Australia Pacific LNG Project
Supplemental information to the EIS

Aquatic Ecology - Pipeline Wet Season Survey

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Australia Pacific LNG Project

Results of the post-wet season pipeline survey

August 2010

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Australia Pacific LNG Project

Results of the post-wet season pipeline survey

August 2010

EXECUTIVE SUMMARY

This report presents the results of the post-wet season water quality and aquatic ecology surveys and provides a seasonal comparison between the dry season and post-wet season surveys for the Australia Pacific LNG Project. The purpose of the report is to provide additional information to support the Aquatic Ecology, Water Quality and Geomorphology Impact Assessment for the gas transmission pipeline provided in Volume 5, Attachment 18 of the EIS.

Post-wet season water quality, fish and macroinvertebrate surveys were conducted during April and May, 2010. Water quality was generally found to be poor to moderate throughout the study area and the majority of sites recorded high turbidity and suspended sediment, high nutrient concentrations and high concentration of aluminium and copper.

Species richness during the post-wet season survey was considerably less than the dry season survey. This was mainly due to site P1 on the Calliope River not being sampled during the post-wet season survey. This site had the highest diversity and abundance of all sites during the dry season survey. Species richness was similar between the dry and post-wet season surveys for sites in the Condamine-Balonne and Dawson catchments. Native fishes dominated the catch (> 95 %) in both dry season and post-wet season surveys.

Two species of conservation significance - the Fitzroy yellowbelly and Agassiz's glassfish, were caught at site P7 in the Dawson catchment during the post-wet season survey. Silver perch was the only species of conservation significance recorded in the Condamine-Balonne catchment during the post-wet season survey that was not recorded in the dry season survey. EIS Volume 5, Attachment 17 provides a description of the habitat requirements, sensitivity and conservation significance of silver perch. This species was considered as part of the impact assessment for the EIS (refer to Volume 5, Attachment 18), so its presence does not alter the outcomes of the assessment.

Macroinvertebrate taxa richness was lower at all sites during the post-wet season survey compared to the dry season survey. Macroinvertebrate composition varied between sites and sampling occasion and no seasonal trends were evident. The composition of the macroinvertebrate community generally indicated moderately degraded conditions, likely to be associated with high nutrient concentrations and poor aquatic and riparian habitat. The majority of sites were dominated by taxa with generalist food preferences and tolerating a range of flow and substrate conditions.

Overall, while the post-wet season sampling provided additional data to support the characterisation of the existing environment, nothing was observed or collected that resulted in any required amendments to the impact assessment undertaken for the EIS (refer to Volume 5, Attachment 18).

Given the dynamic nature of river systems throughout the survey region, these results only provided a snapshot of water quality and biological community structure at the time of sampling, particularly considering the seasonal extremes encountered during the survey periods. Further surveys would be required to confidently establish any seasonal and or inter-annual trends.

Australia Pacific LNG Project

Addendum to Aquatic Ecology, Water Quality and Geomorphology Impact Assessment – Gas Fields

August 2010

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1 INTRODUCTION

1.1 Background

The Environmental Impact Statement (EIS) for the Australia Pacific LNG Project was released for public comment and examination by government advisory agencies on March 29, 2010. The closing date for submissions was May 4, 2010. A technical report providing a detailed aquatic ecology, water quality, aquatic habitat and geomorphic impact assessment for the gas transmission pipeline was submitted as Volume 5, Attachment 18 of the EIS.

Water quality and aquatic ecology data for both dry and wet season were proposed to be included as part of the EIS. However, no significant rainfall events occurred prior to submission of the EIS, so only the dry season data were reported. Australia Pacific LNG was committed to undertaking additional wet season surveys, should a sufficient rainfall event occur.

Widespread rainfall and flooding occurred throughout the Project Area in early February 2010 and then again in early March 2010. To ensure suitable site access was available and to provide sufficient time for post-flooding species recruitment, the post-wet season surveys commenced in mid-April 2010.

This addendum report presents the results of the post-wet season water quality and aquatic ecology surveys and provides a seasonal comparison between the dry season and post-wet season surveys.

This report should be read in conjunction with the Aquatic Ecology, Water Quality and Geomorphology Impact Assessment for the gas fields provided in Volume 5, Attachment 18 of the EIS.

2 WET SEASON SAMPLING METHODS

2.1 Field Surveys

Post-wet season field surveys were undertaken between April 13, 2010 and May 5, 2010. A total of 9 sites were sampled, although not all variables could be sampled at each site due to different water levels and / or habitat availability. Sampling site locations are shown in Figure 2-1.

An additional two sites (P3CE12 on Pump Creek and P1 on the Calliope River) were unable to be accessed during the sampling period. Unfortunately, P1 was the only site located in the Calliope catchment. Therefore, data comparisons between dry season and post-wet season surveys were not possible for the Calliope catchment.

A summary of sampling dates and survey type for each site is provided in Table 2-1.

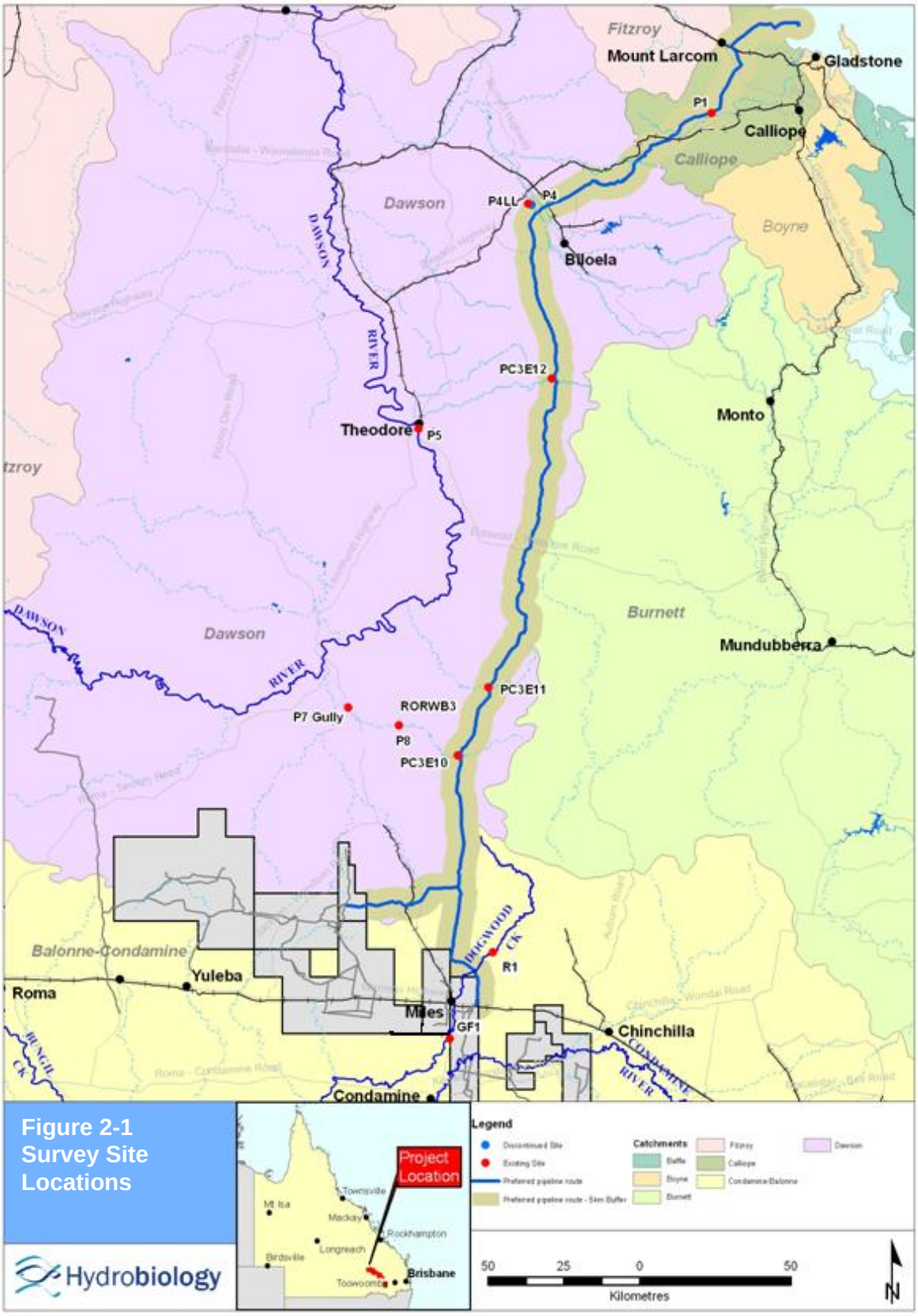

Figure 2-1 Survey Site Locations

Table 2-1 Overview of sample collection dates and survey type

Site	Waterway	Date sampled	WQ	Fish	Macro (edge)	Macro (Bed)	Comments
Condamine-Balonne Catchment							
GF1	Dogwood Creek	22/04/2010 and 23/04/2010	Y	Y	Y	No	Gill nets (25, 30, 40mm)
R1	Dogwood Creek	29/04/2010	Y	Y	Y	No	Gill nets (30, 35, 75mm), bait traps
Dawson Catchment							
P7	Juandah Creek	2/05/2010	Y	Y	Y	Y	Gill nets (30, 35, 70, 125mm), bait traps
P8	Bungaban Creek	3/05/2010	Y	Y	Y	No	Gill nets (25, 30, 40mm), bait traps
RORWB3	Adjacent to Bungaban Creek	3/05/2010	Y	No	Y	Y	Too shallow for fish sampling
P3CE10	Bungaban Creek	4/05/2010	Y	Y	Y	No	Gill nets (30, 40, 70, 125mm), bait traps
P3CE11	Cockatoo Creek	4/04/2010	Y	Y	Y	Y	Gill nets (25, 30, 40mm), bait traps
P5 (WQ)	Dawson River	5/05/2010	Y	No	No	No	WQ only at this site
P3CE12	Pump Creek	6/05/2010	No	No	No	No	No site access - was assumed dry
P4	Kroombit Creek	6/05/2010	Y	Y	No	Y	Gill nets (25, 30, 40mm), bait traps
Calliope Catchment							
P1	Calliope River	7/05/2010	No	No	No	No	No site access

2.2 Sample Collection, Storage and Preservation

Volume 5, Attachment 18 of the EIS contains a detailed description of sample collection, storage and preservation methods. Post-wet season sampling consisted of water quality, fish and macroinvertebrate surveys. No additional fluvial geomorphology or aquatic habitat assessments were undertaken during the post-wet season surveys. However, AUSRIVAS water quality and habitat field sheets were completed and site observations noted to provide additional information to support the water quality and aquatic ecology data collected.

In accordance with the methods used during the dry season surveys, fish sampling methods varied depending on the availability of suitable habitat at each site. Water levels were substantially higher than in 2009 at the majority of sites and a canoe was frequently required to facilitate sampling. The elevated water levels precluded the use of the electrofisher at most sites, so other methods such as gill netting, fyke netting and seine netting were employed, where necessary.

At some sites the higher water levels enabled more habitat to be sampled, using a wider range of sampling methods. This resulted in substantially higher catches and contributed to initial delays in the field program. Subsequently, sampling techniques were adjusted (e.g. reduced set times for bait traps and nets) to ensure sampling could be completed within schedule, while still producing sufficient catches to effectively characterise fish and macrocrustacean populations.

2.3 QA/QC

A detailed description of field and laboratory QA / QC methods is provided in EIS Volume 5, Attachment 18.

A summary of QA / QC issues encountered during the post-wet season surveys is provided below.

2.3.1 Water Quality

Inter and intra-lab duplicates were collected at 10% of sites. Field blanks and trip blanks were also collected. Normal laboratory duplicates, method blanks, single control spikes and duplicate control spikes were run for each analysis batch. All laboratory quality control measures were checked against the certificate of analysis to ensure data were within certified limits.

Some QA / QC issues encountered were easily resolved by re-analysis of retained samples. However, a number of issues were encountered for the post-wet season survey that were unable to be resolved.

A number of samples breached laboratory holding times. Results that exceeded laboratory holding times are highlighted in red in Appendix 1. The reasons for these breaches are summarised below:

- Samples collected for the analysis of TDS and TSS breached laboratory holding times for a number of sites (Appendix 1). Australian Laboratory Services (ALS) requires samples to be delivered with at least 50 % of the holding time remaining. ALS was responsible for the breach of holding time on six sites. However, due to delays in transit between site and laboratory, a number of samples were received with < 50 % of the holding time remaining;

- Samples collected for sites GF1, P8, P3CE10, RORWB3 and P7 spent considerable time in transit and were not received by the laboratory with sufficient time to analyse some parameters (i.e. TDS, TSS, major ions, FRP, pesticides and hydrocarbons) within recommended laboratory holding times. Given the scale of the holding time breach (five of the nine sites sampled), the data have not been discarded. However, data should be interpreted with caution;

- A number of holding time breaches for FRP were recorded by the laboratory, which was based on a 48 hour holding time. All nutrient samples were frozen in the field and delivered to the laboratory in eskies packed with ice. The majority of samples were delivered to the laboratory within 24 hours of despatch, so were presumed to be within the required holding times. However, one batch of samples was considerably delayed in transit (see above) and FRP samples had defrosted more than 48 hours prior to delivery.

Two sites (P4 and RORWB3) recorded elevated TPH concentrations in the post-wet season survey. However, as with the dry season survey, all TPH results were less than detection following an additional silica gel cleanup in the laboratory, again indicating that any TPH present was likely to have resulted from natural, biogenic sources.

2.3.2 Macroinvertebrates

Laboratory QA / QC checks were undertaken on 10 % of field collected residues. Laboratory QA / QC checks were undertaken on 10 % of field collected residues. In accordance with the Queensland sampling and monitoring manual (DERM 2009), error rates in intra-laboratory QA / QC of greater than 10% are considered unacceptable. However, there is no guideline on the acceptability of error rates in residue samples compared to those live picked in the field. There were between 2 and 12 additional taxa in residues compared to their associated live-pick sample. Some of the taxa are small and / or cryptic (e.g. Nematoda, Oligochaeta, Acarina, Tipulidae and Ephydridae) while others (e.g. Simuliidae and Glossiphoniidae) were present at low abundance and consequently had a very low probability of them being detected in the field. Anisoptera juveniles were present in two residues, but this was of little consequence as immature stages are excluded from most analyses, including AUSRIVAS.

The effectiveness of live-picking was judged to have little potential to influence the assessment of macroinvertebrate condition at the sites, in comparison to the lab picked residue samples.

3 WET SEASON SAMPLING RESULTS

This section provides the results obtained during the post-wet season field surveys as compared to the dry season surveys for water quality, fish and macrocrustaceans and macroinvertebrates.

3.1 Water Quality

3.1.1 Overview

Water quality samples were collected at 9 sites during the post-wet season survey. Raw water quality data and column charts comparing the two dry season (Dry 1 and Dry 2) and single post-wet season (Wet) surveys are provided in Appendix 1[1].

Data were compared to relevant ANZECC /ARMCANZ (2000) and Queensland Water Quality Guidelines (QWQG) (EPA 2009) (Appendix 1). Further details are provided in EIS Volume 5, Attachment 18.

In general, water quality was similar between sampling occasions with the majority of sites recording low to moderate turbidity and suspended solids, elevated nutrients, low conductivity and low dissolved oxygen.

No seasonal trends in temperature were evident between dry season and post-wet season surveys.

Pesticides were less than the laboratory detection limits at all sites on all sampling occasions. Two sites (P4 located on Kroombit Creek and RORWB3 an off river waterbody adjacent to Bungaban Creek) recorded total petroleum hydrocarbon (TPH) concentrations during the post-wet season surveys. However, these were found to be less than detection following a silica gel cleanup carried out in the laboratory. This indicated that any TPH present was likely to have resulted from natural biogenic sources (refer to EIS Volume 5, Attachment 18 for additional information).

Given the presence of intensive agriculture throughout the catchments, concentrations of pesticides would be expected to be higher immediately following runoff events. The lack of detectable concentrations of pesticides in the post-wet season survey was possibly a reflection of the lag time between the flooding events and sampling (approximately one month) and associated physical and chemical pesticides degradation processes (e.g. volatilisation, adsorption to soil particles, photodegradation etc).

3.1.2 Condamine-Balonne

Two sites were sampled in Condamine-Balonne catchment (GF1 and R1), both located on Dogwood Creek. Conductivity and pH were within the ANZECC / ARMCANZ (2000) for both sites during the post-wet season survey (Figures A1-2 and A1-3 in Appendix 1).

[1] Note: no data are presented for hydrocarbons or pesticides as all were below laboratory detection limits.

Turbidity exceeded the ANZECC / ARMCANZ (2000) at both sites on all sampling occasions (Figure A1-4 in Appendix 1). Dissolved oxygen concentrations were less than the QWQG at both sites and were considerably lower at site GF1 during the post-wet season survey (36.4 %), compared to the dry season surveys (60.2 % and 69.1 %, respectively) (Figure A1-5 in Appendix 1). The additional inputs of sediment and organic matter from recent inflows may have contributed to the reduced dissolved oxygen concentrations recorded at this site during the post-wet season survey.

Major cations and anions for sites GF1 and R1 showed a slight predominance of bicarbonate over chloride, and magnesium over potassium (Figure A1-8 in Appendix 1).

Total nitrogen, total phosphorus and nitrate + nitrite exceeded the ANZECC / ARMCANZ (2000) at both sites during the post wet season survey. However, all nutrient components were, in general, recorded in lower concentrations than those recorded during the dry season (Figures A1-9 to A1-14 in Appendix 1). Filterable reactive phosphorus marginally exceeded the ANZECC / ARMCANZ (2000) at site R1 (0.02 mg/L) during the post-wet season survey and was within QWQG for GF1. Ammonia was less than the ANZECC / ARMCANZ (2000) during the post-wet season survey. The low concentrations of ammonia and filterable reactive phosphorus and elevated total phosphorus, nitrate and nitrite indicated that sufficient oxygen was present at both sites during the post-wet season surveys to prevent reducing conditions at the sediment-water interface and subsequent release of orthophosphate and ammonia.

3.1.3 Dawson and Don

Water quality was sampled at seven sites in the Dawson and Don catchments during the post-wet season survey. Site RORWB3 (an off river waterbody adjacent to Bungaban Creek) was not sampled during the dry season so a seasonal comparison was not possible. Sites P8 (Bungaban Creek) and P3CE11 (Cockatoo Creek) and P7 (Juandah Creek) were only sampled once during the post-wet season.

Conductivity was within the QWQG at all sites in the Dawson and Don catchments during the post-wet season survey. Conductivity was considerably lower at site P3CE11 during the post-wet season survey (220 µs / cm) than the dry season survey (1611 µs / cm) (Figure A1-2 in Appendix 1). Cockatoo Creek is a clear water, spring fed stream. The reduced conductivity in the post-wet season sample was likely to have resulted from the recent surface water inflows. pH exceeded QWQG at this site on both sampling occasions and site P8 during the post-wet season survey (which was considerably higher than the dry season result) (Figure A1-3 in Appendix 1).

Turbidity exceeded the QWQG at sites P8, P3CE10 and P4 (Kroombit Creek), but was generally lower than levels recorded in the Condamine-Balonne catchment (Figure A1-4 in Appendix 1).

Nitrogen concentrations were generally elevated and nitrate + nitrite, ammonia and total nitrogen exceeded the QWQG at all sites during the post-wet season survey, with the exception of nitrate + nitrite and ammonia at P4 (Figures A1-9 to A1-12 in Appendix 1). This

is consistent with the results of the dry season surveys, although seasonal trends were difficult to establish due to the lack of data for comparison.

Total phosphorus exceeded the QWQG at all sites in the post-wet season survey, with the exception of P8, which was borderline (0.03 mg / L) (Figure A1-13 in Appendix 1). Filterable reactive phosphorus was within the QWQG at all sites except P4 (Kroombit Creek) and P5 (Dawson River) during the post-wet season survey. However, samples collected from sites P8 and P3CE10 (both located on Bungaban Creek), P3CE11 (Cockatoo Creek), RORWB3 (an off river waterbody adjacent to Bungaban Creek) and P7 (Juandah Creek) were delayed in transit and substantially breached the laboratory holding times for filterable reactive phosphorus (Figures A1-14 in Appendix 1). Therefore, these data are questionable.

3.2 Fish and Macrocrustaceans

3.2.1 Fish

3.2.1.1 Overview

A total of 17 native and two non-native fish species were collected from pipeline sites during the dry season and post-wet season survey periods. More species were collected during the dry season survey (17) than during the post-wet season survey (10), with only eight species collected during both survey periods (Table 3-1). Changes in species composition and abundance between surveys reflected, in part, the exclusion of the Calliope River site (P1) from the wet season survey. This site had the highest species richness of pipeline sites (12 spp.) and about 20 % of total catch abundance in the dry season survey, with four species, the long-finned eel (*A. reinhardtii*), mouth almighty (*G. aprion*), Pacific blue-eye (*P. signifier*) and barred grunter (*A. percoides*) not collected from other pipeline sites. Non-native species were not collected from site P1 during the dry season. Raw catch data for each site are included in Appendix 2.

Native fishes were the dominant component in both dry season and post-wet season catches, representing >95 % of the total catch on both occasions. The only exception was site R1 on Dogwood Creek during the dry season, where the non-native fishes, eastern gambusia (*G. holbrooki*) and goldfish (*C. auratus*) comprised 65 % of the catch (Appendix 2). Bony bream (*N. erebi*), gudgeons (*Hypseleotris* spp.), crimson-spotted rainbowfish (*M. fluviatilis*) and spangled perch (*L. unicolor*) were the dominant native species caught during both surveys.

The increased representation in catches of bony bream and spangled perch in post-wet season catches compared to those of dry season catches may have reflected wet season recruitment, as the majority of these fishes were juveniles. Spangled perch recruitment, as opposed to spawning, is much greater in years with a significant wet season flood due to the increase in habitat and food availability during such events (Pusey et al. 2004). Bony bream are also capable of rapid population recovery after flood dispersal. In the Burdekin River in 1991, after cyclonic rains, bony bream populations recovered almost to pre-flood levels within 12 months through immigration and primarily by production (Pusey et al. 2004).

Table 3-1 Summary of fish catch data for post-wet season and dry season surveys from pipeline sites

Catchment		Condamine		Dawson		Calliope	
Number of sites surveyed		2	2	5	5	1	0
Species Name	Common Name	Dry	Wet	Dry	Wet	Dry	Wet
Native Species							
Ambassis agassizii	Agassiz's glassfish			15	4	34	x
Ambassis sp.	Glassfish species			2			x
Anguilla reinhardtii	Marbled eel					4	x
Glossamia aprion	Mouth almighty					10	x
Craterocephalus stercusmuscarum	Fly-speckled hardyhead			53		13	x
Nematalosa erebi	Bony bream	1	229	17	53		x
Hypseleotris spp.	Gudgeon species	11	2	253	31	8	x
Hypseleotris compressa	Empire gudgeon			1		25	x
Morgunda adspersa	Purple-spotted gudgeon			4		5	x
Melanoteania splendida	Crimson spotted rainbowfish			105	25	10	x
Pseudomugil signifer	Pacific blue-eye					2	x
Macquaria ambigua	Golden perch/yellowbelly	5			2		x
Retropinna semoni	Australian smelt	2					x
Tandanus tandanus	Freshwater catfish			1	1	2	x
Neosilurus hyrtlii	Hyrtl's tandan		1		6		x
Amniataba percoides	Barred grunter					4	x
Leiopotherapon unicolor	Spangled perch	1	10	9	48	13	x
Bidyanus bidyanus	Silver perch		2				x
Non-native species							
Gambusia holbrooki	Eastern mosquitofish	10	3	14			x
Carassius auratus	Goldfish	26					x

Note: x = site not surveyed

3.2.1.2 Condamine-Balonne

A total of seven native species and two non-native species (goldfish and eastern gambusia) were recorded for the two pipeline sites (GF1 and R1) on Dogwood Creek for both dry season and post-wet season surveys combined (Appendix 2). Only one specimen of bony bream was collected from site GF1 during the dry season survey (the only fish collected from this site in the dry season survey), while 229 were collected during the post-wet season survey, the latter being the dominant catch component (95 %). Low numbers of three other species (spangled perch, Hyrtl's tandan and silver perch) were collected from this site in the post-wet season survey. Silver perch was the only species of conservation significance recorded in the Condamine-Balonne catchment during the post-wet season survey. EIS Volume 5, Attachment 17 provided a description of the habitat requirements, sensitivity and conservation significance of silver perch.

Only seven fish in total were caught at Site R1 during the post-wet season survey, comprising two native species (gudgeon species and spangled perch) and one non-native species (eastern gambusia). In contrast, a total of 55 fish were caught during the dry season survey, comprising four native species (gudgeon species, yellowbelly, Australian smelt and golden perch) and two non-native species (goldfish and eastern gambusia). This was the

only pipeline site for both surveys where non-native fishes were the dominant catch component (65%) and the only pipeline site where goldfish were collected.

3.2.1.3 Dawson and Don

A total of 12 native species and one non-native species (Eastern gambusia) were collected from five sites within the Dawson and Don catchments (P3CE10, P7, P8, P3CE11 and P4) during dry and wet season surveys. Site P8 was sampled in the wet season survey but not during the dry season, therefore no seasonal comparison is available. Post-wet season catch data for this site indicated a low species richness (four native species) and abundance (35 specimens).

Considerably more fish were caught during the dry season survey, compared to the post-wet season survey. The dominant species in dry season catches were gudgeon species and crimson-spotted rainbowfish, while the dominant components in wet season catches were bony bream, gudgeon species and spangled perch. Non-native fishes were a minor component (< 3 %) of the total catch during the dry season survey, while none were collected from these sites in the post-wet season survey (Appendix 2).

Site P7 (Juandah Creek) and site P3CE11 (Cockatoo Creek) had the highest species richness (five species) and abundance (81 and 39 individuals, respectively) in the dry season survey. Site P7 had the highest species richness (eight species) and abundance (111 individuals) in the post-wet season survey.

Two species of conservation significance - the Fitzroy yellowbelly (*M. ambigua oriens*) and Agassiz's glassfish, were caught at site P7 during the post-wet season survey. EIS Volume 5, Attachment 18 provided a description of the habitat requirements, sensitivity and conservation significance of these species. The crimson-spotted rainbowfish occurred in low numbers in both dry season and wet season surveys at site P7 (three individuals), P8 (one individual) and P3CE10 (one individual). Recent, as yet unpublished, DNA studies of Queensland rainbowfishes have indicated that the Dawson River rainbowfish population, previously classified as the more-widely distributed eastern rainbowfish, *Melanotaenia splendida splendida*, is *M. fluviatilis*, the Crimson-spotted rainbowfish, but with some introgression from *M. splendida* (P. Unmack, Brigham Young University, *pers. comm.*). *M. fluviatilis* was previously considered to occur only in the Murray-Darling system (Lintermans 2009). While its final taxonomic status is yet to be confirmed, the Dawson River population represents a locally distinct genotype of a regional endemic and has therefore been included as a species of conservation significance. Hyrtl's tandan (absent from all Dawson site catches in the dry season survey) was collected in small numbers from site P7 during the wet season survey.

A total of seven native species and one non-native species (the eastern gambusia) were recorded for site P3CE11 (Cockatoo Creek) over both surveys. Crimson-spotted rainbowfish, gudgeon species and the fly-specked hardyhead were the dominant catch components at the site during the dry season survey, while spangled perch and crimson spotted rainbowfish were the dominant catch components in the post-wet season survey. Species richness and abundance were considerably higher at P3CE11 in the dry season survey (six species and 242 fish, respectively) than the post-wet season survey (three species and 29 fish, respectively).

The difference may in part reflect dry season concentration and downstream flushing of fish during the wet season. This site is a shallow, clear water spring fed stream and had a higher proportion of macrophyte coverage than other sites in the Dawson and Don catchments. This may account for the dominance of vegetation-associated species in the dry season survey (e.g. Agassiz's glassfish, fly-specked hardyhead, gudgeon species and crimson-spotted rainbowfish), when the creek's permanent pools provided good refugia.

A total of six species and one non-native species (eastern gambusia) were collected over both surveys at site P4 on Kroombit Creek. The dry season catch (105 fish) was markedly larger than the wet season catch (16 fish), with seven species collected in the dry season survey and only two species (the crimson-spotted rainbowfish and spangled perch) collected in the post-wet season survey. Gudgeon species dominated the catch in the dry season (89%), while the crimson-spotted rainbowfish was the dominant catch component in the post-wet season survey (73%), although the latter was present in low numbers (11).

3.2.2 Macrocrustaceans

A total of two macrocrustacean species (Australian river prawn and redclaw) were collected during the dry season and post-wet season surveys (Table 3-2). Australian river prawns were the dominant total catch component in both surveys. Raw catch data for each site sampled are included in Appendix 2.

No clear seasonal trends in macrocrustacean catch in terms of species richness and abundance were evident when comparing post-wet season and dry season survey data for pipeline sites. Apart from two Dawson catchment sites (P3CE10 located on Bungaban Creek– dry season and P7 located on Juandah Creek- wet season), macrocrustaceans were trapped in low numbers (less than five individuals) from all pipeline sites during dry season and post-wet season surveys.

No macrocrustaceans were collected from sites P4 (Kroombit Creek), P8 or P3CE10 (both on Bungaban Creek) or GF1 (Dogwood Creek) during either survey.

No macrocrustaceans were collected from site R1 on Dogwood Creek during the dry season survey. Only one specimen of the Australian river prawn and two specimens of the redclaw were collected from site R1 during the post-wet season survey.

Table 3-2 Summary of macrocrustacean species and catch sizes for dry season and post-wet season surveys

Species		Condamine		Dawson		Calliope	
	Number of sites surveyed	2	2	5	5	1	0
	Common name	Dry	Wet	Dry	Wet	Dry	Wet
Macrobrachium australiense	Australian river prawn	0	1	37	23	0	x
Cherax quadricarinatus	Redclaw	0	2	37	5	0	x

Note: x = site not surveyed

3.3 Macroinvertebrates

3.3.1 Overview

Macroinvertebrate samples were collected from eight sites during the post-wet season survey. Edge samples were collected from seven sites, while composite bed samples were collected from only four sites (due to variable water depths and habitat availability (Table 3-3-)). Raw macroinvertebrate data and supporting figures are provided in (Appendix 3). Comparisons between dry season and post-wet season surveys are provided for the following: functional feeding groups and SIGNAL 2 scores (edge data only) and flow and substrate preference groups (composite bed data only). Further details are provided in EIS Volume 5, Attachment 18. Site P1, located on the Calliope River, was not sampled during the post-wet season. Therefore, no results are presented for this site.

Taxa richness ranged between 13 and 32 across all sites from edge samples collected during the post-wet season surveys, compared to 15 and 39 during the dry season surveys. Comparisons between dry and post-wet season surveys were difficult, as a large number of sites that were sampled during the post-wet season, were dry or had insufficient habitat to sample during the dry season. For sites that were able to be compared, taxa richness was lower at all sites during the post-wet season surveys (Table 3-3), which was possibly a result of increased macroinvertebrate flushing / drift following the recent floods and lack of time for post-flooding recruitment.

Plecoptera-Ephemeroptera-Trichoptera (PET) richness was similar between the dry and post-wet season surveys, ranging between zero and four taxa across all sites. A higher number of sites recorded between two and four PET taxa during the post-wet season survey.

Table 3-3 Comparison of macroinvertebrate species richness and PET richness between dry and post-wet season surveys (edge samples only)

Catchment	Site	Taxa Richness		PET richness	
		Dry	Wet	Dry	Wet
Condamine	GF1	15	13	0	2
	R1		14		2
Dawson	P8	27	14	0	2
	P3CE10		27		2
	RORWB3		20		2
	P3CE11	39	32	4	4
	P7	29	21	3	3
Calliope	P1	34		4	

SIGNAL 2 scores were low for all sites, ranging from 2.85 to 3.73 (with no abundance weighting) during the post-wet season surveys. Although SIGNAL 2 scores were higher for all sites than those recorded during the dry season, the reduced taxa richness resulted in all sites still falling within either quadrant 2 or quadrant 4 (indicating elevated nutrients, turbidity or salinity) (a description of quadrant boundaries is provided in EIS Vol 5,

Attachment 18)(Figure A3-3 in Appendix 3). This is likely to be a result of a combination of factors, such as poor riparian and aquatic habitat conditions, landuses, regional soils and geology and delayed post-flooding recruitment.

The relative proportion of macroinvertebrate functional feeding groups (in edge samples) for sites sampled during the post-wet season varied considerably between sites and no strong seasonal trends in feeding guild composition were evident. Most sites were dominated by non-specific feeders, such as predators and gatherer/collectors (Figure A3-1 in Appendix 3).

Most sites were dominated by taxa with a weak preference for low / no flow and fine substrate (sand/silt) or taxa that showed no flow or substrate preference (composite bed samples) (Figures A3-4 – A3-5 in Appendix 3). Over 60 % of taxa recorded at site RORWB3 were not classified. The post-wet season results were generally consistent with the results of the dry season surveys and reflected the dominance of sandy/silty substrates throughout the region. Despite the recent flooding, all sites had ceased to flow at the time of sampling.

3.3.2 Condamine-Balonne

Macroinvertebrate edge samples were collected from two sites (GF1 and R1) on Dogwood Creek during the post-wet season. No composite bed samples were collected from these sites, so no seasonal comparison for flow and substrate preference groups was available.

Macroinvertebrate taxa richness was low at these sites compared to sites located in the Dawson and Don catchments. Both GF1 and R1 recorded a PET richness of two during the post-wet season survey. No PET taxa were recorded during the dry season survey.

Both sites were dominated by predators during the post-wet season survey, with smaller proportions of gatherer / collectors and filter feeders. The absence of scrapers at GF1 may be due to recent flushing, although more data would be required to confirm this (Figure A3-1 in Appendix 3).

SIGNAL 2 scores were low at sites GF1 and R1 (3.82 and 3.08, respectively) and both sites fell within quadrant four on the Signal bi-plot (Figure A3-3 in Appendix 3). There were no urban areas and no known industrial pollution located within the upper Dogwood Creek catchment. It was likely that macroinvertebrate composition at these sites was impacted by riparian clearing and agricultural landuses.

3.3.3 Dawson and Don

Macroinvertebrate edge samples were collected from six sites in the Dawson and Don catchments during the post-wet season survey. Composite bed samples were collected from four sites, although only two of these were also sampled during the dry season (Table 3-3).

Taxa richness in edge samples collected during the post-wet season surveys ranged from 14 to 32, compared to 27 to 39 in the dry season survey. Site P8 (Bungaban Creek) recorded the lowest taxa richness for all Dawson and Don catchment sites in both surveys. PET taxa richness ranged from two to four, with the highest richness recorded at P3CE11 (Cockatoo Creek) in both surveys. This site also recorded the highest taxa richness compared to all sites sampled, for both surveys. However, the corresponding SIGNAL 2 scores for site P3CE11

were low during both wet and dry season, suggesting that the macroinvertebrate community is tolerant to a range of water quality conditions (Appendix 3).

No PET taxa were collected at site P8 during the dry season, while two taxa were recorded during the post-wet season survey.

Site P7 on Juandah Creek had the highest SIGNAL 2 score (3.89) and moderate PET richness (3) (Appendix 3). However, overall taxa richness was moderate at this site (21 taxa). Site RORWB3, an off river waterbody adjacent to Bungaban Creek, recorded the lowest SIGNAL 2 score (3.0) and second lowest taxa richness.

Predators, filter feeders and gatherer / collectors dominated the functional groupings at all sites. Shredders were only present in substantial proportions at site P8 during the post-wet season (> 40%) (Figure A3-1 in Appendix 3). The reasons for this were not clear and further surveys would be required to establish any seasonal trends.

A very high proportion of the macroinvertebrate community at sites P8 and P3CE10 showed preference for weak fine substrate and low / no flow. All other sites were dominated by taxa with no preference or that were not classified (Figure A3-4 and A3-5 in Appendix 3).

3.4 Data limitations

Given the dynamic nature of river systems throughout the survey region, water quality and biological communities are likely to be highly variable both seasonally and interannually. Two or three surveys within a 12-month period can only provide a snapshot of the health of these systems at the time of sampling. This is particularly relevant given the seasonal extremes encountered during the survey periods (i.e. extended drought period followed by one of the wettest summers on record[2]). Therefore, data presented in this report need to be interpreted with caution.

Changes in catch composition and species abundances between surveys reflect, in part, differences in species' responses to seasonal changes in flow regimes and sampling methods employed at each site. For example, fish are more concentrated and accessible to capture in shallow, intermittent pools (predominant in the dry season surveys) compared with post-flood streams (encountered in wet season surveys), where fish are more dispersed.

It was not possible to maintain standardised biological sampling methods between dry and wet season surveys (e.g. net selection and soak times varied due to time constraints, water depth and channel width; macroinvertebrate sampling varied depending on water depth and available edge habitat etc). In particular, this may have affected fish catch composition, with some species more amenable to capture by particular sampling methods. For example, small elongate species such as hardyheads and relatively sedentary species such as gudgeons are more easily collected by electrofishing than by gill nets, while plotosid catfish are more easily collected by gill netting than by electrofishing. In the dry season surveys, the predominant sampling methods were electrofishing and small traps, while in the post-wet season surveys, the majority of sites were sampled using gillnets and small traps. Fyke

[2] http://www.abc.net.au/news/stories/2010/03/06/2838439.htm

netting and seine netting were also undertaken at some sites during the post-wet season survey.

4 SUMMARY AND CONCLUSIONS

Water quality, fish and macroinvertebrate surveys were conducted during April and May, 2010, following two significant flooding events in February and March. Data collected during the post-wet season survey were compared to those collected during the dry season surveys.

Water quality was generally found to be similar between the dry and post-wet season surveys, with the majority of sites recording low-moderate turbidity, conductivity and suspended solids, high nutrients and low dissolved oxygen concentrations. No pesticides or hydrocarbons were detected in any of the dry or post-wet season samples.

A total of 17 native and two non-native fish species were collected from pipeline sites during both the dry and post-wet season surveys. All catches were dominated by native species. The overall species richness was lower between dry season (18) and post-wet season (9) surveys, with only seven species recorded from both surveys. The reduced species richness during the post-wet season survey was largely attributed to the exclusion of site P1, which had the highest species richness and abundance of all sites sampled during the dry season survey. The combination of wet season recruitment and different sampling methods used may have also contributed to the reduced species richness during the post-wet season survey.

Silver perch is the only species of conservation significance recorded in the Condamine-Balonne catchment during the post-wet season survey that was not recorded in the dry season survey. EIS Volume 5, Attachment 18 provided a description of the habitat requirements, sensitivity and conservation significance of silver perch. The presence of this species did not alter the impact assessment provided in EIS Volume 5, Attachment 18, as this assessment was based on the assumption that all significant species known to occur throughout the region were present, regardless of whether they were caught or not.

Macroinvertebrate taxa richness was generally lower during the post-wet season survey, compared to the dry season survey. This was likely to be a result of delayed post-flooding recruitment. SIGNAL 2 scores were low for both surveys, although they were higher at all sites during the post-wet season survey. PET richness and functional group structure were similar between dry and post-wet season surveys. The composition of the macroinvertebrate community generally indicated moderately degraded conditions, likely to be associated with high nutrient concentrations and poor aquatic and riparian habitat. The majority of sites were dominated by taxa with generalist food preferences and those tolerating a range of flow and substrate conditions.

Overall, while the post-wet season sampling provided additional data to support the characterisation of the existing environment, nothing was observed or collected that resulted in any required amendments to the impact assessment undertaken for the EIS (refer to Volume 5, Attachment 18).

Given the dynamic nature of river systems throughout the survey region, these results only provided a snapshot of water quality and biological community structure at the time of sampling, particularly considering the seasonal extremes encountered during the survey

periods. Further surveys would be required to confidently establish any seasonal and or inter-annual trends.

5 REFERENCES

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Appendix 1. Raw Water Quality Data

A1-1 Physico-chemical data for dry season and post-wet season surveys

Season	Parameter	GF1	R1	P8	P3CE10	RORWB3	P3CE11	P7	P5	P4	P1
Dry 1	Temp (°C)	17.61	19.13					15	15.62		15.27
Dry 2	Temp (°C)	15.6	12		20.82		24.11			23.07	20.8
Wet	Temp (°C)	20.36	22.55	21.84	19.65	17.5	24.76	22.51	23.65	21.25	
Dry 1	Cond (µS/cm)	78	213	115				276	-	529	1343
Dry 2	Cond (µS/cm)	77	179		154		1611			501	1379
Wet	Cond (µS/cm)	157	107	109.6	209	275	220	342	263	110	
Dry 1	pH	6.72	5.38	5.76				7.18	6.1	8.39	7
Dry 2	pH	7.76	7.48		7.14		8.48			8.53	7.76
Wet	pH	6.35	7.13	7.86	7.45	7.37	8.62	7.57	7.58	7.47	
Dry 1	Turb (NTU)	635.6	298.4	618.4				14.8	45.9	17.2	0.9
Dry 2	Turb (NTU)	350	65.9		15.6		47.2			62.9	1
Wet	Turb (NTU)	135.1	119.8	64.5	40.9	23.1	3.6	18	71.8	50.1	
Dry 1	DO (% sat)	60.2	108.6	43.9				57.1	56.2	125	63
Dry 2	DO (% sat)	69.1	65.9		5.8		134.1			108.9	72.8
Wet	DO (% sat)	36.4	76.5	76.6	43.9	39.8	119.3	77	56.5	50.3	
Dry 1	TDS (mg/L)	924	112	735				162	198	297	764
Dry 2	TDS (mg/L)	602	186		1150		-			288	874
Wet	TDS (mg/L)	283	232	660	183	239	315	254	199	151	
Dry 1	TSS (mg/L)	145	1220	84				55	13	23	8
Dry 2	TSS (mg/L)	47	137		1650					40	3
Wet	TSS (mg/L)	55	13	9	18	16	10	21	30	15	

Note: All parameters measured in mg/L. NB: Green cells = no guideline value; yellow cells = exceeded guideline, red writing = exceeded laboratory holding times.

A1-2 Guideline values for physico-chemical parameters

Guidelines	Conductivity	pH	Turbidity	DO
Condamine	500	6.5 – 7.5	25	90 - 110
Dawson/Calliope	340	6.5 – 7.5	25	90 - 110

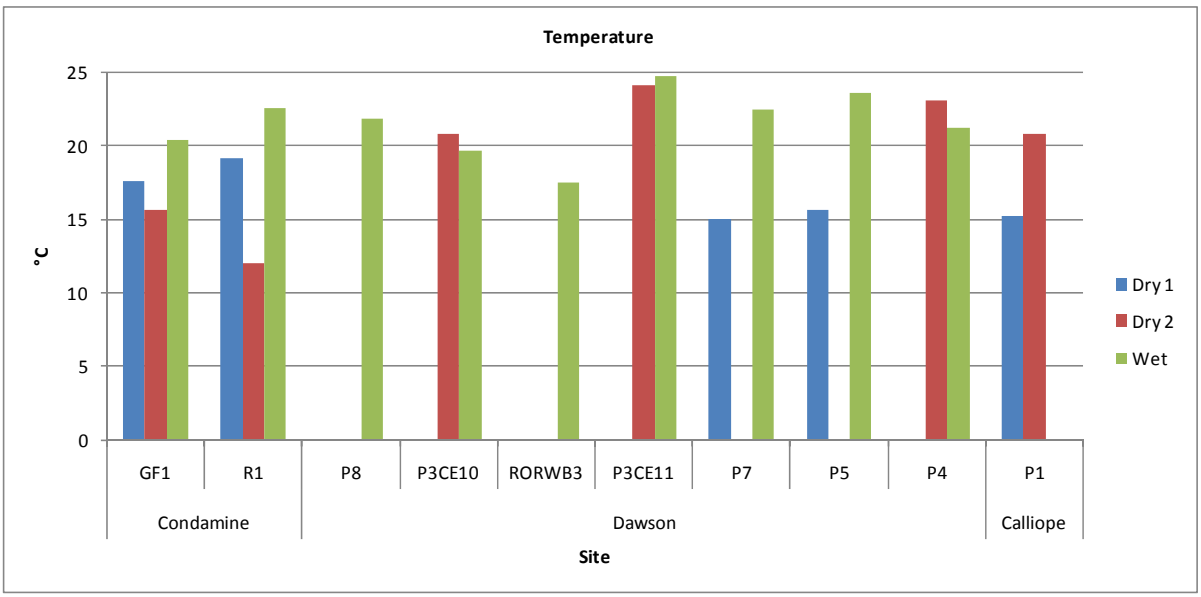
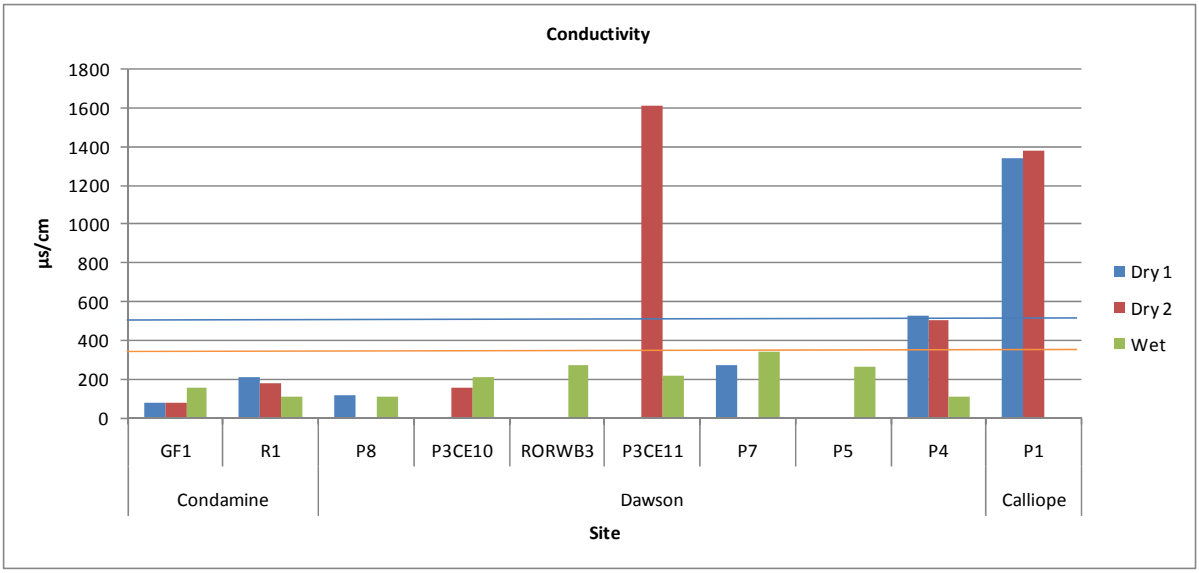
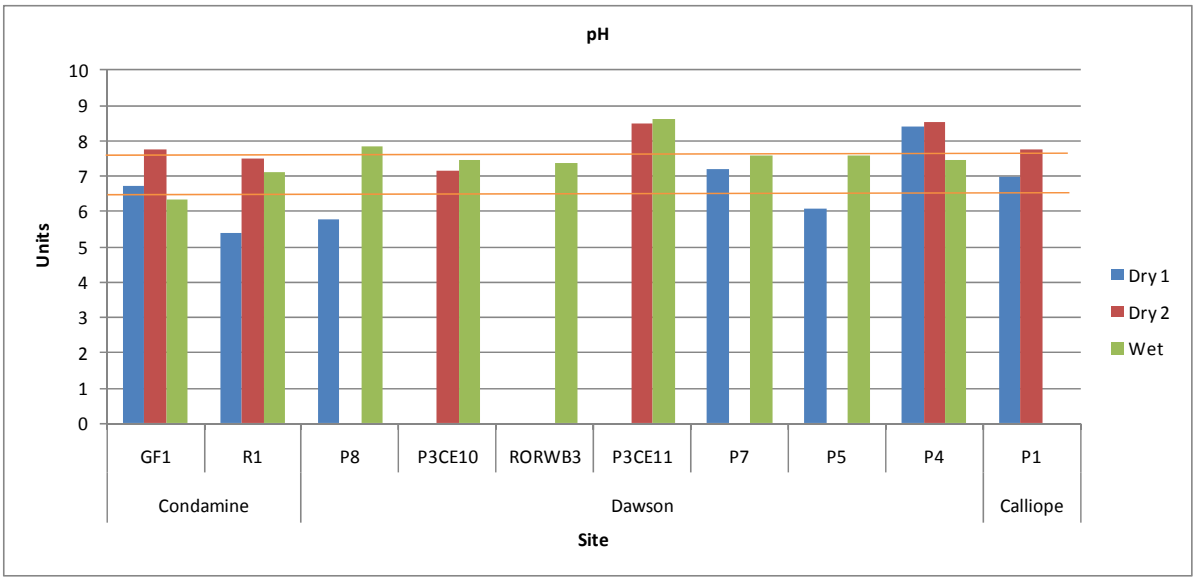


Figure A1-1 Water temperature results for dry season and post-wet season surveys



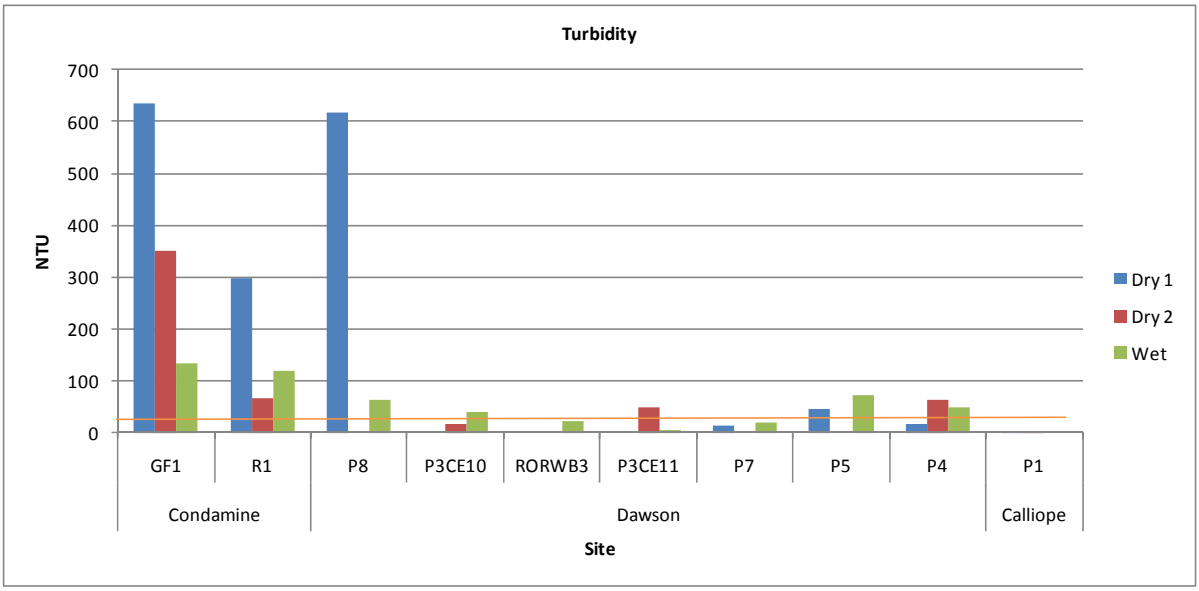
Note: Orange line indicates Dawson/Calliope guideline; Blue line indicates Condamine guideline

Figure A1-2 Specific conductivity results for dry season and post-wet season surveys



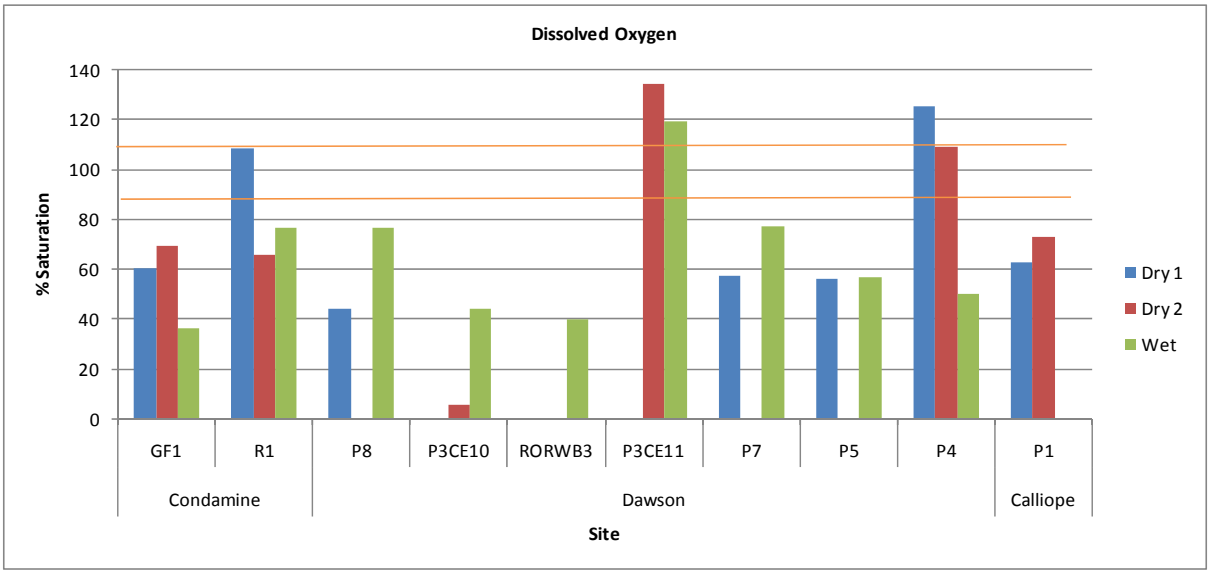
Note: Orange line indicates guideline range for all catchments

Figure A1-3 pH results for dry season and post-wet season surveys (see Table A1-2 for guideline values)



Note: Orange line indicates guideline range for all catchments

Figure A1-4 Turbidity results for dry season and post-wet season surveys (see Table A1-2 for guideline values)



Note: Orange line indicates guideline range for all catchments

Figure A1-5 Dissolved oxygen results for dry season and post-wet season surveys

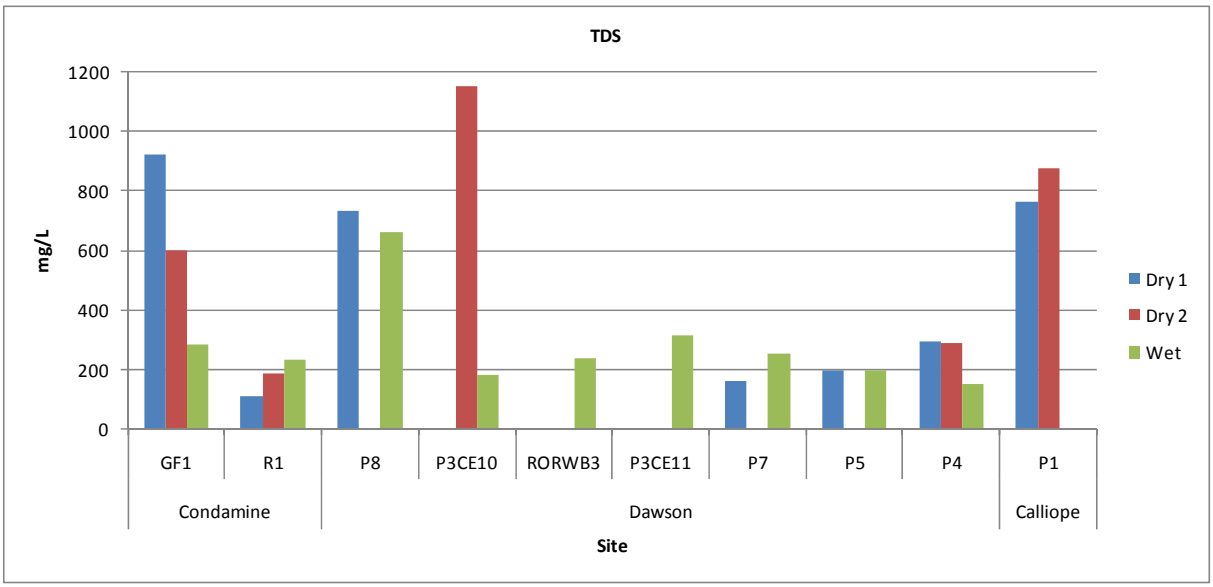


Figure A1-6 TDS results for dry season and post-wet season surveys

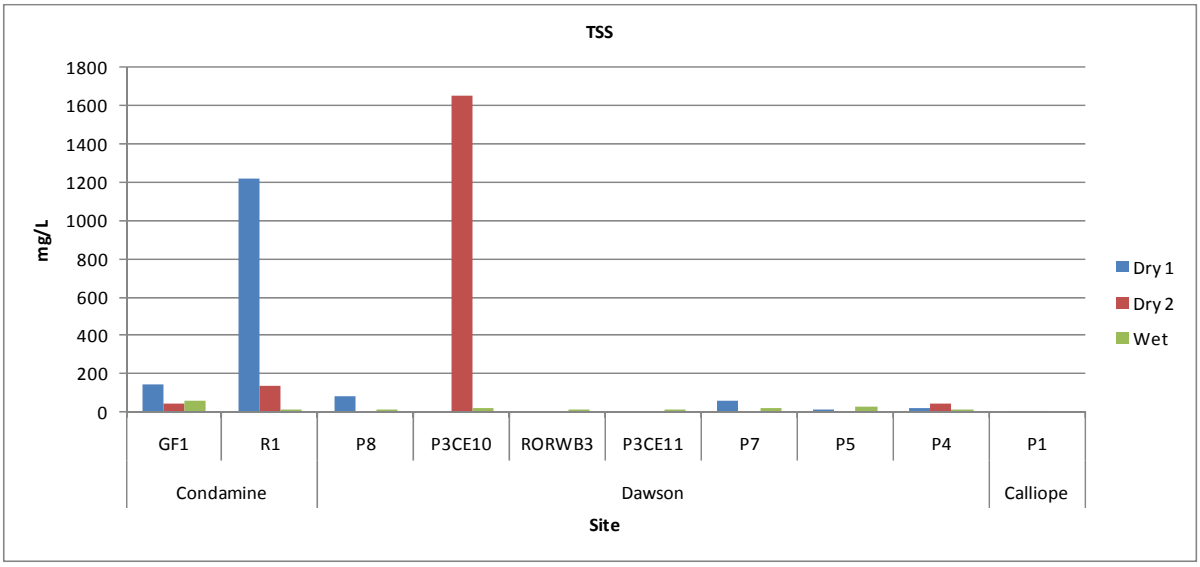


Figure A1-7 TSS results for dry season and post-wet season surveys

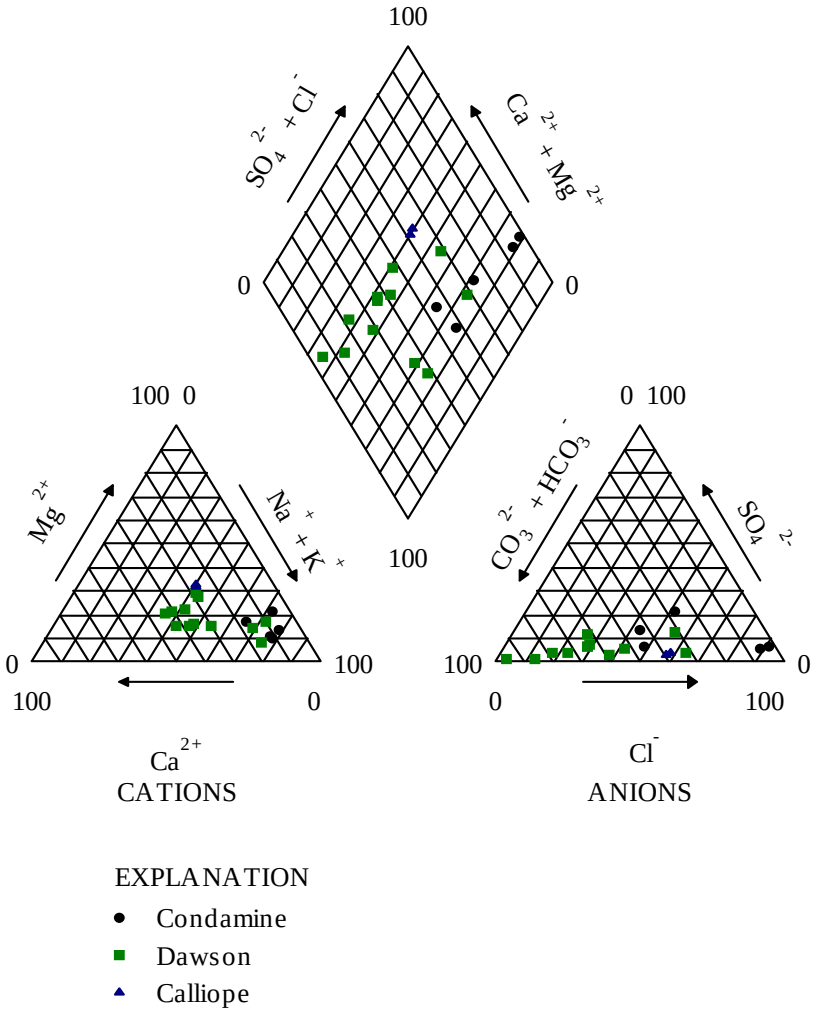


Figure A1-8 Piper plot for dry season and post-wet season surveys showing anions against cations

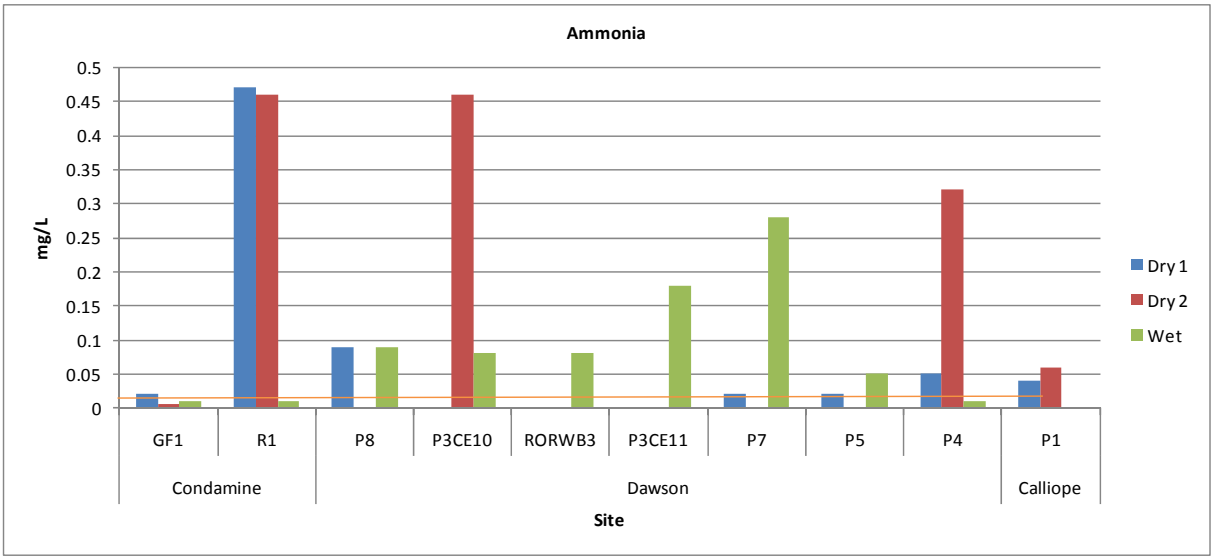
Table A1-3 Nutrient data for dry season and post-wet season surveys

Season	Parameter	GF1	R1	P8	P3CE10	RORWB3	P3CE11	P7	P5	P4	P1
Dry 1	NH4	0.02	0.47	0.09				0.02	0.02	0.05	0.04
Dry 2	NH4	0.005	0.46		0.46					0.32	0.06
Wet	NH4	0.01	0.01	0.09	0.08	0.08	0.18	0.28	0.05	0.01	
Dry 1	Nox	0.32	0.005	0.19				0.005	0.18	0.005	0.005
Dry 2	Nox	0.37	0.06		0.2					0.005	0.005
Wet	Nox	0.04	0.02	0.03	0.03	0.04	0.03	0.04	0.18	0.01	
Dry 1	TKN	2.2	6.4	0.7				1	0.4	1.1	0.3
Dry 2	TKN	1.6	1.5		0.4					1	0.2
Wet	TKN	0.6	1	0.3	0.9	0.6	1	0.8	0.6	0.7	
Dry 1	TN	2.5	6.4	0.9				1	0.6	1.1	0.3
Dry 2	TN	2	1.6		0.6					1	0.2
Wet	TN	0.6	1	0.3	0.9	0.6	1	0.8	0.8	0.7	
Dry 1	TP	0.41	0.67	1.94				0.11	0.23	0.005	0.04
Dry 2	TP	0.27	0.005		1.54					0.16	0.11
Wet	TP	0.07	0.04	0.03	0.28	0.12	0.07	0.06	0.22	0.37	
Dry 1	FRP	0.005	0.005	0.08				0.005	0.04	0.02	0.005
Dry 2	FRP	0.02	0.005		0.005					0.04	0.02
Wet	FRP	0.02	0.005	0.005	0.01	0.005	0.005	0.005	0.03	0.17	

Note: All parameters measured in mg/L. Green cells = no guideline value; yellow cells = exceeded guideline, red writing = exceeded holding time

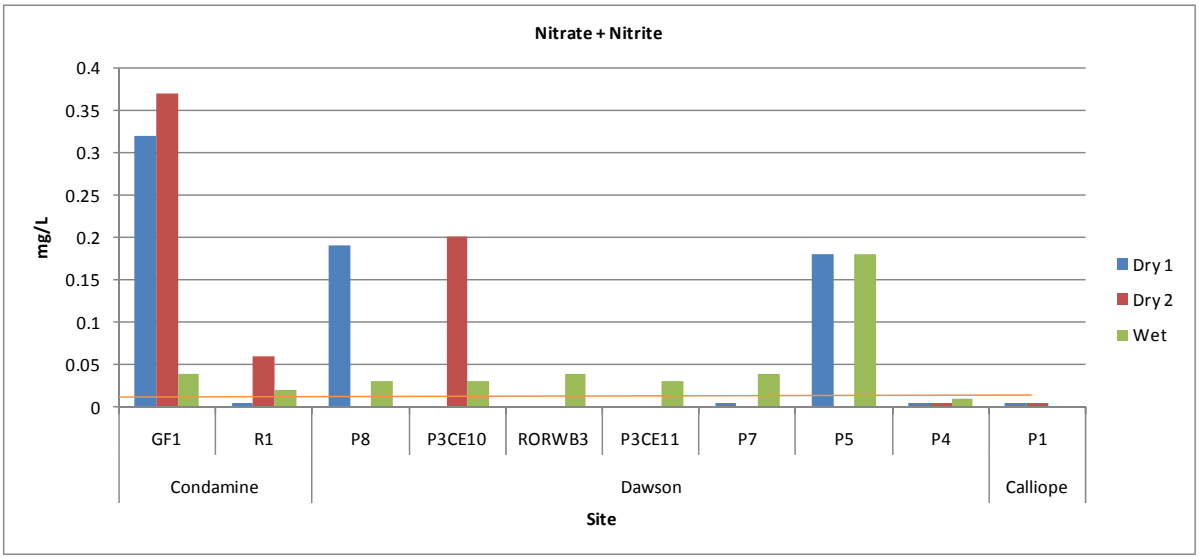
Table A1-4 Guideline values for nutrient data

Guidelines	NH4	Nox	TN	TP	FRP
Condamine	0.01	0.015	0.25	0.02	0.015
Dawson/Calliope	0.01	0.015	0.25	0.03	0.015



Note: Orange line indicates guideline for all catchments

Figure A1-9 Ammonia results for dry season and post-wet season surveys



Note: Orange line indicates guideline for all catchments

Figure A1-10 Nitrate and nitrite results for dry season and post-wet season surveys (see Table A1-4 for guideline values)

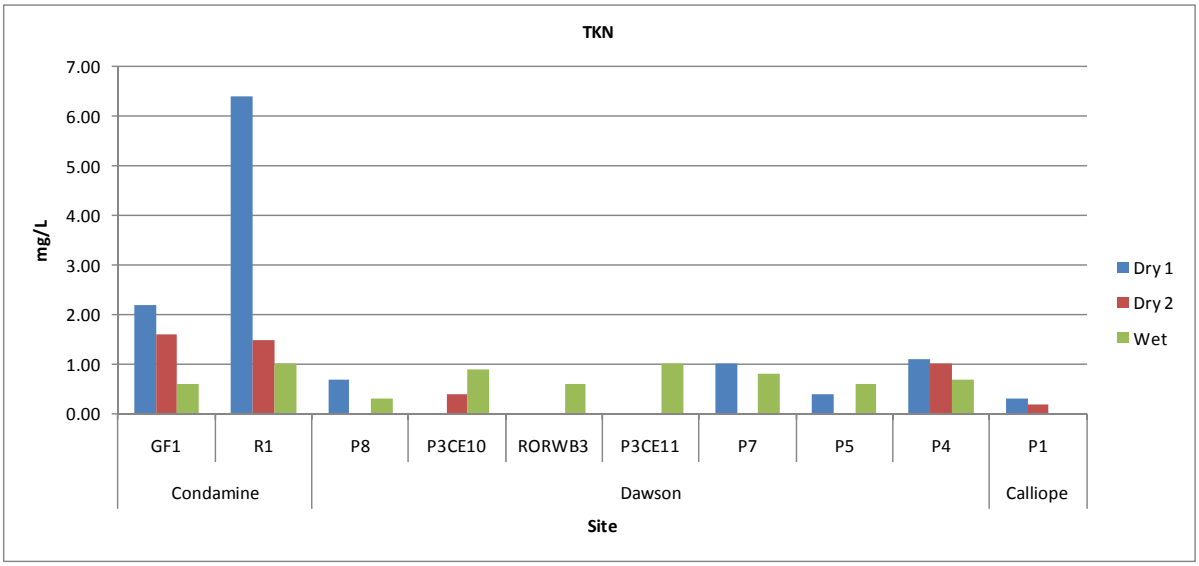
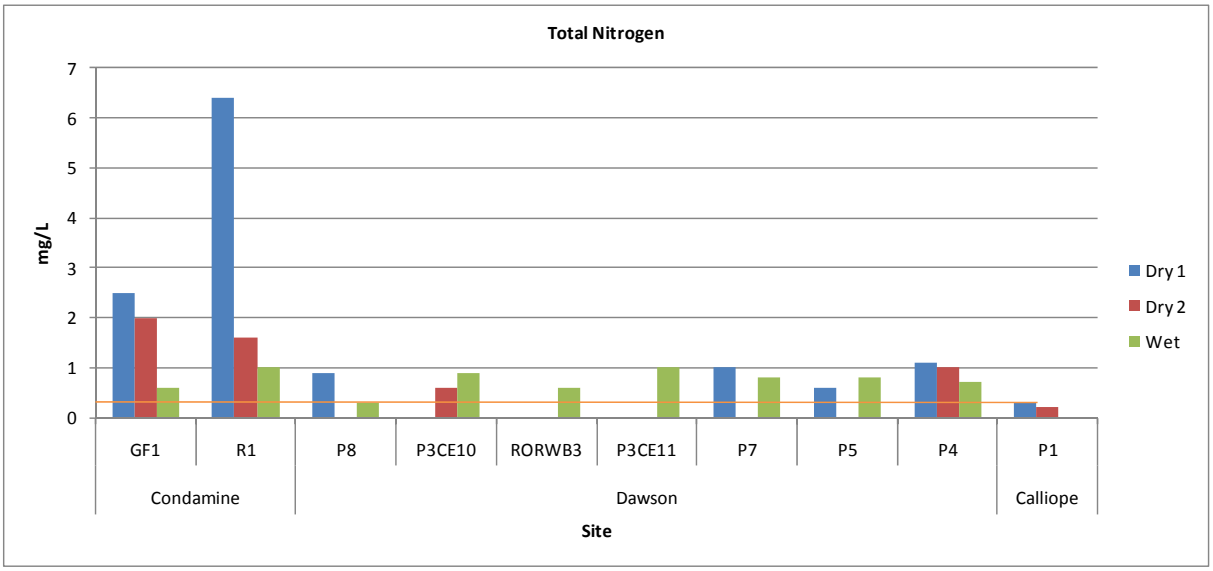
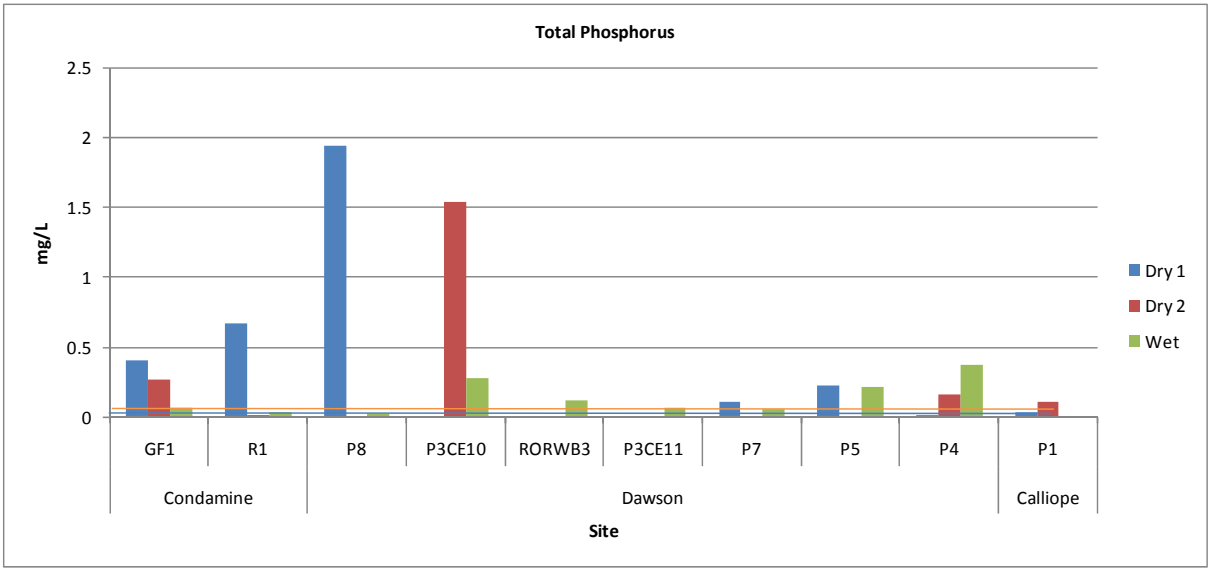


Figure A1-11 TKN results for dry season and post-wet season surveys



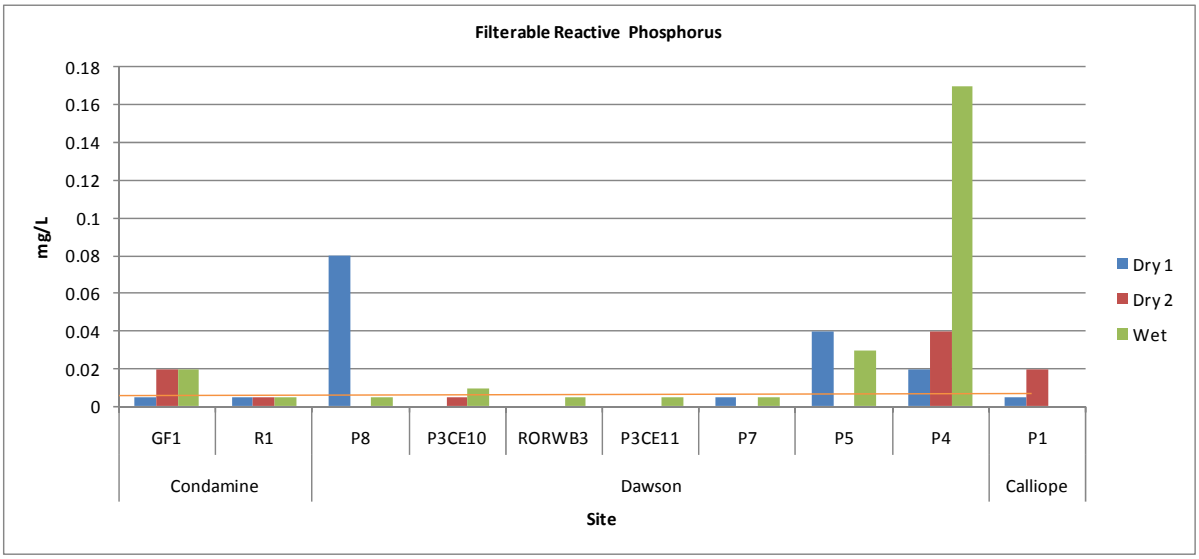
Note: Orange line indicates guideline for all catchments

Figure A1-12 Total nitrogen results for dry season and post-wet season surveys



Note: Orange line indicates Dawson/Calliope guideline; Blue line indicates Condamine guideline

Figure A1-13 Total phosphorous results for dry season and post-wet season surveys



Note: Orange line indicates guideline for all catchments

Figure A1-14 Filterable reactive phosphorous results for dry season and post-wet season surveys

Appendix 2. Raw Fish Data

Table A2-1 Fish diversity and abundance Dry Season – Pipeline sites

Fish family	Fish species	Common name	Condamine		Dawson					Calliope
			GF1	R1	P8	P3CE10	P3CE11	P7	P4LL	P1
Ambassidae	*Ambassis agassizii*	Agassiz's Glassfish					12	3		34
	Ambassis sp.	Glassfish species							2	
Anguillidae	*Anguilla reinhardtii*	Marbled Eel								4
Apogonidae	*Glossamia aprion*	Mouth almighty								10
Atherinidae	*Craterocephalus stercusmuscarum*	Fly-speckled Hardyhead					53			13
Clupeidae	*Nematalosa erebi*	Bony Bream	1					17		
Eleotridae	*Hypseleotris spp.*	Gudgeon species		11		3	78	78	94	8
	Hypseleotris compressa	Empire Gudgeon							1	25
	Morgunda adspersa	Purple-spotted Gudgeon					3		1	5
Melanotaeniidae	*Melanoteania splendida*	Eastern Rainbowfish					93	11	1	10
Pseudomugilidae	*Pseudomugil signifer*	Pacific blue-eye								2
Percichthyidae	*Macquaria ambigua*	Golden Perch/Yellowbelly		5						
Retropinnidae	*Retropinna semoni*	Australian Smelt		2						
Plotosidae	*Tandanus tandanus*	Freshwater catfish						1		2
Poecilidae	*Gambusia holbrooki*	Eastern Mosquitofish		10		4	3	2	5	
Cyprinidae	*Carassius auratus*	Goldfish		26						
Terapontidae	*Amniataba percoides*	Barred grunter								4
	Leiopotherapon unicolor	Spangled perch		1		7		1	1	13
Crustacean Family	**Crustacean Species**	**Common name**								
Palaemonidae	*Macrobrachium sp.*	Prawn species				35	2			
Parastacidae	*Cherax quadricarinatus*	Red claw				37				

Note: Grey shading = Non-native species

Table A2-2 Fish diversity and abundance Wet Season – Pipeline sites

			Condamine		Dawson				
Fish family	**Fish species**	**Common name**	**GF1**	**R1**	**P8**	**P3CE10**	**P3CE11**	**P7**	**P4**
Clupeidae	*Nematalosa erebi*	Bony Bream	229		16	4	5	28	
Eleotridae	*Hypseleotris sp. 1*	Midgley's Carp Gudgeon							
	Hypseleotris spp.	Gudgeon species		2	2			29	
Melanotaeniidae	*Melanoteania splendida*	Eastern Rainbowfish			1	1	9	3	11
Plotosidae	*Tandanus tandanus*	Freshwater catfish						1	
	Neosilurus hyrtlii	Hyrtl's tandan	1					6	
Poecilidae	*Gambusia holbrooki*	Eastern Mosquitofish		3					
Terapontidae	*Leiopotherapon unicolor*	Spangled perch	8	2	16	4	15	8	5
	Bidyanus bidyanus	Silver Perch	2						
Percichthydidae	*Macquaria ambiqua*	Golden Perch / Yellowbelly						2	
Crustacean Family	**Crustacean Species**	**Common name**							
Palaemonidae	*Macrobrachium australiens*	Prawn species		1				23	
Parastacidae	*Cherax destructor*	Red claw		2			4	1	

Note: Grey shading = Non-native species

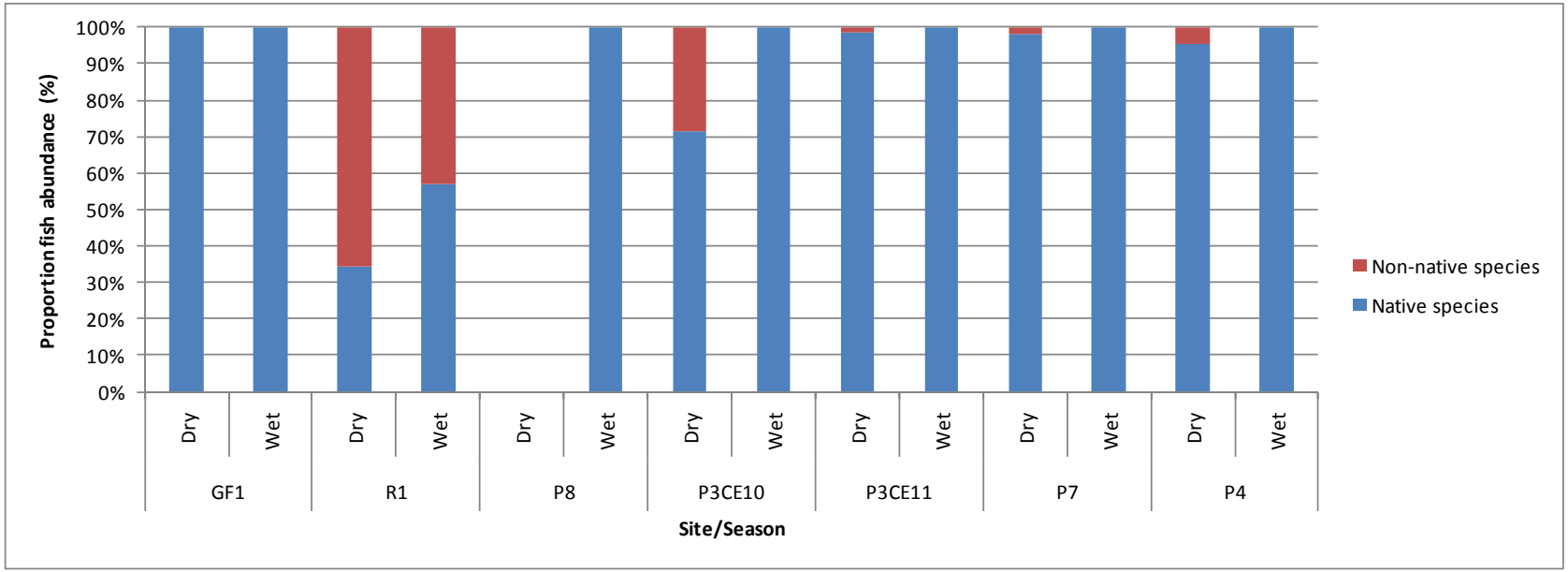


Figure A2-1 Fish abundance at each site showing the proportion of native vs non-native species for dry season and post-wet season surveys

Appendix 3. Raw Macroinvertebrate Data

Table A3-1 Macroinvertebrate abundances and functional feeding guilds – pipeline (edge data)

Taxon	Functional Feeding Guild	GF1 DRY	GF1 WET	R1 WET	P8 DRY	P8 WET	P3CE10 WET	RORWB3 WET	P3CE11 DRY	P3CE11 WET	P7 DRY	P7 WET	P1 DRY
Acarina	Predator	2				4	6	1	4	85		2	3
Aeshnidae	Predator							1					
Ancylidae	Scraper								1		5		
Anisoptera	Predator									1			1
Anostraca	Filter-feeder				2								
Atyidae	Gatherer/collector			1			1		10	9	1		11
Baetidae	Gatherer/collector		3	13			22	5	21	30	3	3	
Belostomatidae	Predator												
Bryozoa	Filter-feeder						3						
Caenidae	Gatherer/collector								9	9	2		
Calamoceratidae	Shredder												8
Caridea	Gatherer/collector								11				
Ceratopogonidae	Predator	6			2	1	3	7	5	5	3	1	2
Chaoboridae	undetermined						1						
Chironomidae (unid.)	undetermined						10						
Chironomidae: s-f Chironominae	Filter-feeder	1		15	1	3	16	25	120	33	46	20	7
Chironomidae: s-f Orthocladiinae	Gatherer/collector		1				2		5	6		1	
Chironomidae: s-f Tanypodinae	Predator			3	1		14	3	92	24	24	5	5
Cirolanidae	Gatherer/collector												
Cladocera	Filter-feeder	8	1		96		39	7	14	33	6	4	
Coenagrionidae	Predator			3					5	6		1	7
Coleoptera	Predator												
Collembola	Gatherer/collector	1											
Copepoda	Gatherer/collector	6			32	2	94		86	205	39	38	1
Corbiculidae	Filter-feeder										3		15
Corbiculoidea	Filter-feeder												
Corduliidae	Predator	1											2
Corixidae	Predator				4	2	1	7	1	2	6		
Culicidae	Filter-feeder			1	45				4	1			
Curculionidae	Shredder												
Dugesiidae	Gatherer/collector	8								1			1
Dytiscidae	Predator	1	2	6	13	8		1	2	6	5		1

Taxon	Functional Feeding Guild	GF1 DRY	GF1 WET	R1 WET	P8 DRY	P8 WET	P3CE10 WET	RORWB3 WET	P3CE11 DRY	P3CE11 WET	P7 DRY	P7 WET	P1 DRY
Ecnomidae	Predator		1			1				2		3	1
Elmidae	Scraper												
Ephydridae	undetermined												
Gerridae	Predator				2					1		1	
Glossiphoniidae	Predator												
Gomphidae	Predator						3			1	1	1	2
Gyrinidae	Predator			16	1	1	1				2		
Hebridae	Predator												
Hemicorduliidae	Predator							2		1			
Hydraenidae	Gatherer/collector			2	7	2	7	8	7	3	1		1
Hydridae	Predator								4				
Hydrobiidae	Scraper								20				5
Hydrochidae	Shredder					6	3		20	2		3	
Hydrometridae	Predator	4			4							1	1
Hydrophilidae	Predator	9		3	7		2	5	2		3	1	2
Hydropsychidae	Filter-feeder												
Hydroptilidae	Predator								34				
Hydryphantidae	Predator								7				
Hyriidae	Predator									1			
Isostictidae	Predator	1									1	1	
Leptoceridae	Shredder			1		16	5	4	46	6	1	2	32
Leptophlebiidae	Gatherer/collector												1
Libellulidae	Predator							1		2			1
Lymnaeidae	Scraper				2				4				
Mesostigmata	Predator								1				
Mesoveliidae	Predator								2				
Naucoridae	Predator												1
Nematoda	Predator				19			25	4		5		
Nepidae	Predator		1								2		
Noteridae	Predator		1				1					1	
Notonectidae	Predator				1	1		7			5		
Ochteridae	Predator												
Oligochaeta	Gatherer/collector				1		2	3	82	3	12		3
Oribatida	Predator								4				

Taxon	Functional Feeding Guild	GF1 DRY	GF1 WET	R1 WET	P8 DRY	P8 WET	P3CE10 WET	RORWB3 WET	P3CE11 DRY	P3CE11 WET	P7 DRY	P7 WET	P1 DRY
Ostracoda	Filter-feeder				12		4	3	1	3	4		2
Palaemonidae	Gatherer/collector		1		7		2		1	3	11	5	1
Parastacidae	Shredder				2						2		
Physidae	Scraper	15											
Pisauridae	Predator		1		9								
Planorbidae	Scraper							10	26				1
Pleidae	Predator	1		2		2	1		6	1	2		15
Porifera	Filter-feeder								1				
Protoneuridae	Predator												7
Psychodidae	Gatherer/collector												
Richardsonianidae	Predator												
Sciomyzidae	Predator				3								
Scirtidae	Filter-feeder				7						1		
Simuliidae	Filter-feeder												
Sisyridae	Predator												1
Spercheidae	Filter-feeder						1						
Sphaeriidae	Filter-feeder												9
Staphylinidae	Predator		1		5						1		
Stratiomyidae	Gatherer/collector								5				
Teleplebiidae	undetermined												
Temnocephalidea	Predator		1		19		1			2	4		
Thiaridae	Scraper								21				7
Tipulidae	Gatherer/collector		1										
Trichoptera	undetermined												
Veliidae	Predator	10	7	8	42	4	3		8	1		6	2
Zygoptera	Predator			1				3	8	2		1	14
Abundance		**74**	**22**	**75**	**346**	**53**	**248**	**128**	**704**	**490**	**201**	**101**	**173**
Total number of taxa		**15**	**13**	**14**	**27**	**14**	**27**	**20**	**39**	**32**	**29**	**21**	**34**

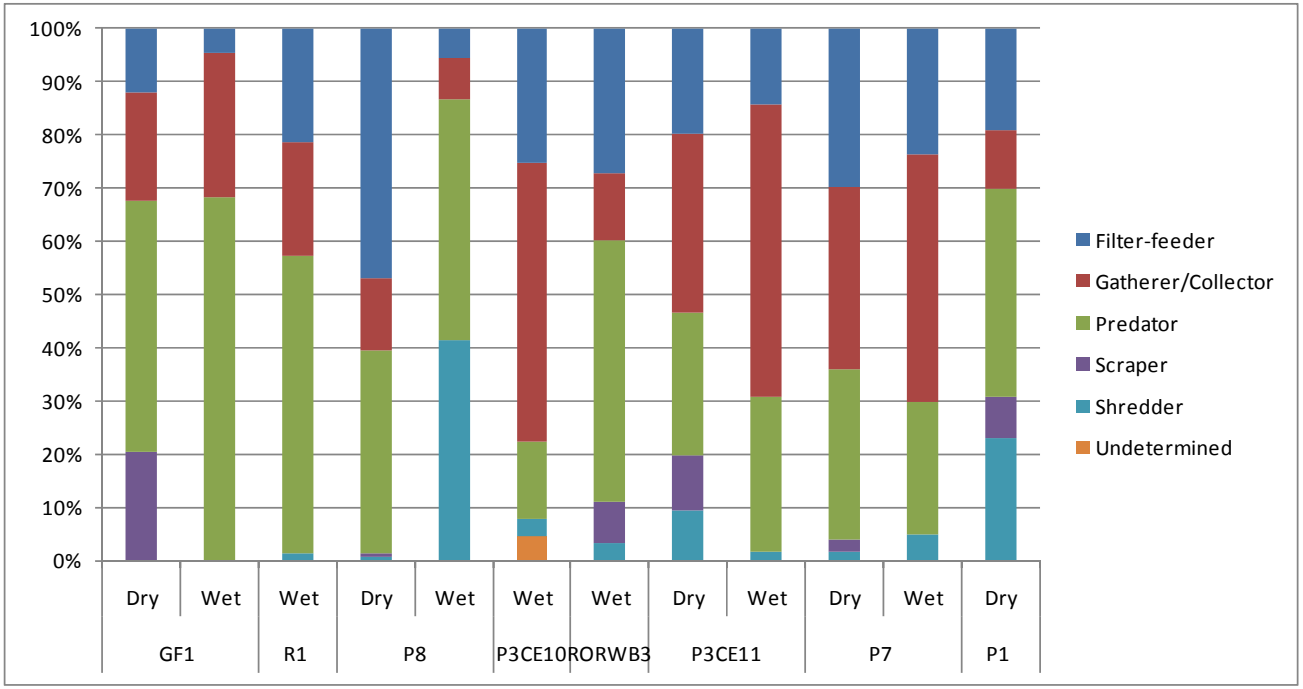


Figure A3-1 Functional feeding groups for dry season and post-wet season surveys

Table A3-2 SIGNAL 2 Scores and Bi-Plot

Catchment	Site	SIGNAL 2 score	
		Dry	Wet
Condamine	GF1	2.85	3.82
	R1		3.08
Dawson	P8	3.00	3.38
	P3CE10		3.61
	RORWB3		3.00
	P3CE11	3.47	3.63
	P7	3.50	3.89
Calliope	P1	3.73	

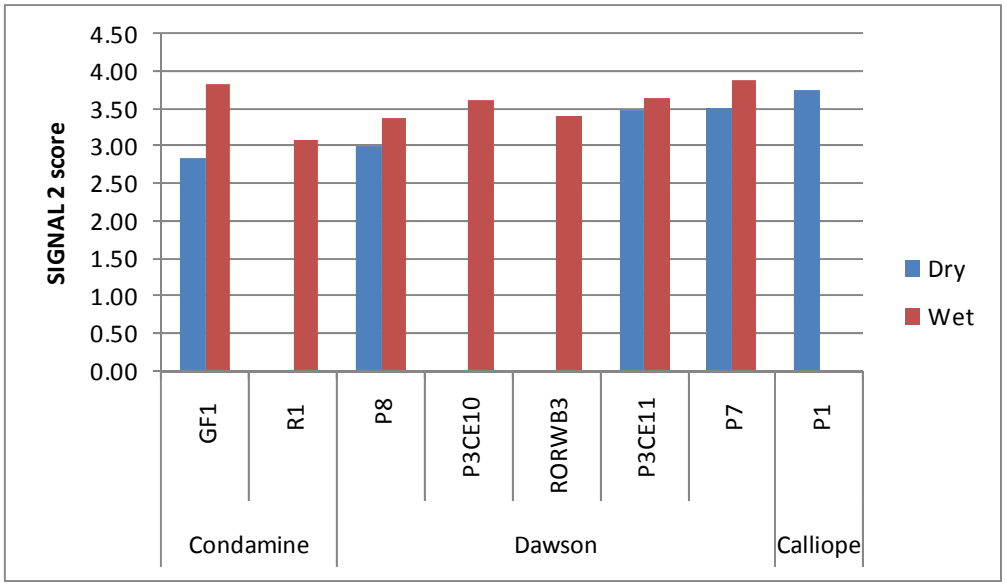


Figure A3-2 SIGNAL 2 scores

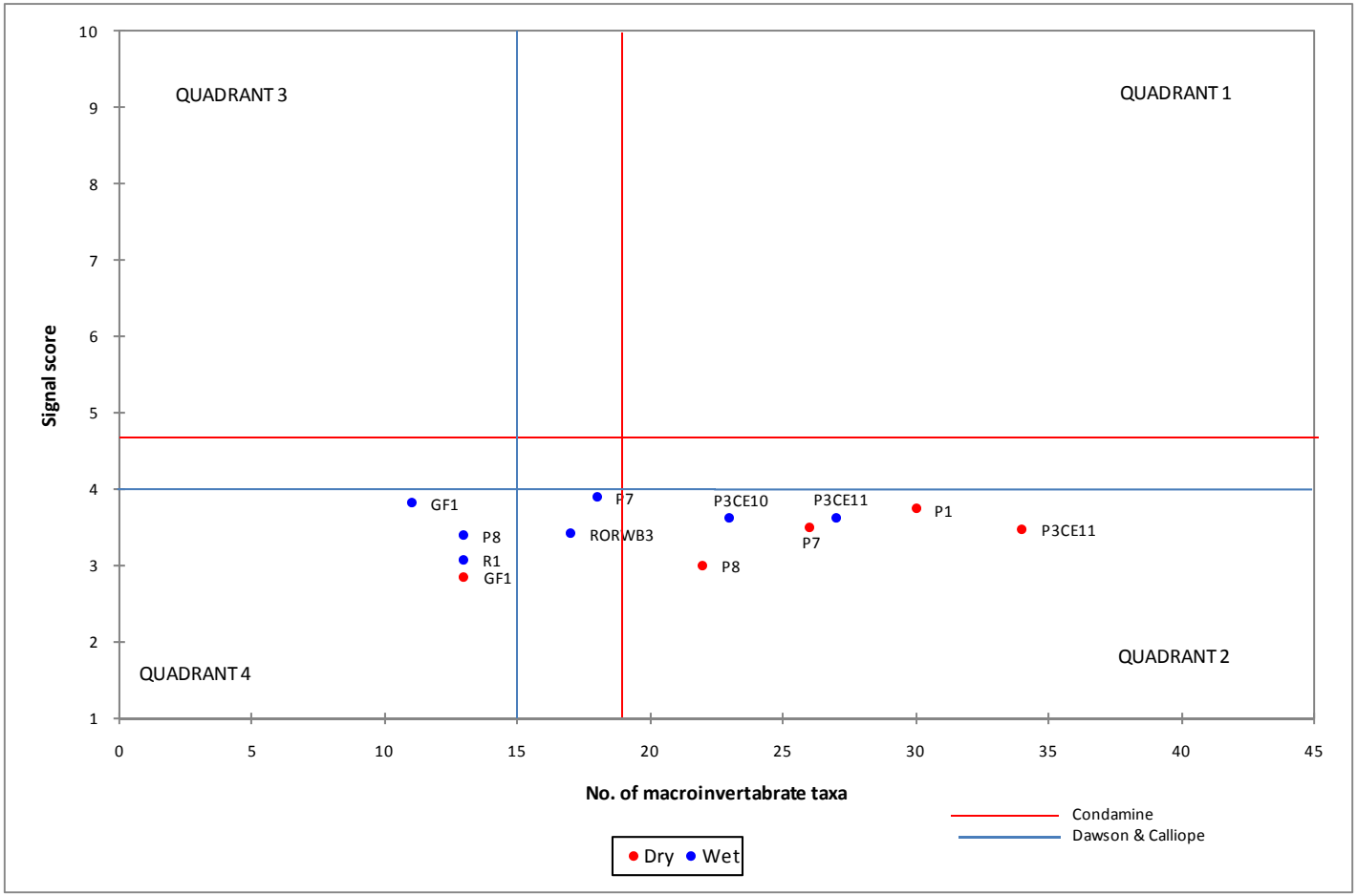


Figure A3-3 Bi-plot of SIGNAL 2 Scores

Table A3-3 Macroinvertebrate flow and substrate data – pipeline sites (bed data)

Taxon	Flow Velocity Preference Group	Substrate Preference Group	GF1	R1	P8	P3CE10	RORWB3	P3CE11	P7	P7	P4	P4LL	P1
			Dry	Dry	Dry	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Dry
Acarina	NP	NP					10	110			70		
Aeshnidae	NP	NC											
Ameletopsidae	L/NF	NC											40
Ancylidae	L/NF	NC			10	10			80	10			10
Anisoptera	NC	NC						10					
Atyidae	L/NF	WF											
Baetidae	NP	NP		10			40						
Belostomatidae	L/NF	SF											
Bryozoa	NC	NC											
Caenidae	NP	NP						60	40				
Calamoceratidae	NP	NP											20
Ceratopogonidae	NP	NP		260		10	740	90	260	30	10	20	
Chaoboridae	NC	NC		10									
s-f Chironominae	NP	NP	70	400	1	70	1390	1030	860	700	620	760	
s-f Orthocladiinae	NP	WC						10					90
s-f Tanypodinae	NP	NP	100	20	3	70	10	90	130		320	50	
Cladocera	L/NF	WF	80	70	790	320	70	30	20		10	390	430
Clavidae	NC	NC											
Coenagrionidae	L/NF	WF											
Collembola	L/NF	SF											
Copepoda	L/NF	WF	1960	20	2240	3010	60	290	360	60	200		
Corbiculidae	NP	NP							10				40
Corbiculoidea	NC	NC						10					
Corduliidae	L/NF	NP											
Corixidae	L/NF	WF				1	1	10			10		
Culicidae	L/NF	SF											
Dugesiidae	HF	WC	20										50
Dytiscidae	L/NF	WF				20					1		
Ecnomidae	NP	WC						10		60			
Elmidae	HF	WC											

Taxon	Flow Velocity Preference Group	Substrate Preference Group	GF1	R1	P8	P3CE10	RORWB3	P3CE11	P7	P7	P4	P4LL	P1
			Dry	Dry	Dry	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Dry
Ephydridae	NC	NC							1				
Gerridae	L/NF	WF											
Glossiphoniidae	NP	NP											
Gomphidae	NP	NP							1				
Hydraenidae	L/NF	SF											
Hydrochidae	NC	NC	5										
Hydrometridae	L/NF	SF											
Hydrophilidae	L/NF	WF					20						
Hydropsychidae	HF	SC											40
Hydroptilidae	NP	WC						10					
Hyriidae	L/NF	SF											950
Isostictidae	L/NF	WF											
Leptoceridae	NP	NP		10				40	40		80		
Leptophlebiidae	NP	WC											
Libellulidae	NP	NP											
Megapodagrionidae	MF	SF											
Mesostigmata	NC	NC											
Naucoridae	NP	NP											
Nematoda	NP	NC	440			10	3600	20	40		40	120	30
Noteridae	L/NF	SF											
Notonectidae	L/NF	SF			1	11	40		1				
Oligochaeta	NP	NP	340	220		880			220	120	70	100	850
Ostracoda	L/NF	WF				10	20	30	70		60	20	30
Palaemonidae	NP	NP							1				
Parasticidae	L/NF	SF											1
Physidae	L/NF	SF											
Planorbidae	L/NF	WF					10						
Psephenidae	HF	SC											40
Ptilodactylidae	HF	SC											
Simuliidae	HF	SC											200
Sphaeriidae	L/NF	SF									10		20
Tabanidae	HF	SC											

Taxon	Flow Velocity Preference Group	Substrate Preference Group	GF1 Dry	R1 Dry	P8 Dry	P3CE10 Dry	RORWB3 Wet	P3CE11 Wet	P7 Dry	P7 Wet	P4 Dry	P4LL Wet	P1 Dry
Temnocephalidea	L/NF	NP											
Thiaridae	NP	NP											410
Tipulidae	HF	SC										10	
Veliidae	L/NF	WF											
Zygoptera	NC	NC	10				30	10					1
Abundance			**3025**	**1020**	**3045**	**4422**	**6041**	**1860**	**2134**	**980**	**1501**	**1470**	**3252**
Number of taxa			**9**	**9**	**6**	**12**	**14**	**17**	**16**	**6**	**13**	**8**	**18**

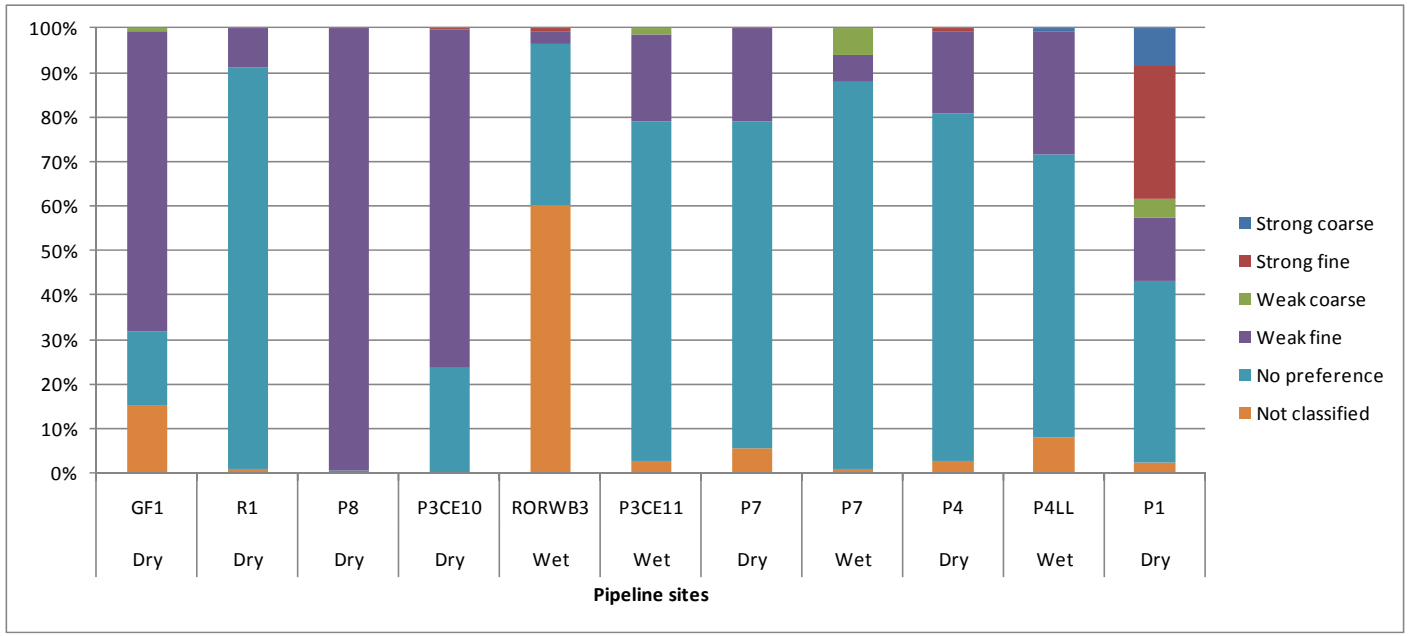


Figure A3-4 Substrate preference groups for dry season and post-wet season surveys

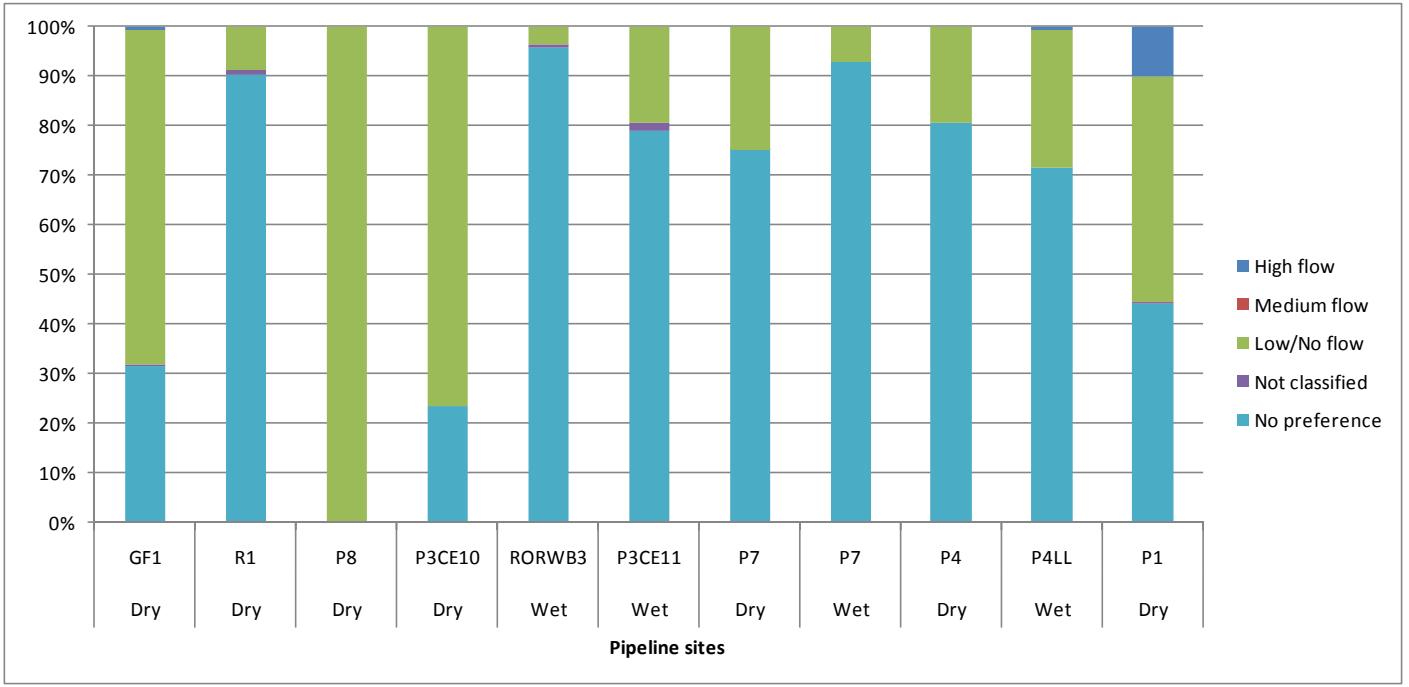


Figure A3-5 Flow preference groups for dry season and post-wet season surveys