mines Limited (UCML). The Ulan Mine Complex is situated in the central west of New South Wales near the village of Ulan; approximately 38 kilometres north-northeast of Mudgee. UCML operates the mine as a joint venture between Glencore Coal Assets Australia (GCAA) and Mitsubishi Development.

In 2010, the NSW Department of Planning and Environment issued Project Approval (PA 08_0184) for continued operations of Ulan Coal Mine. As a requirement of this approval, UCML developed a Biodiversity Management Plan which outlines the management, monitoring and reporting activities needed to satisfy approval specifications.

This is the first Aquatic Monitoring Report prepared by ELA for UCML. The report outlines results from surveys conducted in spring 2016, and makes comparisons to data from previous monitoring reports prepared by Biodiversity Monitoring Services (2012; 2013a; 2013b; 2014 and 2015).

Our results indicate that aquatic macroinvertebrate communities and riparian areas are in a moderate to highly disturbed states, consistent with historical regional land use practices. In comparison to previous monitoring data, no substantial decline is observed. The report also highlights some potential concerns with water quality parameters at a number of sites. Ongoing monitoring to follow these trends and potentially identify the cause and possible avoidance or mitigation measures is recommended.

1 Introduction

1.1 Ulan Coal Mines

The Ulan Mine Complex 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; approximately 38 kilometres north-northeast of Mudgee and 19 kilometres northeast of Gulgong. Ulan Coal Mines Limited (UCML) operates the mine as a joint venture between Glencore Coal Assets Australia (GCAA) and Mitsubishi Development.

UCML owns or has long term leases over most of the land that will be subject to mining activities and required for surface infrastructure. The area is primarily surrounded by rural landholdings, native vegetation and primary industries including agriculture, forestry, and mining (including other coal mining operations). UCML is located in the upper catchments of the Goulburn and Talbragar Rivers.

Project Approval (PA 08_0184) was issued by NSW Department of Planning and Environment (DP&E), on 15 November 2010 for continued operations. PA 08_0184 authorises current and proposed mining of the Ulan Mine Complex for the next 21 years, and production of up to 20 Mtpa (million tonnes per annum) of product coal. PA 08_0184 has been modified several times since 2010, with the latest modification (Ulan West Modification (southern extension)) approved in March 2016.

1.2 Biodiversity Management Plan

UCML developed a BMP to fulfil the requirements of Condition 44, Schedule 3 of PA 08_0184 and to satisfy the requirements of the Commonwealth Department of the Environment and Energy (DotEE) Approval (EPBC Ref: 2009/5252).

The purpose of the BMP is to describe the ecological management strategies, procedures, controls and monitoring programs and associated reporting that are to be implemented for the management of flora and fauna within the Project Area.

The BMP represents the framework for the overall Biodiversity Management Structure. As part of this structure, the Integrated Mining Operations Plan (ULN SD PLN 0079), Offset Management Program (OMP) (Appendix B of OMP) and Bushfire Management Plan (ULN SD ANN 0053) were developed to support the implementation of the BMP.

As part of the BMP, a comprehensive aquatic monitoring program was developed to assess the performance of biodiversity management measures, and determine the ecological condition of creeks on-site.

During spring 2016, aquatic ecology monitoring was undertaken at 13 sites along four creeks (Mona, Cockabutta, Bobadeen and Ulan Creeks) and two rivers (Talbragar and Goulburn Rivers) in the Project Area.

This report provides details of the aquatic taxa and ecological communities present in the Project Area and will be used to suggest improvements to management actions across the Project Area in relation to management of aquatic ecology.

1.3 Surface Water Management Program

UCML developed a Surface Water Management Program (SWMP) to fulfil the requirements of Condition 34, Schedule 3 of PA 08_0184. Implementation of the SWMP also satisfies the requirements of Development Approval (DA) 113-12-98, and Subsidence Management Plan (SMP) approvals.

This SWMP has been developed to ensure compliance with the conditions of PA 08_0184. The SWMP details the program for UCML to measure and assess changes in stream health (including base flows) and channel stability that could be attributable to the mining activities at UCML and establishes the monitoring and reporting requirements to enable water quality and quantity trends to be reported against UCML's Environment Protection Licence (EPL) 394 conditions.

2 Methodology

2.1 Field survey

Aquatic monitoring surveys were undertaken by ELA ecologists Ben Martin and David Allworth between 29 November 2016 and 2 December 2016. Weather conditions during the monitoring was fine and sunny, with air temperatures ranging from 18°C to 30°C.

2.1.1 Survey sites

The Ulan Mine Complex is situated at the heads of the Goulburn River, which drains eastward from the Great Dividing Range towards the coast; and the Talbragar River which drains west into the Murray Darling Basin.

The sites originally designated for long term monitoring (Biodiversity Monitoring Services 2012) were comprised of two sites at the head of the Talbragar River (AQ16 and AQ17) and sixteen sites from four creeks in the Goulburn River catchment and in the Goulburn River itself (AQ1 – AQ15 plus AQ18). Sampling at site AQ19 in the Goulburn River at The Drip commenced in 2012. In 2016, AQ20 was established as an appropriate reference site for the Goulburn River, AQ21 was established to allow monitoring of the Goulburn River Trial Remediation Area.

Monitoring at sites AQ3, AQ4, AQ9 and AQ10 in the Ulan Creek has been discontinued. Baseline data at these sites was deemed to be sufficient, and UCML sought to reduce the number of monitoring sites in the Ulan reek as underground mining is moving away from this area. Monitoring of site AQ1 in the Goulburn River was discontinued as the site was not considered to be an appropriate reference site for the other Goulburn River monitoring locations downstream, the site was replaced by AQ20.

Aquatic sites AQ16 and AQ17 were again not monitored during spring 2016 due to agricultural activities on adjacent land which prevented access. Fish trapping was only undertaken at sites AQ6, AQ11 and AQ15 due to the lack of suitable habitat at other sites, or the risk of theft and vandalism.

A brief description of the sites monitored in 2016 is given in Table 1 and shown in Figure 1.

Table 1: Survey Site Details

Site ID	Easting	Northing	Water course	General Description	Year monitoring commenced
AQ2	761058	6428704	Goulburn River	Beside Ulan Coal Mine in a channelized section of River	2003
AQ5	760300	6429716	Ulan Creek	Ulan Creek behind Rowan's Dam	2003
AQ6	761185	6430521	Goulburn River	Relatively undisturbed stretch of River	2003
AQ7	762068	6431195	Goulburn River	Relatively undisturbed stretch of River	2003
AQ8	756754	6431647	Ulan Creek	Ulan Creek at Old Ulan Hotel site	2006
AQ11	758309	6436142	Ulan Creek	Ulan Creek at series of rock pools in paddock	2006

Site ID	Easting	Northing	Water course	General Description	Year monitoring commenced
AQ12	751646	6436586	Cockabutta Creek	Series of pools in disturbed land on Wonga Roo Road	2011
AQ13	761793	6436977	Bobadeen Creek	Pools in Creek in grazed paddocks	2011
AQ15	754595	6439685	Mona Creek	Large pool in Creek in cleared paddock	2011
AQ18	762769	6432121	Goulburn River	River near The Drip parking area	2003
AQ19	763811	6432556	Goulburn River	River at The Drip	2012
AQ20	757703	6424647	Sportsmans Hollow Creek (upstream of Goulburn River)	Sportsmans Hollow creek access via gate opposite Flannery house	2016
AQ21	761271	6426461	Goulburn River	Goulburn River Trial remediation area	2016

2.1.2 Aquatic macroinvertebrates

A 100 m reach of river or creek was selected at each site for macroinvertebrate sampling. Within the reach, a 10 m composite of riffle and edge habitat was sampled for macroinvertebrates. Macroinvertebrate communities were sampled using the AUSRIVAS protocol at all sites. This involved dislodging macroinvertebrates in riffles by kicking the substrate and allowing flow to carry disturbed macroinvertebrates into the collection net. In edge or pool habitats, the collection net was used to disturb the benthos and/or aquatic vegetation and then swept through the water column to collect dislodged macroinvertebrates. Suitable edge habitats for sampling include backwaters with abundant benthic leaf-litter, fine organic/silt deposits, macrophyte beds, overhanging banks and areas with trailing bank vegetation (Turak et al. 2004).

Macroinvertebrate samples were live-sorted in the field for a minimum of 40 minutes. If new taxa were collected in the period between the 30th and 40th minutes, sorting continued for an additional 10 minutes, for a maximum sorting time of 60 minutes. Sorting stopped if no additional taxa were found. Specific care was taken to ensure cryptic, fast moving taxa were represented. Picked specimens were preserved in jars with 70% ethanol solution and transported to the laboratory for identification.

Macroinvertebrates were identified in the laboratory using a Leica M80 stereo microscope. Taxa were identified to family level, with the exception of Ostracoda and Cladocera (to order), Platyhelminthes (to phylum) and Copepoda (to subclass).

To make an assessment of macroinvertebrate species richness, richness from the current sampling period for each site was compared to richness reported for each site in previous monitoring reports.

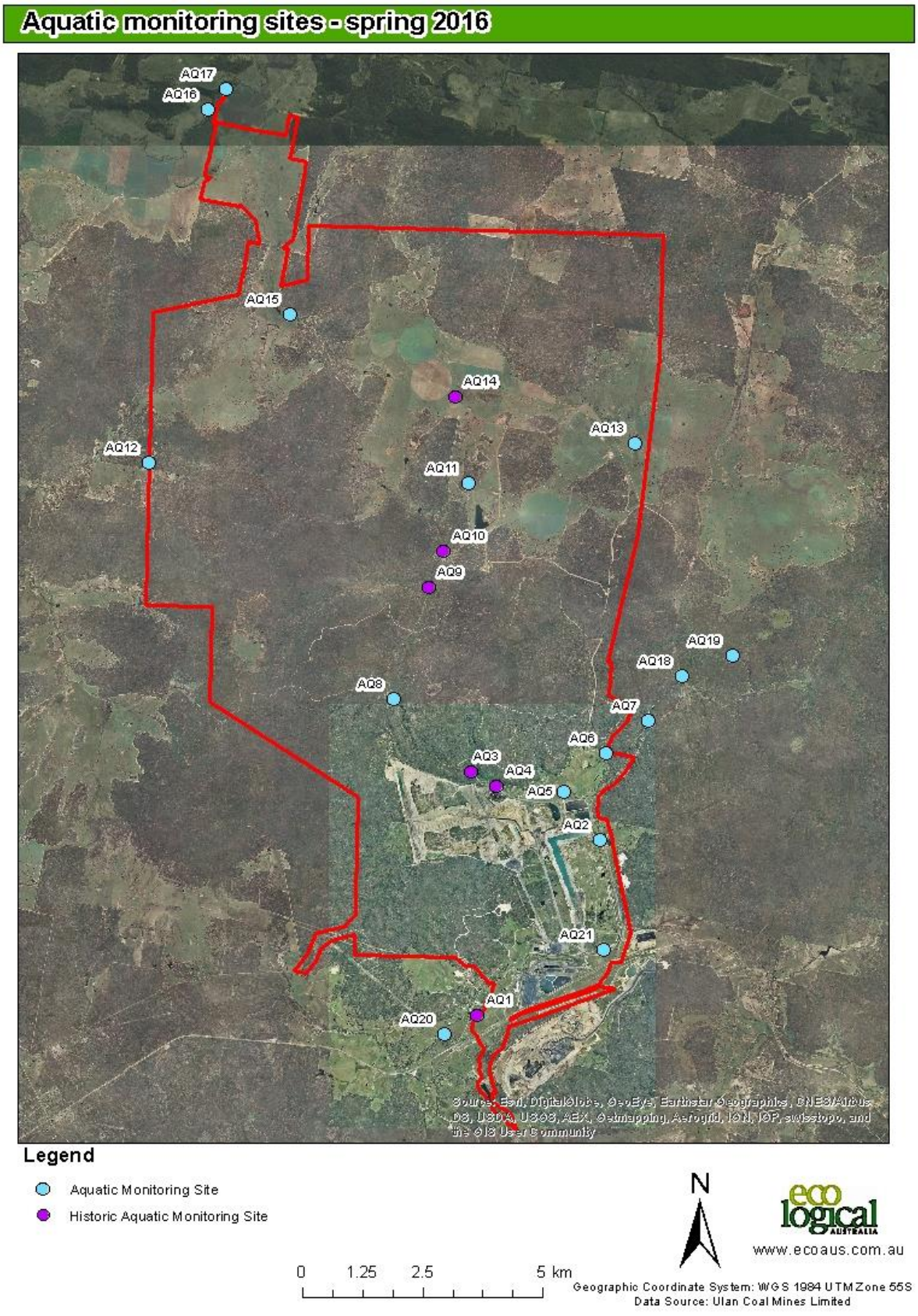

Figure 1: Survey site locations

2.1.3 Riparian Habitat Assessment

Riparian habitat assessment was undertaken using two indices – a version of the Riparian, Channel and Environmental (RCE) inventory (Peterson 1992) that was modified for Australian conditions (Chessman et al. 1997), and the Rapid Appraisal of Riparian Condition (RARC) developed by Charles Sturt University (Jansen et al. 2003) and later updated (Jansen et al. 2008).

Data for the RARC index was collected by conducting four transects through the riparian zone perpendicular to the stream bank within a 200 m longitudinal section of stream. Attributes recorded include riparian vegetation width and structure, ground cover type and the presence of hollow bearing trees and fallen logs.

Data for the RCE index was collected from the same 100 m stretch of stream in which the macroinvertebrate samples were collected. Attributes measured include in-stream vegetation structure, bank and streambed structure and condition, riparian vegetation width and condition and surrounding land use.

2.1.4 Water quality

Water quality parameters including dissolved oxygen (DO) (% saturation and mg/L), pH, electrical conductivity (EC), temperature, turbidity and alkalinity were recorded at each site using water quality, turbidity and alkalinity probes (Table 2). Water for samples was collected from areas where surface films were absent or removed by disturbance prior to sampling. Approximately 10 L was collected from these areas from the lower water column to a maximum depth of approximately 50 cm. This water was allowed to settle for approximately 2 minutes with probes in place prior to taking readings.

Table 2: Water quality attributes measured and equipment used

Parameter	Instrument	Unit of Measurement
Temperature	YSI-556 Multi-parameter Meter	°C
EC	YSI-556 Multi-parameter Meter	µS/cm
DO (%)	YSI-556 Multi-parameter Meter	% Saturation
DO (mg/L)	YSI-556 Multi-parameter Meter	mg/L
pH	YSI-556 Multi-parameter Meter	n/a
Turbidity	Hach 2100Q Portable Turbidimeter	NTU
Alkalinity	Hanna HI755 Alkalinity Colorimiter	ppm

2.1.5 Opportunistic Sightings of Significant Fauna

Opportunistic sightings of significant threatened or migratory fauna including waterbirds, mammals and reptiles were recorded during surveys. General searches for evidence of *Hydromys chrysogaster* (Water Rat); and *Ornithorhynchus anatinus* (Platypus) (e.g. sightings, burrows, scats, etc) were also conducted at each site.

2.1.6 Other Vertebrates and Crustaceans

Fish were sampled using small fyke nets with 60 cm diameter and 5 m single wing (AQ15 and AQ6) and shrimp nets (AQ11 only). These were set in the late afternoon between 3pm and 5pm and collected as early as possible the following morning. Fish and crustacean trapping was not conducted at any other sites due to a lack of suitable habitat for deployment.

2.2 Monitoring Indices

2.2.1 Stream Invertebrate Grade Number-Average Level

To make an assessment of the ecological health of each site, SIGNAL2 scores were calculated for the macroinvertebrate community occurring at each site. SIGNAL2 is a biotic index that allocates a value to each macroinvertebrate taxon based upon their sensitivity to disturbance. A SIGNAL2 score of 10 indicates high sensitivity and a SIGNAL2 score of 1 indicates low sensitivity. The SIGNAL2 score for the entire site is determined by calculating the mean SIGNAL2 scores from all taxa present. SIGNAL2 scores are used to grade water quality into the following categories:

- SIGNAL2 Score >6: Healthy habitat
- SIGNAL2 Score 5-6: Mild disturbance
- SIGNAL2 Score 4-5: Moderate disturbance
- SIGNAL2 Score <4: Severe disturbance (Gooderham and Tsyrlin 2009)

2.3 RCE Inventory

The modified RCE (Chessman et al. 1997) has 13 descriptors, each allocated a score from 1 (most modified) to 4 (least modified). Descriptors include width and condition of the riparian zone, surrounding land use, extent of bank erosion, stream width, water depth, occurrence of pools, riffles and runs, sub-stratum type, presence of snags and woody debris, in-stream and emergent macrophytes, algae and barriers to fish passage. The total score for each site is derived by summing the score for each descriptor and calculating the result as a percentage of the highest possible score.

Sites with a high RCE score (up to 52, or 100%) indicate that the riparian zone is unmodified by human activity, while those with a low score have undergone substantial modification. Based on the classification established by Peterson (1992), site condition was rated as follows:

- RCE Score of 0-24%: Poor
- RCE Score of 25-43%: Fair
- RCE Score of 44-62%: Good
- RCE Score of 63-81%: Very Good
- RCE Score of 85-100%: Excellent

2.3.1 RARC

The RARC index consists of five sub-indices, each with several indicator variables that categorise condition:

- HABITAT – riparian habitat continuity and extent
- COVER – vegetation cover and structural complexity
- DEBRIS – standing dead trees and fallen logs and leaf litter
- NATIVES – dominance of native species versus exotic species
- FEATURES – extent of vegetation regeneration and damage

Data collected at each site were scored by sub-category and the score for each sub-category was summed to give a figure between 0 (extremely poor condition) to 50 (excellent condition). Based on the classification system established by Jansen et al. (2005) sites were then rated as follows:

- RARC Score of <25 Very Poor
- RARC Score of 25-30: Poor
- RARC Score of 30-35: Average

- RARC Score of 35-40: Good
- RARC Score of >40: Excellent

2.3.2 ANZECC

Water quality parameters measured during surveys were compared with the ANZECC (2000) guidelines for protection of aquatic environments. The ANZECC (2000) guidelines provide different ranges for upland and lowland streams, with upland streams being those above 150 m AHD altitude. All sites surveyed for this project are considered as upland river sites.

3 Results

3.1 Macroinvertebrates

Macroinvertebrate taxonomic richness was lower in 2016 (45) than in 2015 (51) (Table 3). Average SIGNAL2 scores for each site ranged from 3.3 (severe disturbance) to 5.8 (mild disturbance). Although these values are low, they represent a general overall improvement on 2015 scores and are comparable with those derived from previous years' monitoring (Figure 2). Pre-impact monitoring data exists from 2003 onwards (Biodiversity Monitoring Services 2011) but was not available for comparison to ascertain whether low SIGNAL2 scores relate to current activities or are within the long term 'normal' range for the region.

Table 3: Macroinvertebrate taxa collected at each site in spring 2016

Class	Sub-class/Order	Family	SIGNAL2 Score	AQ2	AQ5	AQ6	AQ7	AQ8	AQ11	AQ12	AQ13	AQ15	AQ18	AQ19	AQ20	AQ21
Turbellaria		Dugesiidae	2	x	x	x									x	Site not sampled due to unsuitable habitat
Gastropoda		Physidae	1	x			x		x			x				
Arachnida	Acarina		6			x	x		x	x	x					
Crustacea	Cladocera								x	x	x			x		
	Decapoda	Atyidae	3	x	x	x	x		x			x	x	x		
	Copepoda							x	x	x	x					
	Ostracoda				x	x	x						x			
Insecta	Coleoptera	Dytiscidae	2	x	x	x	x	x	x	x	x	x	x	x	x	
		Ptilodactylidae	10					x				x				
		Hydraenidae	3								x		x			
		Gyrinidae	4				x									
		Haliplidae	2									x				
		Elmidae	7						x		x		x			
	Diptera	Chironomidae	3		x		x		x	x				x	x	
		Simuliidae	5			x	x						x	x		
		Culicidae	1		x											
		Dolichopodidae	3					x								
	Ephemeroptera	Baetidae	5	x		x	x	x						x	x	

Class	Sub-class/Order	Family	SIGNAL2 Score	AQ2	AQ5	AQ6	AQ7	AQ8	AQ11	AQ12	AQ13	AQ15	AQ18	AQ19	AQ20	AQ21
		Leptophlebiidae	8		x	x	x	x					x		x	
	Hemiptera	Corixidae	2					x	x	x	x	x	x			
		Gelastocoridae	5					x								
		Notonectidae	1						x	x	x	x	x			
		Veliidae	3							x					x	
		Nepidae	3						x			x				
	Odonata	Hemicorduliidae	5	x	x				x	x		x	x		x	
		Libellulidae	4	x	x	x	x					x	x	x	x	
		Protoneuridae	4	x					x	x	x	x			x	
		Gomphidae	5			x	x						x	x		
		Aeshnidae	4				x									
		Telephlebiidae	9		x			x				x				
	Trichoptera	Leptoceridae	6		x		x	x	x	x		x	x		x	
		Philopotamidae	8		x	x	x	x								
		Calamoceratidae	7						x	x			x	x		
		Hydropsychidae	6				x						x	x		
		Hydroptilidae	4										x		x	
Average SIGNAL2 Score				3.3	4.6	4.8	5.0	5.8	3.8	3.9	3.6	4.0	4.5	4.4	4.2	-
Taxa richness				8	11	10	14	10	13	10	7	13	15	9	11	-

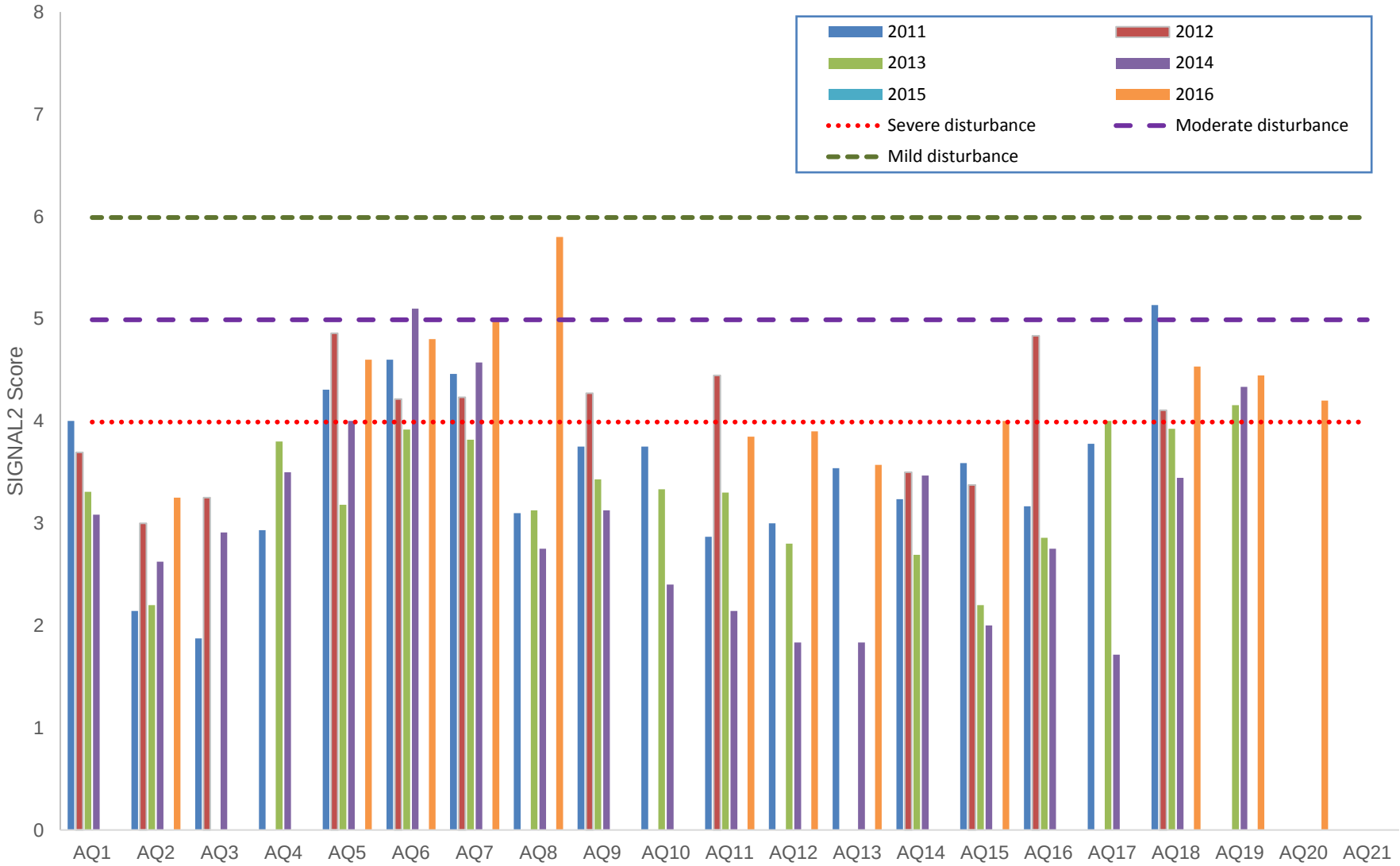

Figure 2: Average SIGNAL2 scores per site over time

3.2 Riparian habitat

3.2.1 River Channel Environment (RCE) Inventory

The RCE Inventory scores in spring 2016 were generally high, with all sites scoring in categories Good or above (refer Table 4). This is comparable with scores derived from previous years' monitoring (Figure 3). Generally, sites had improved scores in 2016 compared to previous years. A lack of raw data for each descriptor from previous years means that it is not possible to determine which site attributes are driving the observed changes. The 2016 data shows that the attributes considered furthest from a non-modified state are channel form, channel sediment accumulation and stream bottom. These attribute scores are generally lowest at sites located in cleared or disturbed areas and reflect the generally high level of erosion in the immediate catchment as noted in field observations.

Table 4: RCE scores for sites surveyed in spring 2016

	AQ2	AQ5	AQ6	AQ7	AQ8	AQ11	AQ12	AQ13	AQ15	AQ18	AQ19	AQ20	AQ21
1. Land use beyond riparian zone	3	2	4	4	3	4	4	2	2	4	4	3	3
2. Width of riparian strip	3	2	4	4	3	4	3	2	2	4	4	3	2
3. Completeness of riparian strip	3	3	4	4	3	4	4	1	1	4	4	2	1
4. Vegetation within 10 m of channel	4	4	4	4	4	4	4	4	1	4	4	4	3
5. Bank structure	3	3	4	4	3	3	4	3	2	4	4	2	2
6. Bank undercutting	1	4	4	4	2	2	4	3	2	3	4	2	1
7. Channel form	2	4	3	2	2	4	2	3	3	3	2	2	2
8. Riffle/pool sequence	1	2	4	4	2	4	2	2	2	4	4	2	1
9. In-stream retention devices	4	4	4	3	3	4	4	4	1	4	4	1	1
10. Channel sediment accumulation	1	4	3	3	2	1	1	2	1	3	3	1	1
11. Stream bottom	1	1	4	4	3	1	1	1	1	4	4	2	1
12. Stream detritus	3	4	4	4	3	3	3	3	3	4	4	3	3
13. Aquatic vegetation	2	2	1	4	4	4	4	4	4	1	3	2	2
Total	**31**	**39**	**47**	**48**	**37**	**42**	**40**	**34**	**25**	**46**	**48**	**29**	**23**
RCE (%)	**59.6**	**75**	**90.4**	**92.3**	**71.2**	**80.8**	**76.9**	**65.4**	**48.1**	**88.5**	**92.3**	**55.8**	**44.2**

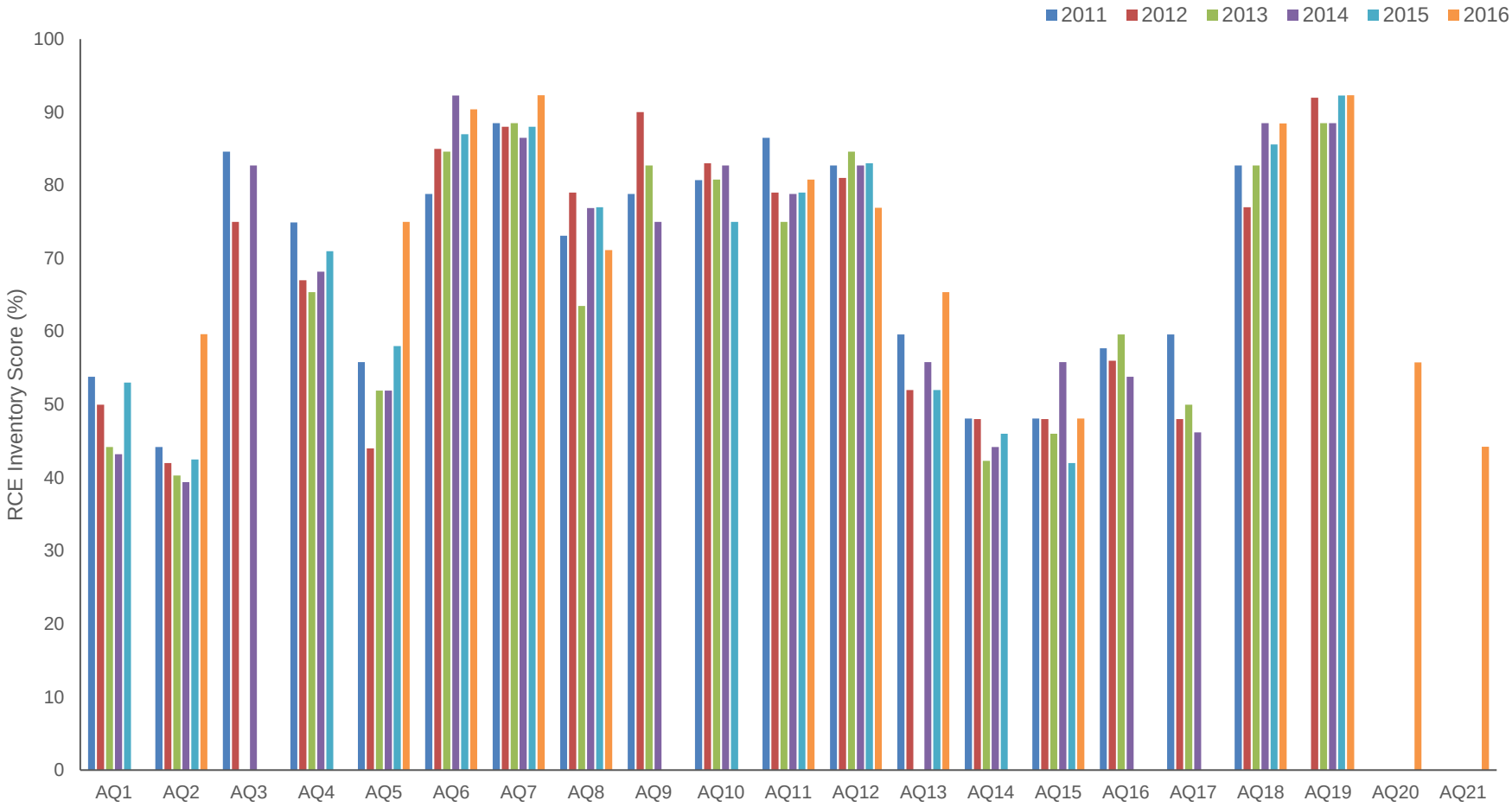

Figure 3: Comparison of RCE Inventory percentage scores across sites over time

3.2.2 RARC

RARC index scores were generally poor with all sites receiving a rating of average or below. Scores derived from 2016 monitoring were generally lower than those derived from previous years' monitoring (Figure 4), however changes in observer may account for some of this difference. For example, transects are undertaken on one bank only and it was not possible to ascertain from previous reports which bank was surveyed at each site in previous years.

These scores, despite being low, are not considered unusual in grazed or otherwise disturbed land such as the land surrounding sites AQ2, AQ13, AQ15 and AQ20. Scores for natives, cover and debris were generally quite low and likely reflect the disturbance history of the land around the survey sites.

Table 5: RARC scores for each site surveyed in spring 2016

Site	Habitat	Cover	Natives	Debris	Features	TOTAL
AQ2	1	0.25	2.25	2	2.75	8.25
AQ5	2	5.75	2.5	1	3.5	14.75
AQ6	9	10	5.75	3.75	4.25	32.75
AQ7	9	9.75	6.25	4	3.25	32.25
AQ8	10	7.25	3.75	4	1.75	26.75
AQ11	9	7	4	2.75	2.25	25
AQ12	9	7.5	4.5	5	2.5	28.5
AQ13	1.5	4.5	1.25	1	6.5	14.75
AQ15	1	4	1	0	0.25	6.25
AQ16	nd	nd	nd	nd	nd	-
AQ17	nd	nd	nd	nd	nd	-
AQ18	9	8.25	4.5	4.5	4.75	31
AQ19	9	8.5	5.25	5	4	31.75
AQ20	1	6	2.5	2.25	4.75	16.5
AQ21	1	6	2.5	2	3.75	15.25

Colours indicate categories as follows: Red = Very Poor; Orange = Poor and Yellow = Average

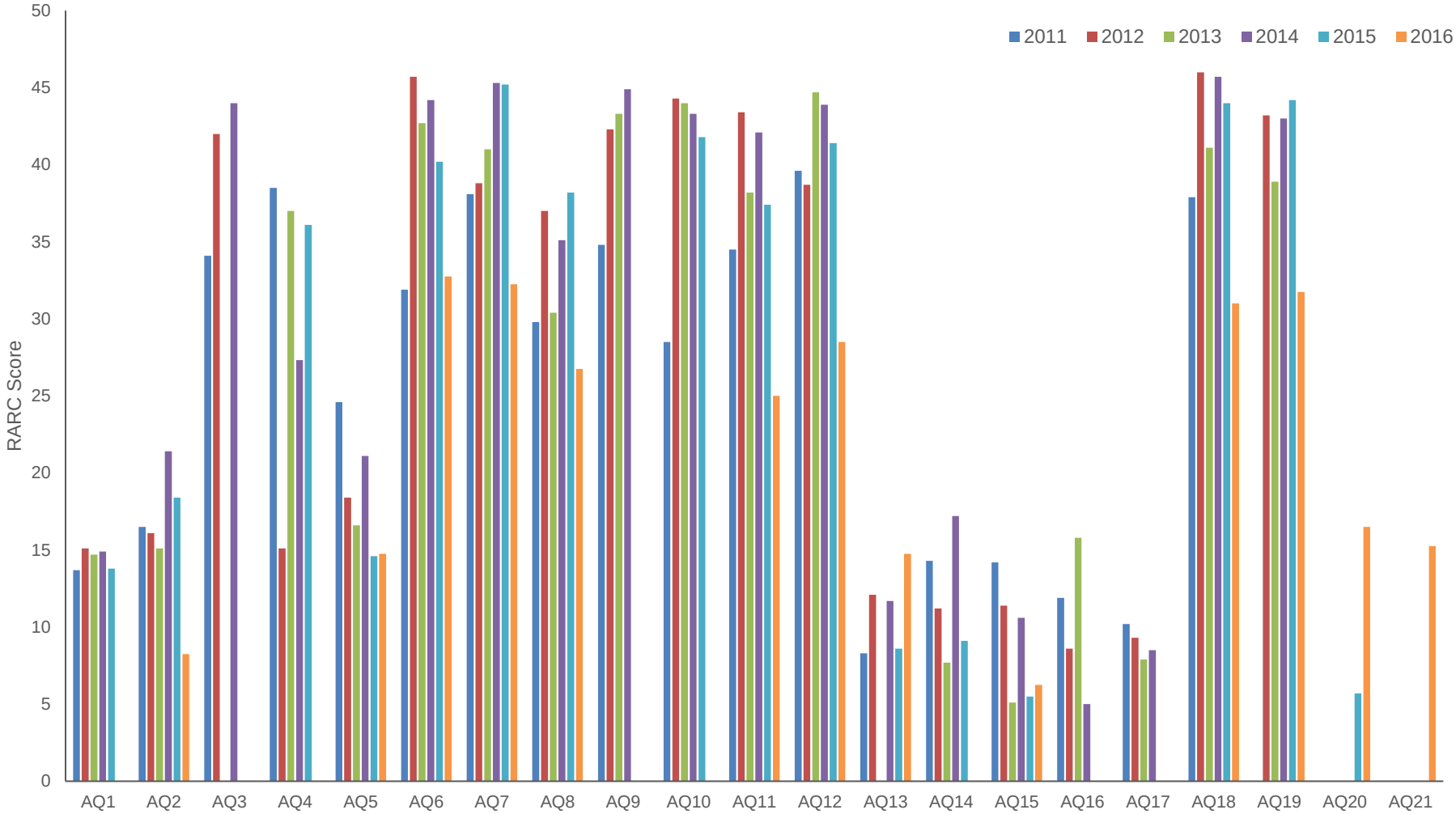

Figure 4: Comparison of RARC scores across sites over time

Condition estimates derived from the RCE and RARC indices differ markedly despite the indices apparently measuring similar attributes. The RARC index was initially derived as a tool to assess the impacts of grazing management practices and stocking rates (Jansen et al., 2005), and so focuses on vegetation community structure and composition, including an assessment of native vs exotic species presence. The RCE method however, has a strong focus on stream structural elements and provides a more generalised assessment of riparian vegetation structure. Additionally, the RCE method assesses overall riparian condition along a 100 m longitudinal section on both banks of the river/creek, whereas the RARC method focuses on four transects running perpendicular to the stream spaced within a 200 m longitudinal section of one bank only.

Condition scores from each index should not be compared against each other, but should be monitored separately over time to assess any observable trends in condition improvement or decline.

3.3 Water quality

Water quality trigger values have been provided within the Surface Water Monitoring Program for each of the catchments present onsite and for key water quality parameters. Where a trigger value for the key water quality parameter is unavailable, the ANZECC (2000) guideline was used for comparison.

At least one water quality parameter was outside the ANZECC (2000) guideline at every site surveyed in 2016 (Table 6). Dissolved oxygen saturation was particularly poor at sites AQ12 and AQ13 (the guideline sets 90% as the lower limit). Field notes for both sites note that flow was negligible and sediments had an anoxic odour. Both of these sites are drying pools in grazing paddocks and it is likely that a concentration of nutrients resulting from ongoing animal input and water level reduction, are producing low DO concentrations.

Measures of pH were generally within the range of the adopted trigger values for pH, although at the upper limit (range is 6.5 – 8.0).

Electrical conductivity, which is a measure of dissolved salts, was elevated above background (upstream) levels at almost all sites, however, none of the sites exceeded the adopted trigger value for Electrical Conductivity contained within the Surface Water Monitoring Program. The guideline value for salinity is within the Goulburn River catchment ranges between 680 upstream, to 854 downstream. Some of the highest readings occur in Ulan Creek and the Goulburn River into which it flows (Figure 5). Despite being high, these values are similar, and in some cases lower, than those recorded in previous years and may be indicative of natural conditions.

Sites AQ5, 6, 7, 8, 18 & 19 area located downstream of UCML EPL394 Licenced Discharge Points 6 and/or 19 which permit the release of water up to 900 µS/cm. These sites showed elevated salinity in comparison to other monitoring locations, however, the results were all in compliance with the adopted trigger values for key water quality parameters.

Table 6: Water quality results

Site	Date	Temp. (°C)	DO (% Saturation)	DO (mg/L)	EC (µS/cm)	pH	Alkalinity (mol/L)*	Turbidity (NTU)
AQ2	01/12/2016	20.5	97.6	8.76	756	7.81	68	0.6
AQ5	01/12/2016	22.4	69.9	6.06	613	7.24	129	5.58
AQ6	01/12/2016	19.2	94.9	8.75	739	7.60	114	1.1
AQ7	01/12/2016	18.4	93.9	8.82	746	7.56	99	2.98

Site	Date	Temp. (°C)	DO (% Saturation)	DO (mg/L)	EC (µS/cm)	pH	Alkalinity (mol/L)*	Turbidity (NTU)
AQ8	30/11/2016	22.3	97.6	8.48	708	8.02	274	23.9
AQ11	29/11/2016	27.6	86.5	6.83	160	7.08	62	11
AQ12	29/11/2016	20.7	25.5	2.26	159	7.12	36	18.2
AQ13	30/11/2016	22.2	39.4	3.41	385	7.28	144	130
AQ15	29/11/2016	26.2	83.8	6.71	310	7.23	112	12.8
AQ18	30/11/2016	26.9	101.2	8.07	754	7.87	99	1.36
AQ19	30/11/2016	26.7	101.3	8.07	753	7.87	101	1.78
AQ20	02/12/2016	20.8	60.2	5.36	136	7.42	46	18.5
AQ21	02/12/2016	17.8	63.1	5.99	606	7.46	129	7.64

* there are no guideline values for alkalinity

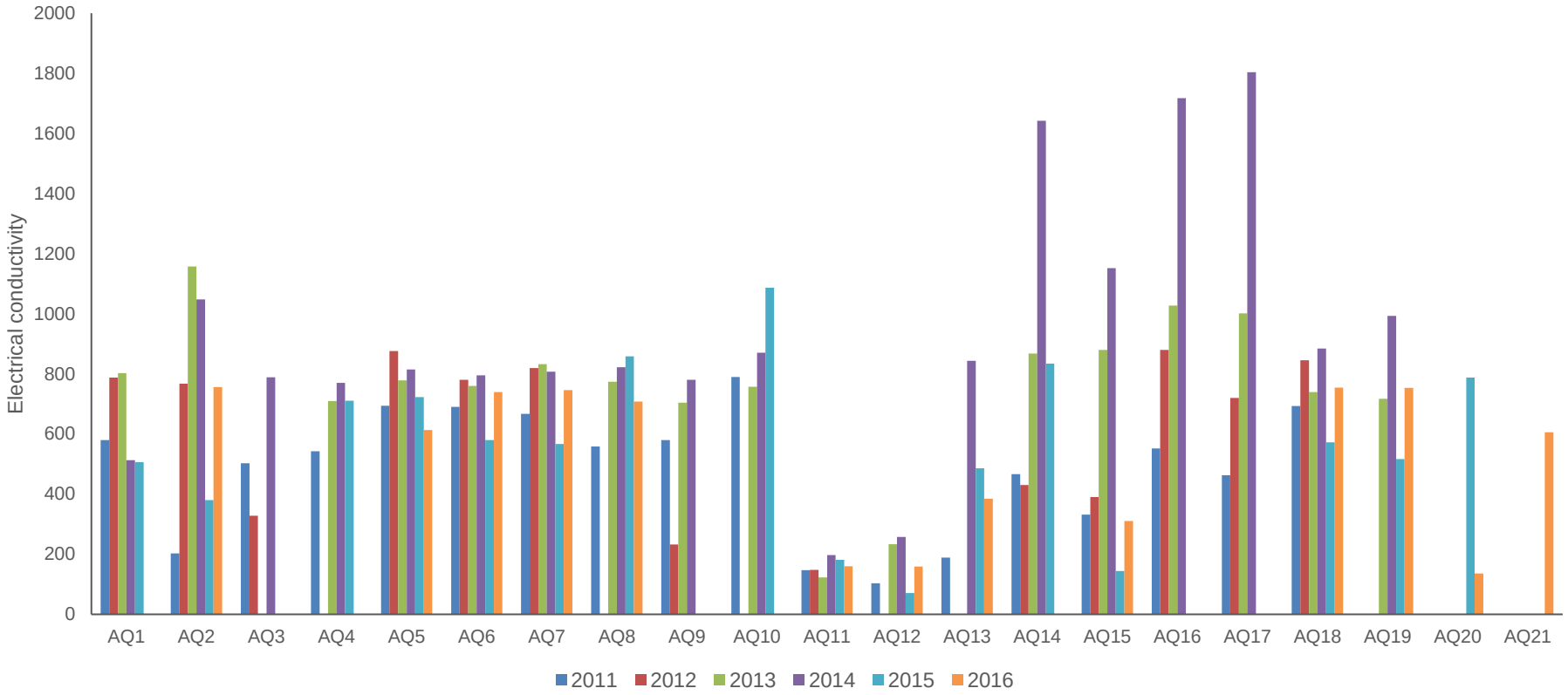

Figure 5: Electrical conductivity measures at each site over time

3.4 Other Vertebrates

Fish trapping occurred at sites AQ6, AQ11 and AQ15 (Table 7). The *Chelodina longicollis* (Eastern Long-neck Turtle), *Cherax destructor* (Yabbies), Carp and Gudgeon captured are all common, widespread species.

The *Tandanus tandanus* (Eel-tailed Catfish) was once widespread throughout south-eastern Australia, but is now in significant decline in the Murray-Darling Basin where the population has been declared as endangered in NSW. However, the species remains relatively common in coastal catchments from the Hunter River region north. The Eel-tailed Catfish was caught within the Goulburn River catchment and therefore does not form part of the endangered population.

Table 7: Fish Trapping Results

Site	Trap Type	No. of Traps	Species	No. of Species	Size (if applicable)
AQ15	Small fyke net	1	Eastern Long-neck Turtle	3	-
			Yabby	6	-
AQ11	Shrimp trap	2	No result	0	-
AQ6	Small fyke net	2	Eel-tailed Catfish	3	32 cm 38 cm 45 cm
			Carp	1	50 cm
			Gudgeon	1	15 cm

4 Recommendations and Conclusion

Results for all monitoring indices are generally unchanged from previous years, indicating that there is no observable ecosystem decline as a result of mining operations in 2016. Riparian condition scores are within the range of what is expected in grazed catchments and likely reflect the disturbance history of the land. SIGNAL2 scores are indicative of aquatic systems in a moderate to severely disturbed state which again may be a reflection of historical disturbance as much as disturbance from mining activities.

Water quality parameters are elevated against the adopted trigger values for key water quality parameters and the ANZECC (2000) guidelines. Data provided in previous reports show that these measurements are not isolated and it is likely that mine water inputs into the catchments, local geology and groundwater inputs may account for some elevated electrical conductivity. It is recommended that monitoring of water quality continues to ensure that there is no exceedance of water quality parameters within the catchments monitored.

Comparison of data from all monitoring years shows that there is inconsistency in the monitoring of sites which makes comparisons difficult in the long term. It is recommended that a review of survey sites be conducted prior to 2017 surveys. AQ16 and AQ17 appear to have problems with access and it is recommended that they are removed from the survey design and replaced with new sites where appropriate.

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ISO 14001 Environmental Management

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HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 9542 5622

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 9542 5622

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2685
F 02 9542 5622

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 9542 5622

BRISBANE
Suite 1, Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7192
F 07 3854 0310

1300 646 131
www.ecoaus.com.au

HUSKISSON
Unit 1, 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 9542 5622

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4302 1266
F 02 9542 5622

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1234
F 02 6372 9230

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1221
F 02 9542 5622

ADELAIDE
2, 70 Pirie Street
Adelaide SA 5000
T 08 8470 6650
F 02 9542 5622