Appendix 8-B

Murray River Coal Project: 2010 to 2012 Aquatic Resources Baseline Report

HD Mining International Ltd.

MURRAY RIVER COAL PROJECT
2010 to 2012 Aquatic Resources Baseline Report

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MURRAY RIVER COAL PROJECT
2010 TO 2012 AQUATIC RESOURCES BASELINE REPORT

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Executive Summary

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Executive Summary

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia, within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly from open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) using underground mining techniques.

To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were conducted by Rescan Environmental Services Ltd. (Rescan). Project-specific studies began in 2010 and have continued through 2012. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into analysis.

This report presents a cumulative summary of aquatic resource (water and sediment quality, primary producers and benthic communities) information compiled for the Project to date. An understanding of the aquatic environment of the area is necessary to inform Project planning and design and to provide baseline information for the environmental assessment process, and the design and implementation of a water management plan.

The objectives of the aquatic resource baseline program were to:

- characterize the spatial and seasonal variability of surface water quality of key waterbodies;
- characterize the sediment quality of key waterbodies;
- identify and quantify the species composition, density, and spatial distribution of the primary producer (periphyton and phytoplankton) and benthic invertebrate communities of key waterbodies; and
- provide baseline information to support the environmental effects assessment process, and a robust aquatic effects monitoring program.

Twenty one stream sites were sampled between 2010 and 2012. Streams in the Project area had alkaline waters and were well buffered. Most streams contained soft water during freshet (May-June) and summer months and hard water during the autumn and winter months. Hardness, alkalinity, total dissolved solids (TDS), and anion concentrations were typically lowest from spring (May) through the summer (September) with concentrations increasing from October to April. Conversely, turbidity and total suspended solids (TSS) had elevated levels during freshet (May-June), and lower levels during winter months. Nitrogen concentrations were low, while total phosphorus concentrations were high during freshet.

Total metal concentrations in stream waters were often below their detection limits. However, concentrations of many metals paralleled the seasonal trend observed for total suspended solids, with higher concentrations measured during freshet in association with increased terrestrial run-off and stream flows caused by snowmelt.

Total aluminum, cadmium, hexavalent chromium, copper, and iron were commonly above their respective CCME guideline for protection of aquatic life, while only total iron was higher than the BC guideline at most sites. Camp Creek sites and a Twenty Creek site were above the greatest number of guidelines, by the greatest factors. Polycyclic aromatic hydrocarbons (PAHs) were below their detection limits at most streams, and were not higher than CCME or BC water quality guidelines.

Overall, the toxicology experiments found no impact of Murray River site water on survival and reproduction of the water flea, *Ceriodaphnia dubia*, or rainbow trout (*Oncorhynchus mykiss*). However, the water flea *Daphnia magna* had considerably reduced survivorship when site water was present at any concentration. Duck weed (*Lemna minor*) may have been being inhibited by water chemistry at the Murray River reference site, though there was no evidence of this at the downstream Murray River site. Murray River water stimulated the growth of the microalga *Pseudokirchneriella subcapitata*.

Most stream sediments were sandy (over 50%), with silt making up a significant component. Total organic carbon and nutrient levels were lower in Murray River compared to its tributary streams. Sediment metal concentrations were also lower in the Murray River streams and greater in Camp Creek, M17-02 Creek, and the reference tributary. This was similar to patterns observed in water quality. Sediment cadmium and nickel concentrations were commonly above the CCME or BC guideline interim sediment quality guideline (ISQG) for the protection of aquatic life. Most stream sites were higher than the CCME and BC ISQG for the PAHs 2-methylnapthalene, phenanthrene, and naphthalene.

Periphyton biomass was low typically less than 1 µg chl *a*/cm^2, and communities varied considerably between years. Periphyton communities were composed largely of Bacillariophyceae (diatoms; 3-97% of the community), though Cyanophyta (blue-green algae) were often dominant or co-dominant in 2010. Chlorophyta (green algae) were dominant or co-dominant in Murray River tributary streams in 2012. Overall, stream periphyton communities were diverse though richness and diversity exhibited considerable inter-annual variation.

Benthic invertebrate samples were collected with a Hess sampler in 2010 and a kick-net in 2011 and 2012. In 2010, stream benthos densities were highest at the reference tributary REFST and in 2011 and 2012, benthos densities were generally higher in Murray River tributaries. In all years, benthos communities were dominated by Ephemeroptera (mayflies), Plecoptera (stoneflies), and Diptera (true flies). Benthos richness and diversity (Simpson's Diversity Index) was generally high in LSA streams.

Metal concentrations in periphyton tissues were often similar to sediment concentrations while metal concentrations in benthic invertebrate tissues were typically a small fraction of sediment concentrations. Stream periphyton tissue arsenic and cadmium concentrations were similar in LSA streams while periphyton tissues collected from Murray River tributaries had elevated mercury and selenium. Arsenic and selenium concentrations were high in stream benthic invertebrate tissues from Murray River tributaries while cadmium and mercury levels were similar among benthic invertebrate tissues collected from LSA streams.

Six wetland sites were sampled in August 2010 and from May to December 2012.

Wetlands in the Murray River Project area contained alkaline, hard water with high buffering capacity. Turbidity and TSS levels were low, except during winter months. Nutrient levels were low, though total phosphorus was elevated in the winter. Metal concentrations were similar among LSA wetlands, except for samples with elevated TSS and TDS; accordingly, metal concentrations were elevated in these samples. Similarly, concentrations of several metals were elevated at W9.0 and W9.3 in November and December 2012 when samples had elevated TSS compared to other samples from these sites.

Total aluminum and total iron were elevated in LSA wetlands and concentrations at most sites were above CCME guidelines for the protection of aquatic life.

Sediments in LSA wetlands were composed primarily of silt and sand. Organic carbon and nutrient levels were high in RW3 compared to other LSA wetlands. Wetland sediment metal concentrations were above the CCME or BC MOE guidelines for arsenic, cadmium, iron, manganese, nickel, and selenium, though RW3 sediments were not higher than any applicable guideline.

Phytoplankton biomass and densities were high in LSA wetlands. Phytoplankton communities were diverse, though there was considerable variability in community composition among wetlands. Dominant or co-dominant algal groups included green algae (Chlorophyta), cyanobacteria (Cyanophyta), dinoflagellates (Pyrrhophyta) and Cryptophyta.

Benthic invertebrate densities in LSA wetlands ranged over an order of magnitude. Benthos communities were dominated by Diptera (primarily Chironomidae), with smaller proportions of Gastropoda (snails), Amphipoda (scuds), and Bivalvia. Leeches (Hirudinea) were co-dominant at one site which was less diverse compared to the other sites.

Overall, sedge tissue metal concentrations reflected sediment metal levels, though tissue metal concentrations were much lower than sediment concentrations. One wetland had elevated sediment and sedge tissue arsenic concentrations while another had elevated sediment and sedge tissue selenium concentrations, compared to other wetland sites. Sedge cadmium and mercury concentrations were below or near their detection limits.

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Table of Contents

Rescan™
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MURRAY RIVER COAL PROJECT
2010 TO 2012 AQUATIC RESOURCES BASELINE REPORT

Table of Contents

Executive Summary i

Acknowledgements v

Table of Contents vii

List of Figures ix

List of Tables xiii

List of Plates xiv

List of Appendices xv

Glossary and Abbreviations xvii

1. Introduction 1-1

2. Background Information 2-1

2.1 Applicable Legislation, Regulations, and Guidelines 2-1

2.2 Regional Setting and Development 2-1

3. Methodology 3-1

3.1 Sampling Area 3-1

3.2 Sampling Locations 3-1

3.2.1 Streams 3-1

3.2.2 Wetlands 3-2

3.3 Sampling Program 3-9

3.3.1 Stream Sampling Program 3-9

3.3.1.1 Water Quality 3-9

3.3.1.2 Water Toxicity 3-15

3.3.1.3 Sediment Quality 3-16

3.3.1.4 Periphyton 3-20

3.3.1.5 Benthic Invertebrates 3-21

3.3.1.6 Tissue Metals 3-23

3.3.2 Wetland Sampling Program 3-25

3.3.2.1 Water Quality 3-26

3.3.2.2 Sediment Quality 3-29

3.3.2.3 Phytoplankton 3-31

3.3.2.4 Benthic Invertebrates 3-31
3.3.2.5 Tissue Metals 3-32

4. Stream Sampling Results 4-1
4.1 Water Quality 4-1
4.1.1 General Parameters and Anions 4-1
4.1.2 Suspended Material 4-1
4.1.3 Nutrients and Total Organic Carbon 4-1
4.1.4 Cyanide 4-15
4.1.5 Total Metals 4-15
4.1.6 Polycyclic Aromatic Hydrocarbons 4-50
4.1.7 Water Quality Guidelines 4-50
4.1.8 Quality Assurance and Quality Control 4-50
4.1.9 Excluded Data 4-55
4.2 Water Toxicity 4-55
4.2.1 Water Quality Guidelines 4-55
4.2.2 Toxicology Testing Results 4-55
4.3 Sediment Quality 4-58
4.3.1 Sediment Particle Size Composition 4-58
4.3.2 Sediment Nutrients 4-58
4.3.3 Sediment Metals 4-58
4.3.4 Polycyclic Aromatic Hydrocarbons 4-71
4.3.5 Sediment Quality Guidelines 4-71
4.3.5.1 Metals 4-71
4.3.5.2 Polycyclic Aromatic Hydrocarbons 4-71
4.4 Periphyton 4-72
4.4.1 Biomass, Density, and Community Composition 4-72
4.4.2 Richness and Diversity 4-72
4.4.3 Quality Assurance and Quality Control 4-72
4.5 Benthic Invertebrates 4-72
4.5.1 Density and Community Composition 4-78
4.5.1.1 Hess Samples 4-78
4.5.1.2 Kick-net Samples 4-78
4.5.2 Richness and Diversity 4-78
4.5.2.1 Hess Samples 4-78
4.5.2.2 Kick-net Samples 4-78
4.5.3 Quality Assurance and Quality Control 4-82
4.6 Tissue Metals 4-82

5. Wetland Sampling Results 5-1
5.1 Water Quality 5-1
5.1.1 General Parameters and Anions 5-1

5.1.2 Suspended Material 5-1
5.1.3 Nutrients and Total Organic Carbon 5-1
5.1.4 Cyanides..... 5-10
5.1.5 Metals..... 5-10
5.1.6 Guidelines 5-10
5.1.7 Quality Assurance and Quality Control 5-28
5.2 Sediment Quality 5-28
5.2.1 Sediment Particle Size Composition 5-28
5.2.2 Sediment Nutrients..... 5-28
5.2.3 Sediment Metals 5-35
5.2.4 Sediment Quality Guidelines 5-35
5.3 Phytoplankton..... 5-35
5.3.1 Biomass, Density, and Community Composition 5-35
5.3.2 Diversity..... 5-35
5.4 Benthic Invertebrates..... 5-35
5.4.1 Density and Community Composition 5-39
5.4.2 Richness and Diversity 5-39
5.5 Tissue Metals 5-39
6. Summary 6-1
References..... R-1

List of Figures

FIGURE **PAGE**

Figure 1-1. Project Location.....1-2
Figure 1-2. Project Study Boundaries 1-3
Figure 1-3. Preliminary Site Layout 1-5
Figure 3.2-1. Stream Sampling Sites, 2010 to 2012.....3-3
Figure 3.2-2. Wetland Sampling Sites, 2010 and 2012 3-7
Figure 4.1-1. pH Levels in Streams, 2010 to 2012 4-2
Figure 4.1-2. Total Alkalinity Levels in Streams, 2010 to 2012.....4-3
Figure 4.1-3. Total Hardness Levels in Streams, 2010 to 2012 4-4
Figure 4.1-4. Total Dissolved Solids in Streams, 2010 to 2012 4-5
Figure 4.1-5. Chloride Concentrations in Streams, 2010 to 2012 4-6
Figure 4.1-6. Sulphate Concentrations in Streams, 2010 to 2012.....4-7
Figure 4.1-7. Fluoride Concentrations in Streams, 2010 to 2012 4-8

Figure 4.1-8. Turbidity Levels in Streams, 2010 to 2012 4-9
Figure 4.1-9. Total Suspended Solids in Streams, 2010 to 2012 4-10
Figure 4.1-10. Total Nitrogen Concentrations in Streams, 2010 to 2012 4-11
Figure 4.1-11. Ammonia Concentrations in Streams, 2010 to 2012 4-12
Figure 4.1-12. Nitrite Concentrations in Streams, 2010 to 2012 4-13
Figure 4.1-13. Nitrate Concentrations in Streams, 2010 to 2012 4-14
Figure 4.1-14. Total Phosphorus Concentrations in Streams, 2010 to 2012 4-16
Figure 4.1-15. Dissolved Orthophosphate Concentrations in Streams, 2010 to 2012 4-17
Figure 4.1-16. Total Organic Carbon Concentrations in Streams, 2010 to 2012 4-18
Figure 4.1-17. Total Cyanide Concentrations in Streams, 2010 to 2012 4-19
Figure 4.1-18. Weak Acid Dissociable Cyanide Concentrations in Streams, 2010 to 2012 4-20
Figure 4.1-19. Total Aluminum Concentrations in Streams, 2010 to 2012 4-21
Figure 4.1-20. Dissolved Aluminum Concentrations in Streams, 2010 to 2012 4-22
Figure 4.1-21. Total Antimony Concentrations in Streams, 2010 to 2012 4-23
Figure 4.1-22. Total Arsenic Concentrations in Streams, 2010 to 2012 4-24
Figure 4.1-23. Total Barium Concentrations in Streams, 2010 to 2012 4-25
Figure 4.1-24. Total Beryllium Concentrations in Streams, 2010 to 2012 4-26
Figure 4.1-25. Total Boron Concentrations in Streams, 2010 to 2012 4-27
Figure 4.1-26. Total Cadmium Concentrations in Streams, 2010 to 2012 4-28
Figure 4.1-27. Dissolved Calcium Concentrations in Streams, 2010 to 2012 4-29
Figure 4.1-28. Total Chromium Concentrations in Streams, 2010 to 2012 4-30
Figure 4.1-29. Total Cobalt Concentrations in Streams, 2010 to 2012 4-31
Figure 4.1-30. Total Copper Concentrations in Streams, 2010 to 2012 4-32
Figure 4.1-31. Total Iron Concentrations in Streams, 2010 to 2012 4-33
Figure 4.1-32. Dissolved Iron Concentrations in Streams, 2010 to 2012 4-34
Figure 4.1-33. Total Lead Concentrations in Streams, 2010 to 2012 4-35
Figure 4.1-34. Total Lithium Concentrations in Streams, 2010 to 2012 4-36
Figure 4.1-35. Total Manganese Concentrations in Streams, 2010 to 2012 4-37
Figure 4.1-36. Total Mercury Concentrations in Streams, 2010 to 2012 4-38
Figure 4.1-37. Total Molybdenum Concentrations in Streams, 2010 to 2012 4-39

Figure 4.1-38. Total Nickel Concentrations in Streams, 2010 to 2012 4-40

Figure 4.1-39. Total Potassium Concentrations in Streams, 2010 to 2012 4-41

Figure 4.1-40. Total Selenium Concentrations in Streams, 2010 to 2012 4-42

Figure 4.1-41. Total Silver Concentrations in Streams, 2010 to 2012 4-43

Figure 4.1-42. Total Thallium Concentrations in Streams, 2010 to 2012 4-44

Figure 4.1-43. Total Tin Concentrations in Streams, 2010 to 2012 4-45

Figure 4.1-44. Total Titanium Concentrations in Streams, 2010 to 2012 4-46

Figure 4.1-45. Total Uranium Concentrations in Streams, 2010 to 2012 4-47

Figure 4.1-46. Total Vanadium Concentrations in Streams, 2010 to 2012 4-48

Figure 4.1-47. Total Zinc Concentrations in Streams, 2010 to 2012 4-49

Figure 4.3-1. Sediment Particle Size in Streams, 2010 to 2012 4-59

Figure 4.3-2. Sediment Total Organic Carbon, Total Nitrogen, and Available Phosphate Concentrations in Streams, 2010 to 2012 4-60

Figure 4.3-3. Sediment Arsenic, Cadmium, and Chromium Concentrations in Streams, 2010 to 2012 4-61

Figure 4.3-4. Sediment Copper, Iron, and Lead Concentrations in Streams, 2010 to 2012 4-62

Figure 4.3-5. Sediment Manganese, Mercury, and Nickel Concentrations in Streams, 2010 to 2012 .. 4-63

Figure 4.3-6. Sediment Selenium, Silver, and Zinc Concentrations in Streams, 2010 to 2012 4-64

Figure 4.3-7. Sediment Hydrocarbon (Acenapthene, Acenaphthylene, and Anthracene) Concentrations in Streams, 2010 to 2012 4-65

Figure 4.3-8. Sediment Hydrocarbon (Benzo(a)anthracene, Benzo(k)fluoranthene, and Benzo(g,h,i)perylene) Concentrations in Streams, 2010 to 2012 4-66

Figure 4.3-9. Sediment Hydrocarbon (Benzo(a)pyrene, Chrysene, and Dibenz(a,h)anthracene) Concentrations in Streams, 2010 to 2012 4-67

Figure 4.3-10. Sediment Hydrocarbon (Fluoranthene, Fluorene, and Indeno(1,2,3-c,d)pyrene) Concentrations in Streams, 2010 to 2012 4-68

Figure 4.3-11. Sediment Hydrocarbon (2-Methylnaphthalene, Naphthalene, and Phenanthrene) Concentrations, 2010 to 2012 4-69

Figure 4.3-12. Sediment Hydrocarbon (Pyrene and Total PAH) Concentrations in Streams, 2010 to 2012 4-70

Figure 4.4-1. Periphyton Biomass and Density in Streams, 2010 to 2012 4-75

Figure 4.4-2. Periphyton Community Composition in Streams, 2010 to 2012 4-76

Figure 4.4-3. Periphyton Richness and Diversity in Streams, 2010 to 2012 4-77

Figure 4.5-1. Benthos Density in Streams, 2010 to 2012 4-79

Figure 4.5-2. Benthos Community Composition in Streams, 2010 to 2012 4-80

Figure 4.5-3. Benthos Richness and Diversity in Streams, 2010 to 2012..... 4-81

Figure 4.6-1. Arsenic Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012 4-83

Figure 4.6-2. Cadmium Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012 4-84

Figure 4.6-3. Mercury Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012 4-85

Figure 4.6-4. Selenium Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012 4-86

Figure 5.1-1. pH and Total Alkalinity Levels in Wetlands, 2010 to 2012 5-2

Figure 5.1-2. Total Hardness Levels and Total Dissolved Solids in Wetlands, 2010 to 2012.....5-3

Figure 5.1-3. Chloride and Sulphate Concentrations in Wetlands, 2010 to 2012.....5-4

Figure 5.1-4. Fluoride and Turbidity Concentrations in Wetlands, 2010 to 2012 5-5

Figure 5.1-5. Total Suspended Solids and Total Nitrogen Concentrations in Wetlands, 2010 to 2012.....5-6

Figure 5.1-6. Ammonia and Nitrite Concentrations in Wetlands, 2010 to 2012 5-7

Figure 5.1-7. Nitrate and Total Phosphorus Concentrations in Wetlands, 2010 to 2012.....5-8

Figure 5.1-8. Dissolved Orthophosphate and Total Organic Carbon Concentrations in Wetlands, 2010 to 2012.....5-9

Figure 5.1-9. Total Cyanide and Weak Acid Dissociable Cyanide Concentrations in Wetlands, 2010 to 2012..... 5-11

Figure 5.1-10. Total and Dissolved Aluminum Concentrations in Wetlands, 2010 to 2012 5-12

Figure 5.1-11. Total Antimony and Arsenic Concentrations in Wetlands, 2010 to 2012 5-13

Figure 5.1-12. Total Barium and Beryllium Concentrations in Wetlands, 2010 to 2012..... 5-14

Figure 5.1-13. Total Boron and Cadmium Concentrations in Wetlands, 2010 to 2012 5-15

Figure 5.1-14. Dissolved Calcium and Total Chromium Concentrations in Wetlands, 2010 to 2012 ... 5-16

Figure 5.1-15. Total Cobalt and Copper Concentrations in Wetlands, 2010 to 2012 5-17

Figure 5.1-16. Total and Dissolved Iron Concentrations in Wetlands, 2010 to 2012..... 5-18

Figure 5.1-17. Total Lead and Lithium Concentrations in Wetlands, 2010 to 2012..... 5-19

Figure 5.1-18. Total Manganese and Mercury Concentrations in Wetlands, 2010 to 2012..... 5-20

Figure 5.1-19. Total Molybdenum and Nickel Concentrations in Wetlands, 2010 to 2012..... 5-21

Figure 5.1-20. Total Potassium and Selenium Concentrations in Wetlands, 2010 to 2012 5-22

Figure 5.1-21. Total Silver and Thallium Concentrations in Wetlands, 2010 to 2012 5-23

Figure 5.1-22. Total Tin and Titanium Concentrations in Wetlands, 2010 to 2012 5-24

Figure 5.1-23. Total Uranium and Vanadium Concentrations in Wetlands, 2010 to 2012 5-25

Figure 5.1-24. Total Zinc Concentrations in Wetlands, 2010 to 2012 5-26

Figure 5.2-1. Sediment Particle Size for Wetlands, 2010 5-29

Figure 5.2-2. Sediment Total Organic Carbon, Total Nitrogen, and Available Phosphate Concentrations in Wetlands, 2010..... 5-30

Figure 5.2-3. Sediment Arsenic, Cadmium, and Chromium Concentrations in Wetlands, 2010 5-31

Figure 5.2-4. Sediment Copper, Iron, and Lead Concentrations in Wetlands, 2010 5-32

Figure 5.2-5. Sediment Manganese, Mercury, and Nickel Concentrations in Wetlands, 2010..... 5-33

Figure 5.2-6. Sediment Selenium, Silver, and Zinc Concentrations in Wetlands, 2010 5-34

Figure 5.3-1. Phytoplankton Biomass, Density, Richness and Diversity in Wetlands, 2010..... 5-37

Figure 5.3-2. Phytoplankton Community Composition in Wetlands, 2010..... 5-38

Figure 5.4-1. Benthos Density, Community Composition, Richness and Diversity in Wetlands, 2010 . 5-40

Figure 5.5-1. Arsenic and Cadmium Concentrations in Sediment and Sedge Tissue in Streams, 2010 5-41

Figure 5.5-2. Mercury and Selenium Concentrations in Sediment and Sedge Tissue in Streams, 2010 5-42

List of Tables

TABLE **PAGE**

Table 3.2-1. Stream Sampling Sites for the Aquatic Resources Baseline Monitoring Program, 2010 to 2012.....3-5

Table 3.2-2. Wetland Sampling Sites for the Aquatic Resources Baseline Monitoring Program, 2010 to 2012.....3-8

Table 3.3-1. Stream Samples Collected and Sampling Schedule, 2010 to 2012 3-11

Table 3.3-2. Stream Water Quality Parameters and Realized Detection Limits, 2010 and 2012..... 3-13

Table 3.3-3. Stream Sediment Quality Parameters and Realized Detection Limits, 2010 to 2012..... 3-17

Table 3.3-4. Taxa Excluded from Taxonomic Analyses Based on the CABIN Protocol 3-23

Table 3.3-5. Stream Periphyton Tissue Metal Parameters and Realized Detection Limits, 2011 and 2012..... 3-24

Table 3.3-6. Stream Benthic Invertebrate Tissue Metal Parameters and Realized Detection Limits, 2010 and 2012 3-25

Table 3.3-7. Wetland Samples Collected and Sampling Schedule, 2010 and 2012..... 3-26

Table 3.3-8. Wetland Water Quality Parameters and Realized Detection Limits, 2010 and 2012 3-27

Table 3.3-9. Wetland Sediment Quality Parameters and Realized Detection Limits, 2010 3-30

Table 3.3-10. Wetland Sedge Tissue Metal Parameters and Realized Detection Limits, 2010..... 3-33

Table 4.1-1. Percentage of CCME Guideline Exceedances and Average Factor of Exceedances in Stream Replicates, 2010 to 2012 4-51

Table 4.1-2. Percentage of BC Guideline Exceedances and Average Factor of Exceedances in Stream Replicates, 2010 to 2012 4-53

Table 4.2-1. Toxicity Test Results for the *Ceriodaphnia dubia* Survival and Reproduction Test, 2010 4-56

Table 4.2-2. Toxicity Test Results for the *Lemna minor* Growth Inhibition Test, 2010..... 4-56

Table 4.2-3. Toxicity Test Results for the *Pseudokirchneriella subcapitata* Growth Inhibition Test, 2010 4-57

Table 4.2-4. Toxicity Test Results for the *Oncorhynchus mykiss* Survival Test, 2010..... 4-57

Table 4.2-5. Toxicity Test Results for the *Daphnia magna* Survival Test, 2010 4-58

Table 4.3-1. Percentage of CCME and BC Guideline Exceedances and Average Factor of Exceedances in Stream Sediment Replicates, 2010 to 2012..... 4-73

Table 5.1-1. Percentage of CCME Guideline Exceedances and Average Factor of Exceedances in Wetland Replicates, 2010 to 2012..... 5-27

Table 5.1-2. Percentage of BC Guideline Exceedances and Average Factor of Exceedances in Wetland Replicates, 2010 to 2012..... 5-28

Table 5.2-1. Percentage of CCME and BC Guideline Exceedances and Average Factor of Exceedances in Wetland Sediment Replicates, 2010 to 2012 5-36

List of Plates

PLATE **PAGE**

Plate 3.2-1. Site MR-REF on the Murray River, August 2010. 3-2

Plate 3.2-2. Site M20-04 on M20 Creek, August 2010. 3-9

Plate 3.3-1. Invertebrates for tissue metal analysis, August 2010..... 3-24

Plate 3.3-2. Macrophytes at site LW4, August 2010. 3-29

Plate 3.3-3. Wetland Sedge for tissue metal analysis, August 2010. 3-32

List of Appendices

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Appendix 2-1. Toxicity Testing on the Samples MR5 and MR-REF: Final Toxicity Test Report

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Appendix 3-2. Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

Appendix 3-3. Stream Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

Appendix 4-1. Stream Sampling Results 2011

Appendix 4-2. Stream Sampling Results 2012

Appendix 4-3. Stream Periphyton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010 to 2012

Appendix 4-4. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Appendix 4-5. Stream Periphyton Taxonomy Laboratory Quality Assurance and Quality Control, Murray River Coal Project, 2011 to 2012

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Appendix 5-3. Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2010

Appendix 5-4. Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2011 and 2012

Appendix 6-1. Stream Periphyton Tissue Metal Analytical Results, Murray River Coal Project, 2011 and 2012

Appendix 6-2. Stream Benthic Invertebrate Tissue Metal Analytical Results, Murray River Coal Project, 2010 and 2012

Appendix 6-3. Stream Periphyton Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

Appendix 6-4. Stream Benthic Invertebrate Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Appendix 7-2. Wetland Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010

Appendix 7-3. Wetland Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010

Appendix 8-1. Wetland Sediment Quality Analytical Results, Murray River Coal Project, 2010

Appendix 8-2. Wetland Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

Appendix 9-1. Wetland Phytoplankton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010

Appendix 9-2. Wetland Phytoplankton Taxonomic Results, Murray River Coal Project, 2010

Appendix 10-1. Wetland Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Appendix 11-1. Wetland Sedge Tissue Metal Analytical Results, Murray River Coal Project, 2010

Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ALS	ALS Environmental Ltd.
BC	British Columbia
BC MOE	British Columbia Ministry of Environment
Benthos	Benthic Invertebrates
CABIN	Canadian Aquatic Biomonitoring Network
CCME	Canadian Council of Ministers of the Environment
CEPA	*Canadian Environmental Protection Act*
Chl *a*	Chlorophyll *a*
COC	Chain of Custody
COPC	Contaminants of Potential Concern
CWA	*Canada Water Act*
DDW	Distilled Deionized Water
DL	Detection Limit
EEM	Environmental Effects Monitoring
EDI	Environmental Dynamics Inc.
EPT	Ephemeroptera, Plecoptera, Trichoptera
HD Mining	HD Mining International Ltd.
IC	Inhibition Concentration
ISQG	Interim Sediment Quality Guideline
LC	Lethal Concentration
LEL	Lower Effects Level
LSA	Local Study Area
MMER	Metal Mining Effluent Regulations
NTU	Nephelometric Turbidity Unit
PAHs	Polycyclic aromatic hydrocarbons
PEL	Probable Effect Level
PRC	Peace River Coalfield
Project	Murray River Coal Project
RCA	Reference Condition Approach

Rescan	Rescan Environmental Services Ltd.
RPD	Relative Percent Difference
RSA	Regional Study Area
SEL	Severe Effect Level
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
QA/QC	Quality Assurance and Quality Control

1. Introduction

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1. Introduction

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum (6 Mtpa) underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia (Figure 1-1), and consists of 57 coal licences covering an area of 16,024 hectares. The Project is located within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly from open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) through underground mining techniques.

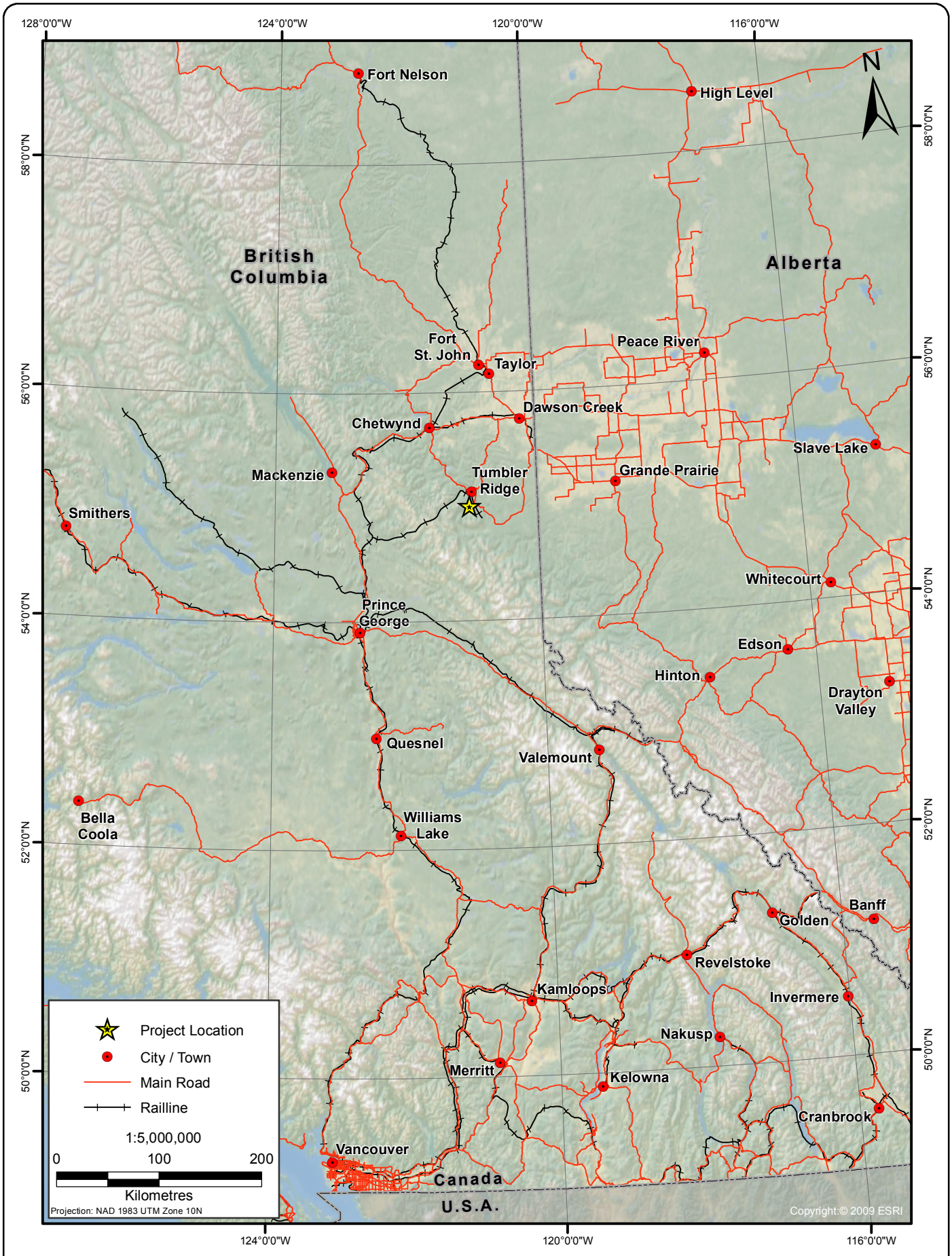
In October 2011, HD Mining submitted an application to the BC Ministry of Energy and Mines and Ministry of Environment seeking permission to complete a bulk sampling program as part of exploration of the property. In March 2012, HD Mining received approval to conduct a 100,000 tonne bulk sample for the purpose of conducting testing to assist in developing markets for the coal.

Beyond the bulk sample program, in order to develop a full mine at the proposed 6 Mtpa, the Project is subject to both the BC and Canadian environmental assessment processes. Development of any infrastructure for the full mine is not permitted before the requirements of these processes are met.

To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were initiated by Rescan Environmental Services Ltd. (Rescan). EDI Environmental has assisted with field sampling work. Project-specific studies began in 2010 and have continued through 2012. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into analysis.

In order to help guide the scope of baseline studies, regional and local study areas (RSA and LSA, respectively) have been developed (Figures 1-2 and 1-3). The RSA is intended to encompass an area beyond which effects of the Project would not be expected. It is also intended to be ecologically relevant based on the home range of key wildlife species known to inhabit the region. The LSA encompasses an area surrounding the proposed Project infrastructure within which direct effects from the Project may be anticipated. Its boundary has also been developed following natural terrain and drainage boundaries in order to be ecologically relevant. For consistency, the same RSA and LSA are used for all environmental studies.

This report presents a cumulative summary of all aquatic resource (water and sediment quality, periphyton/phytoplankton and benthic invertebrates) information collected in support of the Project to date. Understanding of the aquatic ecosystems in the area is necessary to inform Project planning and design and to provide baseline information for future environmental assessment, and the design and implementation of a water management plan.



hd Mining | MURRAY RIVER COAL PROJECT

Project Location

Figure 1-1

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PROJECT # 0194106 GIS # MUR-15-058 VERSION # T0.10 April 10 2013

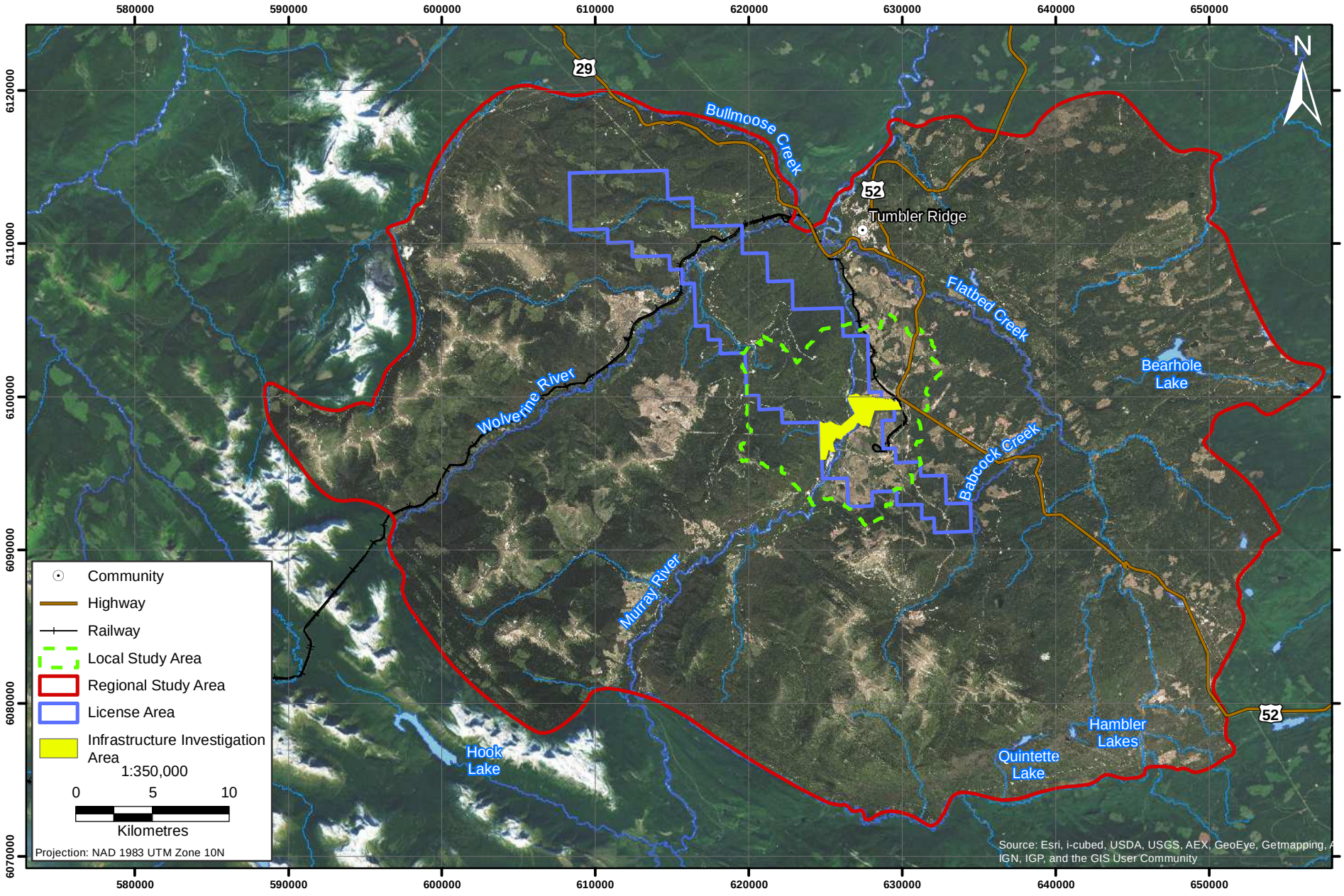

Figure 1-2

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MURRAY RIVER COAL PROJECT

Project Study Boundaries

Figure 1-2

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The objectives of the aquatic resource baseline program were to:

- characterize the spatial and seasonal variability of surface water quality of key waterbodies in the regional study area (RSA) with a focus on the local study area (LSA);
- characterize the sediment quality of key waterbodies in the RSA with a focus on the LSA;
- identify and quantify the species composition, density, and spatial distribution of the primary producer (stream periphyton and wetland phytoplankton) and benthic invertebrate communities in the RSA with a focus on the LSA; and
- provide baseline information to support a future environmental effects assessment, and a robust aquatic effects monitoring program.

Chapter 2 of this report outlines available background information, Chapter 3 describes the methodology used for this baseline study, Chapters 4 and 5 present the results of data collection, and Chapter 6 summarizes the key findings.

PROJECT # 0791-007-01 *GIS #* MUR-15-071 *VERSION #* T0.10 February 18 2013

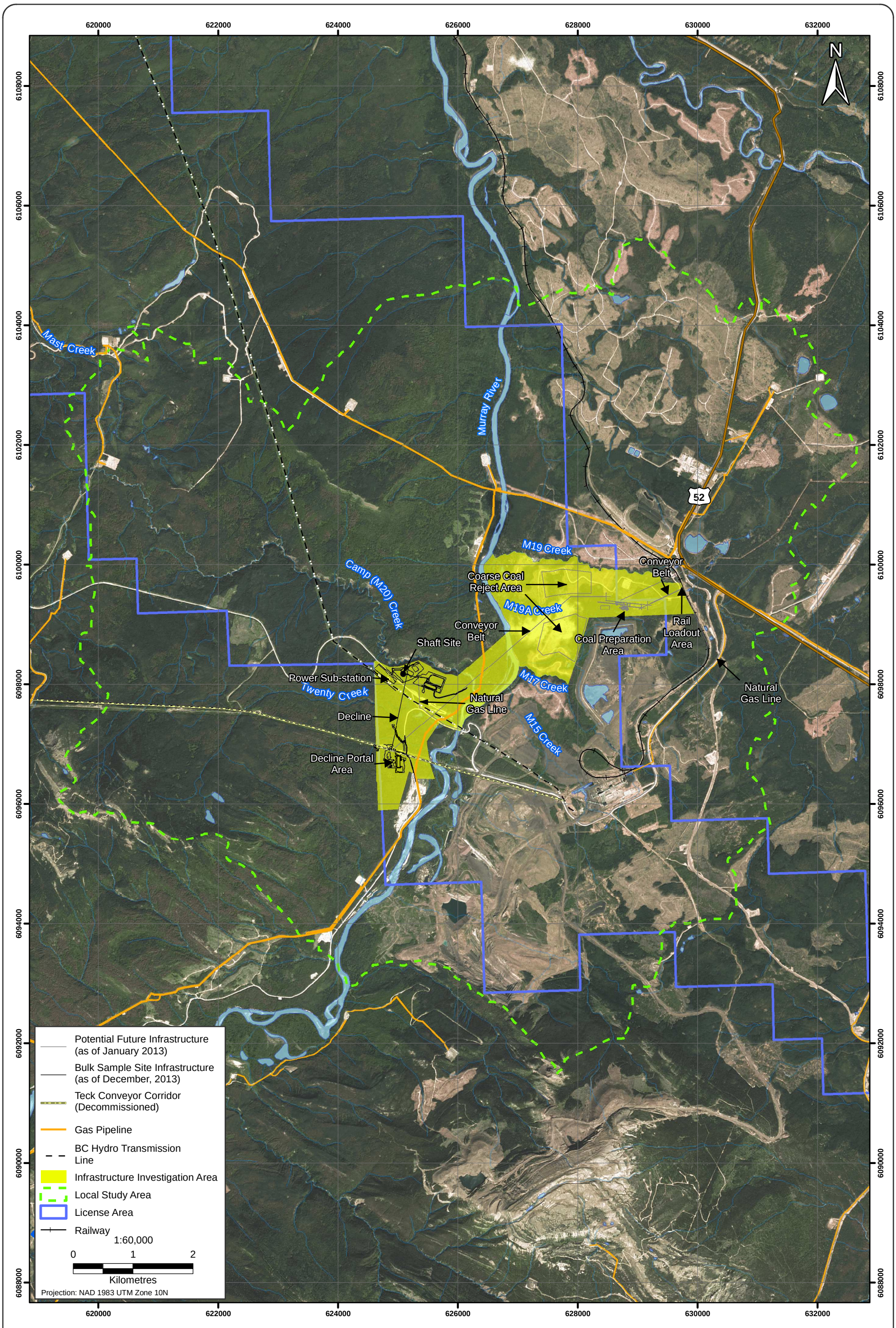

Figure 1-3

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MURRAY RIVER COAL PROJECT

Preliminary Site Layout

Figure 1-3

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2. Background Information

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2. Background Information

2.1 APPLICABLE LEGISLATION, REGULATIONS, AND GUIDELINES

Waters and aquatic habitat are subject to key federal legislation including the *Canada Water Act* (CWA; 1985), the *Fisheries Act* (1985), and the *Canadian Environmental Protection Act* (CEPA; 1999). Provincial legislation will also include the BC *Mines Act* (1996), *Water Act* (1996), *Environmental Management Act* (2003) and *Coal Act* (2004).

Regulations designed to protect water resources are based on the avoidance of deleterious impacts to water quality, sediment quality and aquatic organisms. Specific regulations do not exist for individual contaminants; however, the Canadian Council of Ministers for the Environment (CCME) has developed consensus based environmental quality guidelines for the protection of aquatic life (CCME 2002 and 2007). The BC Ministry of Environment (MOE) has established water and sediment quality criteria for the protection of fresh water aquatic life (BC MOE 2006 and 2013). In addition, the BC MOE have prepared a baseline monitoring guidance document for mine proponents and operators which was used to guide the sampling program (BC MOE, 2012).

All water and sediment quality parameters were screened against available BC Ministry of the Environment and CCME guideline values for the protection of freshwater aquatic life (CCME 2002 and 2007; BC MOE 2006 and 2013).

2.2 REGIONAL SETTING AND DEVELOPMENT

The Murray River Coal Project is located in north-eastern BC's Rocky Mountain foothills and is part of the Southern Alberta Upland Ecoregion within the Boreal Plains Ecoprovince (Demarchi 2011). The region is characterized by a continental climate with little precipitation, moderately warm summers and cold winters. Vegetation in lowland areas consists of moist grasslands and trembling aspens (*Populus tremuloides*). Upland areas are dominated by white spruce (*Picea glauca*), black spruce (*Picea mariana*) and lodgepole pine (*Pinus contorta*).

The Murray River is a moderate-gradient system stretching 200 km from its origin at Upper Blue Lake, in the Hart Ranges of the Rocky Mountains, to its confluence with the Pine River on the Peace Lowlands to the northeast. It flows north into the Pine River, 40 km downstream from the Village of Chetwynd, BC. Both the Pine and Murray Rivers belong to the greater Peace River drainage system, which flows into the Slave River, a tributary of the greater Mackenzie River Watershed (Rescan 2013). Murray River has a drainage area of 5,550 km^2 upstream of its outlet into Pine River (Rescan 2013).

The Project is located in a 275 km stretch of coal deposits and associated coal properties that comprise BC's northeast coal block in the Peace River District. Anthropogenic influences in the immediate Project area include existing coal mines, oil and natural gas wells, logging, and the Tumbler Ridge town-site.

Coal mines in the immediate Project area include the Quintette mine which operated for between 1982 and 2000 and has recently been granted BC government approval to reopen, the currently operating Wolverine and Trend mines, the Hermann Mine which has received an environmental certificate, the Roman project which has been granted a conditional environmental assessment certificate, and a number of mines are undergoing feasibility studies and environmental assessments including the Horizon project.

Oil and natural gas wells are scattered throughout the Murray River Watershed and 242 new wells were approved for development within a 100 km radius of Tumbler Ridge in 2008 and 2009. Logging in the Murray River watershed is ongoing, and large areas of pine forest were destroyed by the mountain pine beetle. Tumbler Ridge has a population of 3,500 and is located on the east bank of the Murray River. The town derives its drinking water from a groundwater well; however, it does hold a water licence to draw water from Murray River as a secondary source. The Tumbler Ridge sewage outfall discharges into the Murray River, upstream of the confluence with the Wolverine River.

3. Methodology

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3. Methodology

3.1 SAMPLING AREA

The Murray River Watershed encompasses a number of major and minor tributaries. South of the Project area the larger tributaries Wolverine Creek and Flatbed Creek flow into the Murray River. Smaller tributaries M20 (Camp) Creek and Twenty Creek (located on the west side of Murray River) and M19 Creek and M17 Creek (located on east side of the river), are in close proximity to the proposed Project surface facilities (shaft area on the west side and coal preparation and reject area on the east side; Figure 1-3). Even numbered tributary creeks occur on the west side of the river, and odd numbered creeks are on the east side of Murray River.

The spatial boundaries for water quality, sediment quality, and aquatic resources were defined by regional and local study areas (RSA and LSA, respectively; Figure 1-2).

3.2 SAMPLING LOCATIONS

3.2.1 Streams

Sampling locations were chosen annually by considering proposed Project footprints and regulator correspondence; as a result locations have varied from year to year. Reference sites were selected outside of the LSA and were at least 10 km from the mine site to reduce the potential for direct or indirect effects due the proposed Project, such as fugitive dust. In addition, reference sites were selected in areas with limited or no anthropogenic activity. Watercourse size was also considered; thus, reference sites were established on the Murray River and Club Creek to account for different morphologies between the Murray River and its smaller tributaries.

A total of 21 stream water quality and aquatic biology sites were sampled in the Project area from 2010 to 2012. Ten sites were established in 2010, seven along the Murray River (MR-REF and MR1 to MR4, MR6 and MR9) and three in tributary streams (M20-05, M20-04, and REFST). Five of those sites (MR1 to MR4 and M20-04) were sampled historically for the Hermann Mine baseline studies. In 2011 and 2012, the aquatic resource sampling program was refined according to changes in infrastructure, and consultation with BC MOE. Sites were added to characterize baseline aquatic resources upstream and downstream of the proposed eastern and western surface facilities and to support a future cumulative effects assessment. Stream sampling locations are illustrated in Figure 3.2-1 and the rationale for site locations are outlined in Table 3.2-1.

Reference site MR-REF was established on the Murray River over 10 km upstream of the Project and upstream of potential effects from Hermann Mine activities (Plate 3.2-1). Sites MR1 and MR2 were established on Murray River between the outflows of water flowing from the proposed Hermann Mine (which was granted an EA certificate in 2006). MR9 is upstream of all Project activities and discharge locations; therefore, MR9 will be the Murray River control site for the Project. If/when the Hermann Mine opens MR9 would be downstream of these activities and act as a control for Hermann effects.

On the Murray River, MR3 and MR4 are respectively located upstream and downstream of the bulk sample discharge sites. MR7 and MR7B are upstream and MR8 is downstream of the Project's proposed east footprint. Site MR6, located on the Murray River nearly 12 km downstream of the Project but upstream of the confluences of Wolverine River or Flatbed Creek, will serve as a far-field impact site. MR10 is located downstream of all Murray River Project activities, Tumbler Ridge sewage outflow, Wolverine, Trend/Roman, Hermann and Quintette mine influences.

Plate 3.2-1. Site MR-REF on the Murray River, August 2010.

Four sites were located on M20 Creek: upstream of all Project activities (M20-03), downstream of a natural sediment source and upstream of the bulk sample site (M20-05), upstream of a proposed sediment pond discharge pipe (M20-06), and downstream of the proposed western infrastructure (M20-04; Plate 3.2-2). Two sites were located on Twenty Creek, one upstream of the proposed western surface facilities (TC-01) and one downstream (TC-02). A sampling site was established on M17 creek downstream of the proposed eastern surface facilities and two sampling sites on M19 Creek, upstream and downstream of the facility. Site REFST was established on Club Creek as a reference site for the smaller tributaries, particularly M20 Creek. Club Creek drains a watershed similar in size to that of M20 Creek, and is located outside of the LSA.

3.2.2 Wetlands

Numerous wetlands in the Project area were documented in the Murray River 2010-2011 Wetland Baseline Report (Rescan 2011). Six wetlands were selected to further characterize the physical (water quality, sediment quality) and biological environment (phytoplankton, benthic invertebrates, sedge tissue metals).

In 2010, four wetland sampling locations (REF, LW4, LW11, and RW3) were chosen based on the availability of open water habitat and the uniqueness of the habitat as determined by the wetland characterization study (see the *Murray River 2010-2011 Wetland Baseline Report*). In 2012, two wetland sampling locations (W9.0 and W9.3) were sampled for water quality as this area was identified as a potential option for sediment pond effluent discharge. Wetland sampling locations are illustrated in Figure 3.2-2 and the rationale for site locations are outlined in Table 3.2-2.

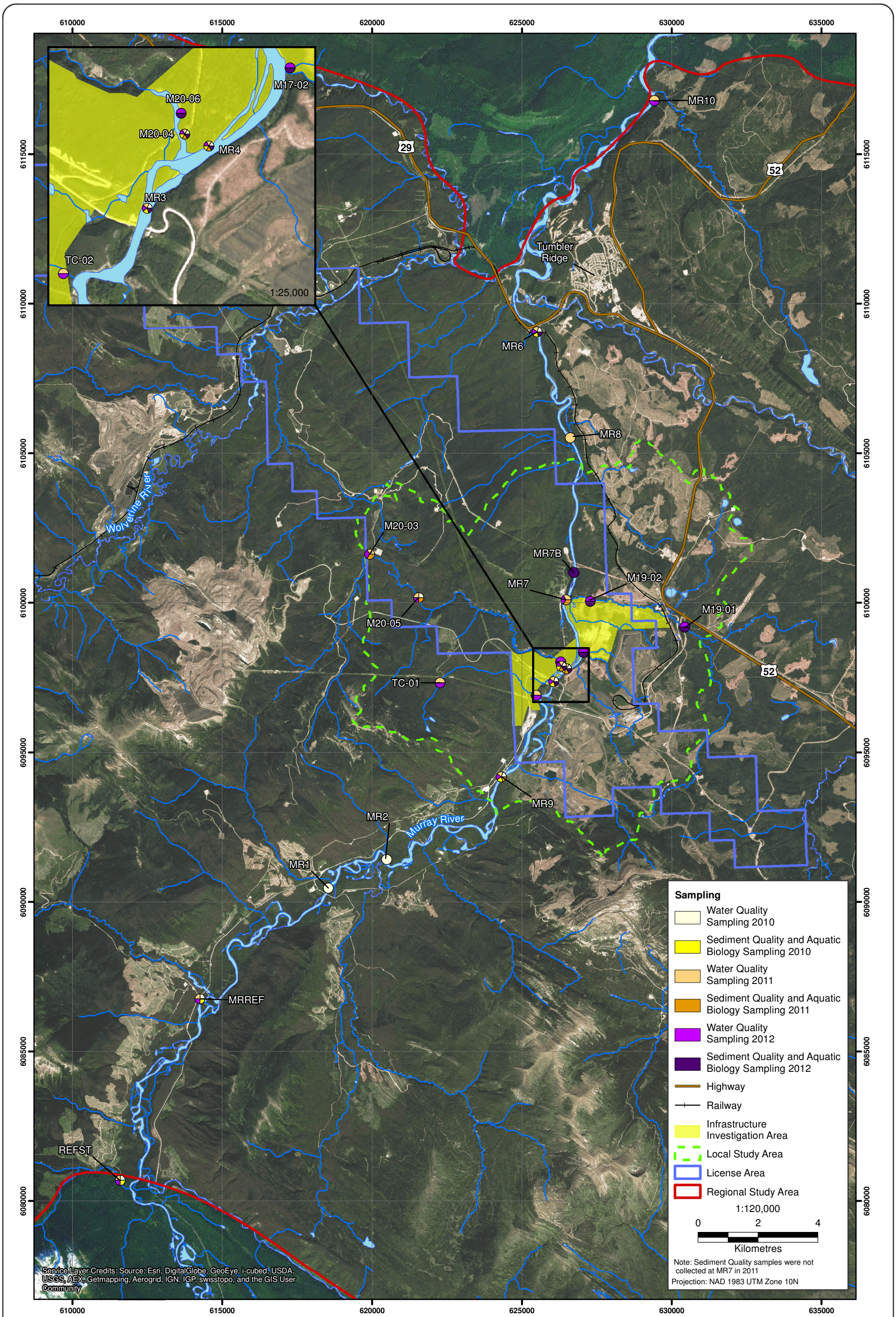

Figure 3.2.1

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MURRAY RIVER COAL PROJECT

Stream Sampling Sites, 2010 to 2012

Figure 3.2.1

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Table 3.2-1. Stream Sampling Sites for the Aquatic Resources Baseline Monitoring Program, 2010 to 2012

Stream Sampling Sites	Name in 2010 Report	Water Quality		Aquatic Life		Location and Rationale
		Easting	Northing	Easting	Northing	
Murray River						
MR-REF		614254	6086757 [a,b,c]	614254	6086757 [a]	Reference station on Murray River, located outside the LSA and upstream of all mining influence
MR1		618539	6090459 [a]		n/a	Monitoring station on Murray River downstream of Canary Creek confluence. Station to monitor the potential effects from Hermann Mine activities
MR2		620487	6091416 [a]		n/a	Monitoring station on Murray River downstream of South Hermann Creek confluence. Station to monitor the potential effects from Hermann Mine activities
MR9	MR3	624025	6093603 [a]	624311	6094181 [a,b]	Reference monitoring station on Murray River downstream of M14 Creek confluence and all Hermann Mine Activity. Reference station upstream of potential effects from the Project
		624332	6094213 [b,c]		n/a	Water quality sampling location moved further downstream in 2011 to allow complete mixing of M14 Creek water
MR3	MR4	626058	6097363 [a,b,c]	626058	6097363 [a]	Monitoring station on Murray River, located upstream of the potential Project discharge zone (M20 Creek)
				625911	6097042 [c]	Aquatic life sampling location moved in 2012 to ensure representative samples could be collected
MR4	MR5	626486	6097796 [a,b,c]	626486	6097796 [a]	Monitoring station on Murray River, located immediately downstream of the potential Project discharge zone (M20 Creek)
				626493	6097797 [b,c]	Aquatic life sampling location moved in 2012 to ensure representative samples could be collected
MR7		626471	6100097 [b,c]	626337	6099950 [b]	Monitoring station on Murray River (west side), located upstream of the Project's proposed east footprint
MR7B		626730	6101011 [c]	626730	6101011 [c]	Monitoring station on Murray River (east side), located immediately downstream of the Project's proposed east footprint (moved MR7 Aquatic Life sampling location to east side)
MR8		626615	6105516 [b]		n/a	Monitoring station on Murray River, located downstream of the Project's east footprint
MR6		625502	6109058 [a,b,c]	625502	6109058 [a]	Far-field monitoring station on Murray River, located downstream from the Project upstream of Flatbed Creek and Tumbler Ridge
		n/a		625521	6109103 [c]	Aquatic life sampling location moved in 2012 to ensure representative samples could be collected
MR10		629420	6116790 [b,c]		n/a	Far-field monitoring station on Murray River, located downstream of Wolverine River and Flatbed Creek confluences. Station to monitor the potential cumulative effects of mining activity in the Murray River area and sewage discharge from Tumbler Ridge
Twenty Creek						
TC-01		622268	6097326 [b,c]		n/a	Monitoring station on Twenty Creek, located upstream of the Project's west surface facilities
TC-02		625474	6096907 [b,c]		n/a	Monitoring station on Twenty Creek, located downstream of the Project's west surface facilities
M20 Creek (Camp Creek)						
M20-03		619921	6101621 [b,c]	619880	6101618 [b]	Monitoring station on M20 Creek, located upstream of the Project's west surface facilities and downstream of Hermann Mine activities
M20-05	M20-U/S	621555	6100170 [a,b,c]	621661	6099951 [b]	Monitoring station on M20 Creek, located downstream of a natural sediment source within the Project's western footprint
M20-06		626293	6098024 [c]	626293	6098024 [c]	Monitoring station on M20 Creek, located upstream of the proposed sediment pond discharge pipe
M20-04	M20-D/S	626318	6097879 [a]	626318	6097879 [a]	Monitoring station on M20 Creek, located downstream of the Project's west footprint
		626265	6097901 [a,b,c]	626265	6097901 [b,c]	Water quality sampling location moved upstream of bridge in October 2010, aquatic life sampling location followed in 2011
M17 Creek						
M17-02		627050	6098340 [c]	627038	6098308 [c]	Monitoring station on M17 Creek, located downstream of the Project's proposed east surface facilities
M19 Creek						
M19-01		630433	6099185 [c]	630433	6099185 [c]	Monitoring station on M19 Creek, located upstream of the Project's proposed east surface facilities
M19-02		627283	6100044 [c]	627273	6100047 [c]	Monitoring station on M19 Creek, located downstream of the Project's proposed east surface facilities
Reference Stream (Club Creek)						
REFST		611594	6080688 [a,b,c]	611594	6080688 [a]	Reference station on Club Creek (watershed similar in size to M20 Creek), located upstream of all mining influences and potential Project effects

Notes:

UTM Zone 10U

[a] *2010*

[b] *2011*

[c] *2012*

West Project footprint and facilities include the shaft site, power sub-station, and decline portal area

East Project footprint and facilities include the coarse coal reject area, coal preparation area, and rail loadout area

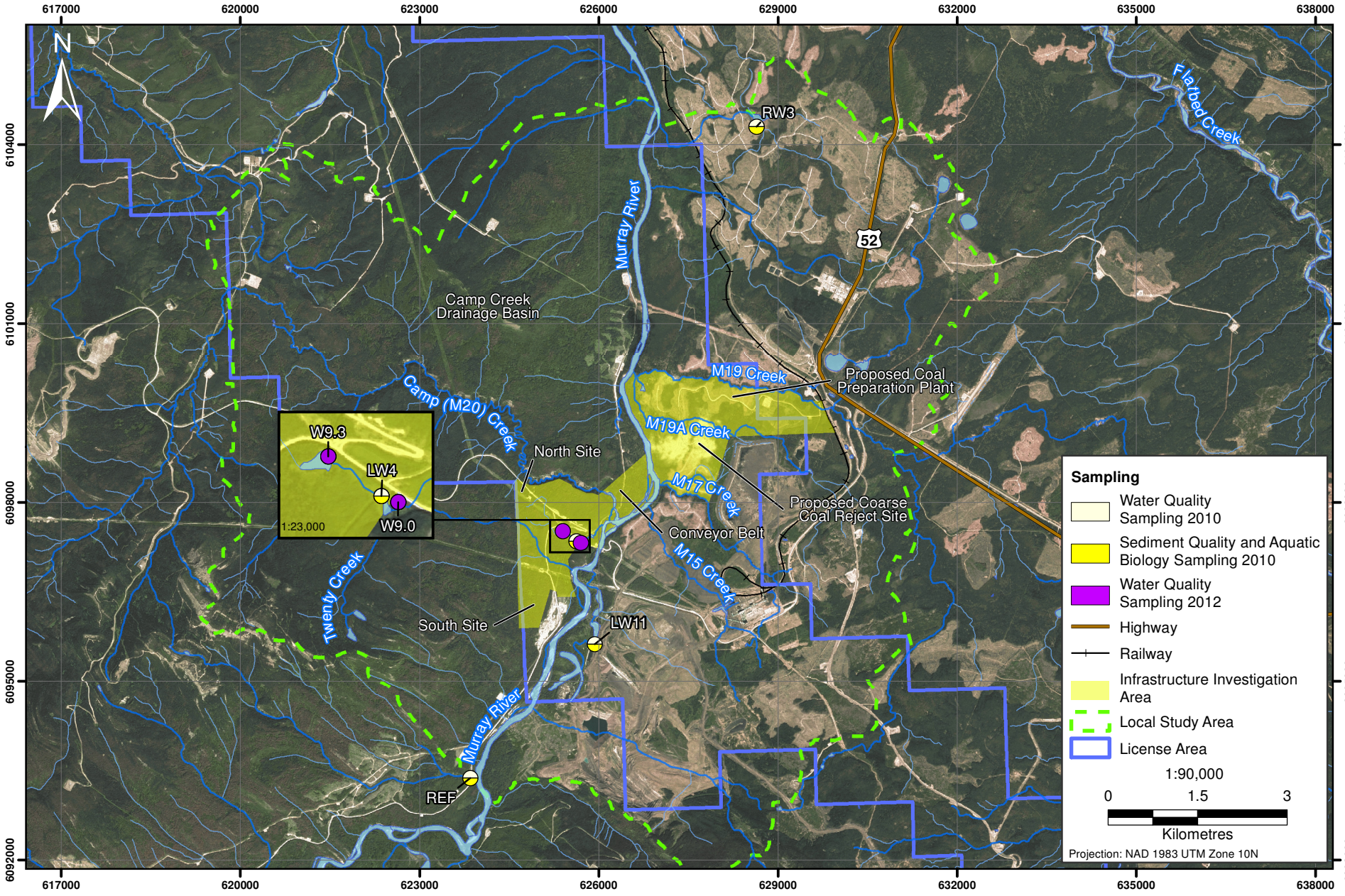

Figure 3.2.2

MURRAY RIVER COAL PROJECT

Wetland Sampling Sites, 2010 and 2012

Figure 3.2.2

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Table 3.2-2. Wetland Sampling Sites for the Aquatic Resources Baseline Monitoring Program, 2010 to 2012

Wetland Sampling Sites	Easting	Northing	Rationale
REF	623849	6093375	Reference wetland located adjacent to M14 Creek located outside the project footprint and LSA boundry
LW4	625628	6097346	Monitoring wetland inside the Project's west surface project footprint and inside the LSA boundry
LW11	625931	6095621	Monitoring wetland located east of Murray River outside the project footprint and inside the LSA boundry
RW3	628641	6104302	Reference wetland located downstream of MR8, east of Murray River, and outside the LSA boundry
W9.0	625700	6097320	Monitoring wetland area locates adjacen to Murray River Forest River Road and Mast Road (potential discharge area)
W9.3	625400	6097516	Monitoring wetland area locates adjacen to Murray River Forest River Road and Mast Road (potential discharge area)

Plate 3.2-2. Site M20-04 on M20 Creek, August 2010.

3.3 SAMPLING PROGRAM

The following sections describe the stream and wetland sampling program for the Project, conducted in 2010 to 2012. The sampling schedule is presented in Table 3.3-1 for streams and Table 3.3-2 for wetlands.

3.3.1 Stream Sampling Program

Stream water quality, water toxicity, sediment quality, periphyton, benthic invertebrate (benthos), and periphyton and benthos tissue metal samples were collected at a total of 21 sites in 2010 to 2012 (Tables 3.2-1 and 3.3-1).

3.3.1.1 Water Quality

Sampling

Stream water quality sampling was conducted by Rescan in May 2010 to August 2010 and by Environmental Dynamics Inc. (EDI) in September 2010 to December 2012. Sampling was performed monthly or quarterly at various sites depending on the rationale for sampling at that site. For example, sites established to monitor influence from other mines (e.g., MR1, MR2 and MR9) were sampled quarterly, while sites established to monitor potential Project effects and reference sites were sampled monthly (Table 3.3-1). Weekly samples were collected at select sites during the high flow freshet period (May/June). Polycyclic aromatic hydrocarbons (PAHs), organic contaminants that form during the combustion of hydrocarbons such as coal and gasoline, were sampled in 2010 at MR-REF and MR4 (June, August, and October) and at MR6 (August).

Water quality samples were collected as single replicates in clean, pre-labelled bottles. Field personnel wore nitrile gloves, faced upstream and submerged the sample bottles until they were full and

preserved as required. Samples were stored in a dark, cool place until shipment. Dissolved metal samples were filtered and preserved under clean conditions at the laboratory to avoid contamination due to field filtration. Samples collected from May to August 2010 and February 2011 to December 2012, were analyzed by ALS Environmental Ltd. (ALS) in Burnaby, BC. In October 2010, December 2010, and January 2011 the water samples were analyzed by CARO Analytical Services (Richmond, BC).

Analysis

Collected water samples were analyzed for parameters relevant to coal mining activity: sulphate, total suspended solids and turbidity, nitrogen compounds present in blasting agents (e.g., ammonia, nitrate), selenium, and organics such as polycyclic aromatic hydrocarbons. A complete list of the analyzed parameters and their realized detection limits are presented in Table 3.3-2. The samples analyzed by CARO were analyzed for a reduced set of parameters and generally at higher detection limits. In 2011, following a recommendation from BC MOE, dissolved orthophosphate and total dissolved phosphorous were added to the list of water quality parameters measured. The detection limits were the lowest achievable by the laboratory to facilitate comparison with provincial and federal guidelines for the protection of aquatic life. In some cases, elevated chloride concentrations caused increased analytical detection limits.

For graphing purposes, half the detection value was used for samples with a result below the detection limit. This is an acceptable form of replacement for results below the detection limit (Croghan 2003). Ecologically important water quality parameters and those with comparable water quality guidelines were presented graphically. Water quality guidelines include BC MOE approved and working water quality guidelines (BC MOE 2006; Nagpal et al. 2006), and CCME water quality guidelines (CCME 2007) for the protection of freshwater aquatic life. Weekly samples collected during freshet (May/June) were presented graphically as monthly averages. Replicate samples were also averaged for graphing. Error bars were used to indicate variability in sampling and was represented by the standard error of weekly or replicate values.

Each parameter value was compared to CCME and BC water quality guidelines for the protection of freshwater aquatic life. For each water quality parameter, the percentage of samples above the guideline and the average factor by which concentrations were higher than the guideline were calculated and presented in tabular format. In some cases, parameter values were below the detection limit and the detection limit was greater than the guideline. These values could not be conclusively determined as above or below the guideline, and thus, were not included in the calculations.

Quality Assurance and Quality Control

The quality assurance and quality control program (QA/QC) for this study included the use of chain of custody forms (COCs), sample blanks, and sample replication.

To determine sources of potential contamination during water sampling, one travel blank and one field blank were processed and submitted during each sampling trip. The travel blanks, designed to identify potential contamination from the transportation, storage, and handling of samples, were filled with distilled deionized water (DDW) and preserved at the analytical laboratory and remained unopened with the collected samples throughout the sampling trip. The field blanks, designed to identify potential contamination from airborne dust, sample preservation, sample handling, or other sources, were filled with DDW in the laboratory but were subsequently treated identically to field-collected samples (opened to air for same duration as field samples and preserved).

Table 3.3-1. Stream Samples Collected and Sampling Schedule, 2010 to 2012

	May 2010 to January 2011[a]							February 2011 to December 2011[a]					January 2012 to December 2012[a]					
	WQ	WQ - PAH	SQ	SQ - PAH	Biology	Tissue Metals[b]	Water Toxicity	WQ	SQ	SQ - PAH	Biology	Tissue Metals[b]	WQ	WQ - Site Preparation[c]	SQ	SQ - PAH	Biology	Tissue Metals[b]
Murray River																		
MR-REF	M, W	F, S, O	S	S	S	S	S	M, W	-	-	-	-	M, W	-	-	-	-	-
MR1	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MR2	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MR9	Q	-	-	-	-	-	-	M	S	S	S	S	M	-	S (metals)	-	S	S
MR3	M, W	-	S	-	S	-	-	M, W	-	-	-	-	M, W	S	S	S	S	S
MR4	M, W	F, S, O	S	S	S	S	S	M, W	S	S	S	S	M, W	S	S (metals)	-	S	S
MR7	-	-	-	-	-	-	-	M	-	-	S	S	M	-	-	-	-	-
MR7B	-	-	-	-	-	-	-	-	-	-	-	-	S	-	S	S	S	S
MR8	-	-	-	-	-	-	-	M	-	-	-	-	M*	-	-	-	-	-
MR6	M, W	S	S	S	S	S	-	M	-	-	-	-	M	-	S	S	S	S
MR10	-	-	-	-	-	-	-	Q	-	-	-	-	Q	-	-	-	-	-
Twenty Creek																		
TC-01	-	-	-	-	-	-	-	M	-	-	-	-	M*	-	-	-	-	-
TC-02	-	-	-	-	-	-	-	M	-	-	-	-	M*	-	-	-	-	-
M20 Creek																		
M20-03	-	-	-	-	-	-	-	M	S	S	S	S	M	-	-	-	-	-
M20-05	Q	-	-	-	-	-	-	M	S	S	S	S	M	-	-	-	-	-
M20-06	-	-	-	-	-	-	-	-	-	-	-	-	M*	-	S	S	S	S
M20-04	M, W	-	S	-	S	-	-	M, W	S	S	S	S	M, W	-	S (metals)	-	S	S
M17 Creek																		
M17-02	-	-	-	-	-	-	-	-	-	-	-	-	M*	-	S	S	S	S
M19 Creek																		
M19-01	-	-	-	-	-	-	-	-	-	-	-	-	M*	-	S	S	S	S
M19-02	-	-	-	-	-	-	-	-	-	-	-	-	O*	-	S	S	S	S
Reference Stream																		
REFST	M, W	-	S	-	S	-	-	M, W	-	-	-	-	M, W	-	-	-	-	-

Notes:

Biology sampling parameter refers to periphyton and benthic invertebrate sampling.

Dashes indicate sampling not conducted for that parameter at that site.

[a] *Sampling completed by Rescan in 2010 and EDI in 2011 and 2012.*

[b] *Tissue metal analysis performed on benthic invertebrates in 2010 and on periphyton in 2011.*

[c] *Sampling during site preparation included measuring TSS and turbidity only.*

M = monthly; Q = quaterly; W = weekly during freshet; S = summer; F = freshet; O = other

PAH = polycyclic aromatic hydrocarbons.

Table 3.3-2. Stream Water Quality Parameters and Realized Detection Limits, 2010 and 2012

Parameter	Unit	Realized Detection Limit (RDL)		
		2010	2011	2012
Physical Tests				
Colour, True	CU	5	5	5
Conductivity	µS/cm	2	2 - 5	2
Hardness (as $CaCO_3$)	mg/L	0.5 - 2.54	0.5 - 2.50	0.5
pH	pH	0.01 - 0.1	0.01 - 0.5	0.1
Total Suspended Solids	mg/L	1 - 3	1 - 9	3 - 15
Total Dissolved Solids	mg/L	5 - 10	10	-
Turbidity	NTU	0.1	0.1 - 3	0.1
Anions and Nutrients				
Acidity (as $CaCO_3$)	mg/L	1	1 - 2	1
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1 - 2	1 - 2	1 - 2
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1 - 2	1 - 2	1 - 2
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1 - 2	1 - 2	1 - 2
Alkalinity, Total (as $CaCO_3$)	mg/L	1 - 2	1 - 2	1 - 2
Ammonia (as N)	mg/L	0.005 - 0.02	0.005 - 2.0	0.005 - 0.025
Bromide (Br)	mg/L	0.05 - 1	0.05 - 0.1	0.05 - 1.0
Chloride (Cl)	mg/L	0.1 - 0.5	0.1 - 0.5	0.5 - 10.0
Fluoride (F)	mg/L	0.02 - 0.1	0.02 - 0.5	0.02 - 0.4
Nitrate (as N)	mg/L	0.005 - 0.01	0.005 - 0.02	0.005 - 0.1
Nitrite (as N)	mg/L	0.001 - 0.01	0.001 - 0.01	0.001 - 0.02
Total Kjeldahl Nitrogen	mg/L	0.05	0.05	0.05 -0.094
Total Nitrogen	mg/L	0.05 - 0.06	0.001 - 0.05	0.001 - 0.001
Orthophosphate (as P)	mg/L	0.01	0.01 - 0.05	0.001
Phosphorus - Total Dissolved	mg/L	-	0.002	0.002
Phosphorus - Total	mg/L	0.002 - 0.02	0.002 - 0.2	0.002 - 0.2
Sulphate (SO_4)	mg/L	0.5 - 1.0	0.5 - 1.0	0.5 - 10.0
Cyanides				
Cyanide, Weak Acid Dissociable	mg/L	0.001 - 0.002	0.001 - 0.003	0.001 - 0.002
Cyanide, Total	mg/L	0.001 - 0.01	0.001 - 0.011	0.001 - 0.002
Organic Carbon				
Total Organic Carbon	mg/L	0.5	0.5	0.5 - 1.0
Metals (Total and Dissolved)				
Aluminum (Al)	mg/L	0.001 - 0.05	0.003 - 0.05	0.003 - 0.006
Antimony (Sb)	mg/L	0.0001 - 0.001	0.0001 - 0.003	0.0001 - 0.0002
Arsenic (As)	mg/L	0.0001 - 0.005	0.0001 - 0.005	0.0001 - 0.0002
Barium (Ba)	mg/L	0.00005 - 0.005	0.00005 - 0.05	0.00005 - 0.0001
Beryllium (Be)	mg/L	0.0001 - 0.001	0.0001 - 0.001	0.0001 - 0.0002
Bismuth (Bi)	mg/L	0.0005	0.0005 - 0.001	0.0005 - 0.001

(continued)

Table 3.3-2. Stream Water Quality Parameters and Realized Detection Limits, 2010 and 2012 (continued)

Parameter	Unit	Realized Detection Limit (RDL)		
		2010	2011	2012
Metals (Total and Dissolved; cont'd)				
Boron (B)	mg/L	0.004 - 0.04	0.01 - 0.04	0.01 - 0.02
Cadmium (Cd)	mg/L	0.00001 - 0.0001	0.00001 - 0.01	0.00001 - 0.00005
Calcium (Ca)	mg/L	0.02 - 1	0.02 - 5	0.02 - 0.04
Chromium (Cr)	mg/L	0.0001 - 0.005	0.0001 - 0.02	0.0001 - 0.0002
Cobalt (Co)	mg/L	0.00005 - 0.0005	0.0001 - 0.0005	0.0001 - 0.0002
Copper (Cu)	mg/L	0.0001 - 0.001	0.0005 - 0.002	0.0005 - 0.001
Iron (Fe)	mg/L	0.01 - 0.1	0.03 - 0.1	0.03
Lead (Pb)	mg/L	0.00005 - 0.001	0.00005 - 0.03	0.00005 - 0.0001
Lithium (Li)	mg/L	0.0001 - 0.005	0.0005 - 0.005	0.0005 - 0.001
Magnesium (Mg)	mg/L	0.005 - 0.1	0.005 - 0.1	0.005 - 0.01
Manganese (Mn)	mg/L	0.00005 - 0.002	0.00005 - 0.005	0.00005 - 0.0001
Mercury (Hg)	mg/L	0.00001 - 0.0005	0.00001 - 0.0002	0.00001 - 0.00005
Molybdenum (Mo)	mg/L	0.00005 - 0.001	0.00005 - 0.001	0.00005 - 0.0001
Nickel (Ni)	mg/L	0.0002 - 0.002	0.0005 - 0.002	0.0005 - 0.0035
Phosphorus (P)	mg/L	0.3	0.2 - 0.3	0.3
Potassium (K)	mg/L	0.05	0.05 - 0.3	0.05 - 0.1
Selenium (Se)	mg/L	0.0001 - 0.003	0.0001 - 0.05	0.0001 - 0.0002
Silicon (Si)	mg/L	0.05	0.05 - 5	0.05
Silver (Ag)	mg/L	0.00001 - 0.0005	0.00001 - 0.05	0.00001 - 0.00002
Sodium (Na)	mg/L	0.01 - 2.0	0.2 - 2.0	2
Strontium (Sr)	mg/L	0.0001	0.0001 - 2.0	0.0001 - 0.0004
Thallium (Tl)	mg/L	0.00002 - 0.0002	0.00001 - 0.0002	0.00001 - 0.00002
Tin (Sn)	mg/L	0.0001	0.0001 -0.002	0.0001 - 0.0002
Titanium (Ti)	mg/L	0.005 - 0.05	0.01 - 0.05	0.01
Uranium (U)	mg/L	0.00001 - 0.0002	0.00001 - 0.01	0.001 - 0.002
Vanadium (V)	mg/L	0.001 - 0.01	0.001 - 0.01	0.001 - 0.002
Zinc (Zn)	mg/L	0.001 - 0.01	0.003 - 0.04	0.003 - 0.006
Hydrocarbons				
EPH10-19	mg/L	0.1 - 0.25	-	-
EPH19-32	mg/L	0.1 - 0.25	-	-
LEPH	mg/L	0.1 - 0.25	-	-
HEPH	mg/L	0.1 - 0.25	-	-
PAH	mg/L	0.1 - 0.25	-	-
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.00001 - 0.00005	-	-
Acenaphthylene	mg/L	0.00001 - 0.00005	-	-
Acridine	mg/L	0.00001 - 0.0001	-	-

(continued)

Table 3.3-2. Stream Water Quality Parameters and Realized Detection Limits, 2010 and 2012 (completed)

Parameter	Unit	Realized Detection Limit (RDL)		
		2010	2011	2012
Polycyclic Aromatic Hydrocarbons (cont'd)				
Anthracene	mg/L	0.00001 - 0.00005	-	-
Benz(a)anthracene	mg/L	0.00001 - 0.00005	-	-
Benzo(a)pyrene	mg/L	0.00001	-	-
Benzo(b)fluoranthene	mg/L	0.00001 - 0.00005	-	-
Benzo(g,h,i)perylene	mg/L	0.00001 - 0.00005	-	-
Benzo(k)fluoranthene	mg/L	0.00001 - 0.00005	-	-
Chrysene	mg/L	0.00001 - 0.00005	-	-
Dibenz(a,h)anthracene	mg/L	0.00001 - 0.00005	-	-
Fluoranthene	mg/L	0.00001 - 0.00005	-	-
Fluorene	mg/L	0.00001 - 0.00005	-	-
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001 - 0.00005	-	-
Naphthalene	mg/L	0.00002 - 0.0003	-	-
Phenanthrene	mg/L	0.00002 - 0.0001	-	-
Pyrene	mg/L	0.00001 - 0.0001	-	-
Quinoline	mg/L	0.00001 - 0.0001	-	-

Notes:
Analyses completed by ALS Environmental, except October and December 2010 and January 2011 samples which were completed by CARO Analytical Services.
Some detection limits were elevated due to sample matrix interference.
Dashes indicate samples were not analyzed for that parameter.

To assess the variability associated with collecting stream water quality samples, a minimum of 10% of the water samples during each sampling trip were collected in replicate (a single replicate per trip). The variability between replicate samples was calculated for each measured parameter as the relative percent difference (RPD) between replicates, where:

$$RPD = [((rep1 - rep2) / (rep1 + rep2)) / 2)] \times 100$$

The results of RPD calculations were examined to detect patterns of sampling heterogeneity, sample contamination, or analytical errors. Parameters with both replicates measuring less than five times the analytical detection limit were not included in the RPD calculations because results are increasingly unreliable as values approach the detection limit (Clark 2003). Field replicates with values greater than five times the detection limit and with RPD values exceeding 20% were noted and the data interpreted accordingly.

3.3.1.2 Water Toxicity

Baseline toxicity testing was conducted to complement the Murray River stream water quality monitoring program in 2010. Aquatic toxicity tests are used to measure and predict the effect of potentially harmful substances on indigenous aquatic life. Due to the nature of the terrain and geology of the region, surface waters can contain naturally high concentrations of some potentially harmful substances. Establishing the background toxicity of receiving streams is useful in order to distinguish

between existing toxicity and any new toxicity related to potential future discharges into receiving streams, associated with Project development.

Toxicity bioassays were conducted on important primary, secondary, and tertiary producers in the Project area. Rainbow trout (*Oncorhynchus mykiss*) and the common water flea (*Daphnia magna*) have been used extensively in Canada for evaluating the acute (short-term) lethal effects of substances toward salmonid fish and primary consumers (Environment Canada 1990, 2000). The freshwater microcrustacean (*Ceriodaphnia dubia*), green alga (*Pseudokirchneriella subcapitata*), and aquatic macrophyte (duckweed; *Lemna minor*) have been used for evaluating the chronic (long-term) effects on primary consumers and producers (Environment Canada 2007a, 2007b, 2007c).

Sampling

Water toxicity samples were collected at MR4 and MR-REF sites on August 16, 2010, concurrently with water quality sampling (Table 3.3-1). Water for bioassays was collected in clean, pre-labelled 20 L containers. Water samples were stored in coolers on ice packs and shipped to the fully accredited Nautilus Environmental Laboratory (Burnaby, BC) within 36 hours.

Analysis

Toxicity tests followed standard protocols developed by Environment Canada (1990, 2000, 2007a, 2007b, 2007c), and are summarized in the Nautilus report (Appendix 2-1). Acute tests included the 48-h LC_{50} test with the water flea, *Daphnia magna,* and the 96-h LC_{50} test using rainbow trout. LC_{50} is the lethal concentration of test water required to kill 50% of test organisms during a specified time period. Chronic tests included the 7-d partial life cycle test with the invertebrate, *Ceriodaphnia dubia*, the 72-h growth inhibition toxicity test with the green alga *Pseudokirchneriella subcapitata*, and the 7-d growth inhibition test using the aquatic plant *Lemna minor* (duckweed).

Water quality samples collected concurrently for the stream water quality baseline provided water chemistry information (general, ions, nutrients, metals) that was used to assess potential sources of toxicity. Variables above water quality guidelines were considered potential causes of any toxic effects observed in the bioassays.

Quality Assurance and Quality Control

COC forms were used for water samples as part of the toxicity QA/QC program. Standard protocols were followed regarding sample handling and storage, holding times, culture of stocks, lab acclimation of test water and organisms, test validity, and controls. Negative and positive controls were used to ensure that appropriate testing performance criteria were met, thus, ensuring that dilution waters were not detrimental and that the test organisms healthy.

3.3.1.3 Sediment Quality

Sediments provide habitat for a wide range of benthic organisms, including attached algae (periphyton), rooted plants, and benthic invertebrates. Contaminants can accumulate in fine grained sediments and pose a hazard to the health of these organisms.

Sampling

Sediment quality samples were collected in August 2010 by Rescan and in 2011 and 2012 by EDI (Table 3.3-1). Samples were collected in triplicate at six sites in 2010. In 2011, a single sediment sample was collected at four sites, and five replicates were collected at M20-05. In 2012, sediment quality samples were collected for metal analysis at ten sites and for total organic carbon (TOC) and

PAH analysis at seven of those sites (Table 3.3-1). Sediment samples in 2012 for metal analysis, were collected separately to target fine clay and silt particles (i.e., particle sizes < 63 µm).

At each site, sediment samples were collected using a plastic spoon and bowl (metal analyses) or metal spoon and bowl (PAH analyses). Surface fine grain sediments in submerged depositional areas were targeted for sample collection. Each sample was a composite of several scoops that were homogenized and transferred into clean, pre-labelled Whirl-Pak bags. Sample bags were sealed (no air bubbles) and kept cool in the dark until analysis. Replicates were collected from separate distinct areas of the site, covering a stretch of 50 to 250 m, depending on site width and access. For analyses, samples were shipped to ALS (Burnaby, BC) in 2010 and to Maxxam Analytics (Burnaby, BC) in 2011 and 2012.

Analysis

In 2010, sediment samples were analyzed for moisture, particle size, nutrients, organic carbon, and metal concentrations. Sediment PAH concentrations were analyzed at MR-REF, MR4, and MR6. In 2011 and 2012, sediment samples were analyzed for moisture, particle size, metal concentrations, and extractable hydrocarbons. A complete list of the analyzed parameters and their realized detection limits are presented in Table 3.3-3. The lowest analytical detection limits possible for the sediment samples were used for all analyses.

Table 3.3-3. Stream Sediment Quality Parameters and Realized Detection Limits, 2010 to 2012

		Realized Detection Limit (RDL)		
Parameter	**Unit**	**2010**	**2011**	**2012**
Physical Tests				
Moisture	%	0.1	0.3	0.3
Particle Size				
Gravel (>2 mm)	%	0.1	2	2
Sand (2 mm - 0.063 mm)	%	0.1	2	2
Silt (0.063 mm - 4 µm)	%	0.1	2	2
Clay (<4 µm)	%	0.1	2	2
Nutrients				
Total Nitrogen	%	0.02	-	-
Plant Available Nutrients				
Available Phosphate	mg/kg	2 - 8	-	-
Available Sulphate	mg/kg	2	-	-
Organic Carbon				
Total Organic Carbon	%	0.1	-	0.02
Metals				
Aluminum (Al)	mg/kg	100	100	100
Antimony (Sb)	mg/kg	0.1	0.1	0.1
Arsenic (As)	mg/kg	0.2	0.5	0.5
Barium (Ba)	mg/kg	1	0.1	0.1
Beryllium (Be)	mg/kg	0.1	0.4	0.4
Bismuth (Bi)	mg/kg	0.1	0.1	0.1
Cadmium (Cd)	mg/kg	0.05	0.05	0.05

(continued)

Table 3.3-3. Stream Sediment Quality Parameters and Realized Detection Limits, 2010 to 2012 (continued)

Parameter	Unit	Realized Detection Limit (RDL)		
		2010	2011	2012
Metals (cont'd)				
Calcium (Ca)	mg/kg	100	100	100
Chromium (Cr)	mg/kg	1	1	1
Cobalt (Co)	mg/kg	0.3	0.3	0.3
Copper (Cu)	mg/kg	0.5	0.5	0.5
Iron (Fe)	mg/kg	100	100	100
Lead (Pb)	mg/kg	0.1	0.1	0.1
Lithium (Li)	mg/kg	-	5	5
Magnesium (Mg)	mg/kg	10	100	100
Manganese (Mn)	mg/kg	0.2	0.2	0.2
Mercury (Hg)	mg/kg	0.01	0.05	0.05
Molybdenum (Mo)	mg/kg	0.1	0.1	0.1
Nickel (Ni)	mg/kg	0.8	0.8	0.8
Phosphorus (P)	mg/kg	10	10	10
Potassium (K)	mg/kg	100	100	100
Selenium (Se)	mg/kg	0.1	0.5	0.5
Silver (Ag)	mg/kg	0.05	0.05	0.05
Sodium (Na)	mg/kg	100	100	100
Strontium (Sr)	mg/kg	0.1	0.1	0.1
Sulphur (S)	mg/kg	500	-	-
Thallium (Tl)	mg/kg	0.1	0.05	0.05
Tin (Sn)	mg/kg	0.2	0.1	0.1
Titanium (Ti)	mg/kg	1	1	1
Uranium (U)	mg/kg	0.05	0.05	0.05
Vanadium (V)	mg/kg	2	2	2
Zinc (Zn)	mg/kg	2	1	1
Zirconium (Zr)	mg/kg	-	0.5	0.5
Hydrocarbons				
EPH10-19	mg/kg	200	-	-
EPH19-32	mg/kg	200	-	-
LEPH	mg/kg	200	-	-
HEPH	mg/kg	200	-	-
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/kg	0.005	0.005 - 0.02	0.0005 - 0.003
Acenaphthylene	mg/kg	0.005	0.01	0.0011 - 0.012
Anthracene	mg/kg	0.004	0.004	0.001 - 0.005
Benz(a)anthracene	mg/kg	0.01	0.02	0.001 - 0.005
Benzo(a)pyrene	mg/kg	0.01	0.02	0.001 - 0.005

(continued)

Table 3.3-3. Stream Sediment Quality Parameters and Realized Detection Limits, 2010 to 2012 (completed)

Parameter	Unit	Realized Detection Limit (RDL)		
		2010	2011	2012
Polycyclic Aromatic Hydrocarbons (cont'd)				
Benzo(b&j)fluoranthene	mg/kg	0.01	0.02	0.001 - 0.005
Benzo(g,h,i)perylene	mg/kg	0.01	0.05	0.002 - 0.01
Benzo(k)fluoranthene	mg/kg	0.01	0.02	0.001 - 0.005
Chrysene	mg/kg	0.015 - 0.04	0.02	0.001 - 0.005
Dibenz(a,h)anthracene	mg/kg	0.005	0.05	0.0005 - 0.003
Fluoranthene	mg/kg	0.01	0.02	0.001 - 0.005
Fluorene	mg/kg	0.01	0.02	0.001 - 0.005
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	0.05	0.002 - 0.01
2-Methylnaphthalene	mg/kg	0.01	0.02	0.001 - 0.005
Naphthalene	mg/kg	0.01	0.01	0.001 - 0.005
Phenanthrene	mg/kg	0.01	0.02	0.001 - 0.005
Pyrene	mg/kg	0.01	0.02	0.001 - 0.005
Total PAHs	**mg/kg**	**0.39 - 0.54**	**0.05**	**0.0011 - 0.012**

Notes:
Analyses were conducted by ALS Environmental in 2010 and by Maxxam Analytics in 2011 and 2012.
Some detection limits were elevated due to sample matrix interference or sample dilution.
Dashes indicate samples were not analyzed for that parameter.

Ecologically important sediment quality parameters and those with comparable sediment quality guidelines graphed in the results section. Guidelines include the CCME sediment quality guidelines (CCME 2002) and BC MOE working sediment quality guidelines (BC MOE 2006) for the protection of freshwater aquatic life. BC has adopted the established CCME sediment quality guidelines. The CCME sediment guidelines include the interim sediment quality guidelines (ISQGs) and the probable effect levels (PELs) which provide a flexible interpretive tool to evaluate the toxicological significance of sediment chemistry data. A sediment parameter concentration below the ISQG is not expected to be associated with any adverse biological effects, while concentrations above the PEL are expected to be frequently associated with adverse biological effects. BC sediment quality guidelines are analogous to the ISQG and PEL, and consist of a Lower Effects Level (LEL) and Severe Effects Level (SEL). These screening levels provide practical means to characterize sites that may have minimal, potential, or significant toxicological concern.

For graphing purposes, half the detection limit was used for samples with a result below the detection limit. Replicate samples collected were presented graphically as averages, with the error bars representing standard error.

Each parameter value was compared to CCME and BC sediment quality guidelines for the protection of freshwater aquatic life. For each sediment quality parameter, the percentage of samples above the guideline and the average factor by which concentrations were higher than the guideline were calculated and presented in tabular format. In some cases, parameter values were below the detection limit and the detection limit was greater than the guideline. These values could not be conclusively determined as above or below the guideline, and thus, were not included in the calculations.

Quality Assurance and Quality Control

COC forms were used for all sediment quality samples as part of the QA/QC program. To account for within-site variability three samples were collected at each site in 2010 and five samples at a single site in both 2011 and 2012. To assess field sampler and laboratory consistency, replicate (split) samples were collected from two sites in both 2011 and 2012. Split samples were collected by homogenizing the sample and separating the sediment into two separate containers filled by alternating spoonfills of sediment. To evaluate sample homogenization in the laboratory, ALS (2010) created replicate samples by splitting samples. The magnitude and potential causes of variability between field and laboratory replicates were assessed by examining the RPD (calculated as described in Section 3.3.1.1).

3.3.1.4 Periphyton

Primary producers play a crucial role in ecosystems; they photosynthesize (convert light energy to chemical energy) and ultimately provide energy to higher trophic levels. In streams and rivers in the region, the dominant primary producers are periphyton, a diverse group of algae that are attached to various submerged substrates in the aquatic environment. Periphyton are early warning indicators of environmental change because they have short life cycles, exhibit taxon-specific responses to stressors, and are sessile (cannot escape exposure to contamination).

Sampling

Periphyton samples were collected in August by Rescan (2010) and by EDI (2011 and 2012), as part of the aquatic resource sampling program (Table 3.3-1). Periphyton samples were collected in triplicate in 2010 for biomass and taxonomy at six sites. Each 2010 replicate was composed of three subsamples. In 2011, six replicates were collected for biomass and three replicates were collected for taxonomy at six sites. In 2012, six replicates were collected for biomass and three replicates were collected for taxonomy at ten sites.

Each periphyton sample was collected from a randomly selected rock by walking forward with eyes closed and pointing down into the water at the rock to be sampled. Although the individual sample rocks were chosen randomly, rocks were chosen from specific areas that would represent the range of site conditions, including microenvironments that may support different species. For each rock, a circular template was used to scrape and rinse the attached periphyton from the template area, into a plastic sample jar. In 2010, an 11.8 cm^2 template was used to collect composite sample of three subsamples from each rock (total area: 35.3 cm^2). In 2011 and 2012, a 78.5 cm^2 template was used to collect at least one template area of periphyton for each sample (the number of templates collected depended on the density of periphyton present and the spatial distribution). Periphyton results were standardized to the area sampled.

Periphyton biomass samples as chlorophyll *a* (chl *a*) were filtered through a 0.45 µm pore size membrane. In 2010, filters were folded in half, wrapped in labeled aluminum foil and frozen prior to shipping to ALS for analysis. In 2011 and 2012, magnesium carbonate solution ($MgCO_3$) was added to samples before filtering, filters were wrapped in foil, kept cool (4°C) and shipped to Maxxam.

Periphyton taxonomy samples were collected in 250 mL plastic bottles, preserved with Lugol's solution, and shipped to the taxonomic laboratory. Fraser Environmental Services in Surrey, BC (2010) and EcoAnalysts Inc. in Moscow, ID (2011 and 2012) identified and enumerated periphyton samples to the lowest practical taxonomic level.

Analysis

Periphyton biomass was estimated as µg chl *a*/cm^2 of at each sampling site. Biomass were graphed and compared to BC MOE guidelines (BC MOE 2001).

Periphyton taxonomic counts were normalized to density (cells/cm^2). Community composition, genus richness, and diversity were calculated for each site and presented graphically. The community composition for each sampling site was determined by calculating the percentage of periphyton taxa in major groups (e.g., Bacillariophyceae, Chlorophyta, etc.). Richness is the simplest measure of biodiversity and is a count of the number of taxa (in this case, genera) present in each sample. Diversity indices that integrate both richness and abundance are often used as an indication of overall ecosystem health. High richness and diversity scores typically indicate a healthy ecosystem. For richness and diversity calculations, taxa were grouped by genus. Individuals of unknown taxa were excluded from the analysis. Simpson's Diversity Index was calculated as:

$$\textit{Simpson Diversity Index (D)} = 1 - \sum_{i=1}^{F} p_i^2$$

where F is the number of genera present and p_i is the relative abundance of each genus calculated as n_i/N, where n_i is the number of individuals in genus i and N is the total number of individuals.

Quality Assurance and Quality Control

Chain of custody forms were used for all periphyton samples as part of the QA/QC program. Laboratory QA/QC of periphyton taxonomy included a re-count of 10% of the slide-mounted diatom subsamples and an extra subsample and count for 10% of the soft-algae samples. For QA/QC samples with percent similarities less than 85%, taxonomic discrepancies were to be resolved and the samples re-identified as necessary. Percent similarity was calculated according to Washington (1984):

$$\textit{Percent Similarity} = 100 - 0.5 \times \sum |pi1 - pi2|$$

where:
*pi*1 = the proportion of the ith taxon for the original taxonomist
*pi*2 = the proportion of the ith taxon for the QA taxonomist.

3.3.1.5 Benthic Invertebrates

Secondary producers consume primary producers and other invertebrates, providing an important link to higher trophic level organisms such as fish and birds. Benthic invertebrates have close contact with benthic substrates, are abundant and sessile, and have a wide range of environmental tolerances that make them good indicators of local conditions and environmental change. As consumers, benthic invertebrates are sensitive to both abiotic and biotic parameters, and as such their community composition provides an indication of ecosystem quality and ecosystem change. It is often useful to subdivide benthic communities into sensitive taxa for monitoring purposes. The taxa Ephemeroptera, Plecoptera, and Trichoptera (EPT) are known to be sensitive to physical and chemical disturbance (Poulton et al. 1995) and will be analyzed separately to help characterize the baseline levels of this important group.

Sampling

Two methods were used to collect benthic invertebrates: a Hess net was used in 2010 at six sites, and a kick-net was used in 2011 at six sites and in 2012 at ten sites (Table 3.3-1). Kick-net samples were collected based on the Canadian Aquatic Biomonitoring Network (CABIN) protocol (Environment Canada 2010).

CABIN is a bioassessment tool for rivers and streams using benthic invertebrates. A key advantage of the CABIN protocol for invertebrate sampling is the standardized data handling, storage, and analysis tools provided. The protocol allows for a reference condition approach (RCA) when analyzing the data, and is becoming increasingly popular with provincial regulators in BC. The CABIN protocol streamlines sampling (only one benthic sample is required per site) and provides a robust site assessment, since the model incorporates data over a large geographic area (e.g., Fraser River basin). Currently, the reference model for the geographic area incorporating Murray River (Skeena Model) is not as robust as other model areas (e.g., Fraser Model). Inclusion of new stream sites strengthens the overall regional CABIN model, contributing to the development of a powerful bioassessment tool during the operation phase of the Project.

In 2010, five replicate samples were collected at each site using a 250 µm mesh size Hess sampler with a surface area of 0.096 m^2. Each replicate was composed of three grabs that were collected a minimum of 10 m apart. The sampler was driven 10 cm into the sediment of an undisturbed riffle zone with the cod-end facing downstream. The sediments were disturbed for one minute allowing the stream current to rinse the suspended benthos into the cod-end. The collected material was rinsed in a 250 µm sieve bucket, with the remaining material placed into a plastic jar and preserved to a final concentration of 10% buffered formalin. Samples were shipped to Cordillera Consulting (Summerland, BC) where they were transferred to 70% ethanol before being sorted, counted, and identified to the lowest taxonomic level.

In 2011 and 2012, kick-net sampling was conducted by CABIN certified field personnel using a standard CABIN kick-net (400 µm mesh). Three samples were collected per site by moving backwards in a zigzag pattern for exactly three minutes while disturbing the stream substrate. Contents of the kick-net samples were rinsed carefully into a sample jar and preserved to a final concentration of 10% buffered formalin. CABIN-specified environmental data was also collected at each sampling site. The samples were sent to EcoAnalysts, Inc. for enumeration and identification to at least the family taxonomic level by CABIN certified taxonomists.

Analysis

Prior to enumeration and identification, the organic contents of the benthos samples were evenly distributed into the bottom of a Caton-style tray (tray with a 250 µm mesh bottom divided into 48 squares). Grid squares were randomly selected and their contents transferred to a Petri dish for sorting. Organisms were counted and placed into 70% ethanol. Grids were sorted until the target number of organisms (300 organisms) was reached (Environment Canada 2012a).

The benthic invertebrate counts were normalized in 2010 (Hess samples) by surface area (0.288 cm^2) and in 2011/2012 (kick-net samples) by time (3 min). Benthos density (Hess: organisms/m^2; Kick-net: organisms/min), community composition (relative abundance), taxa richness (# taxa/sample), and diversity (Simpson's Diversity Index) were calculated from the taxonomic data and graphed in the results section. Organisms were included in the calculations only if identified to at least the family level and if they were relevant species in the CABIN protocol (see Table 3.3-4 for excluded organisms). Richness and diversity were calculated at the family level as described in Section 3.3.1.4. EPT richness was also determined.

Table 3.3-4. Taxa Excluded from Taxonomic Analyses Based on the CABIN Protocol

Taxon	Rationale
Ostracoda	Not adequately sampled with a 400 um kick-net
Cladocera	Generally not benthic and can bias samples collected close to reservoirs
Copepoda	Generally not benthic and can bias samples collected close to reservoirs
Porifera	Not adequately sampled with a 400 um kick-net
Nematoda	Not adequately sampled with a 400 um kick-net
Platyhelminthes	Not adequately sampled with a 400 um kick-net
Non-benthic taxa	Terrestrial drop-ins

Quality Assurance and Quality Control

COC forms were used for all benthos samples as part of the QA/QC program. In 2010, 10% of Hess samples were resorted for quality control. If 90% of the total number of organisms were not recovered during the initial sort, samples from that group were re-sorted. (Environment Canada 1993). This was calculated using the equation:

$$Sorting\ Efficiency\ (\%) = 1 - \left[\frac{QA/QC\ Re\text{-}sort\ Count}{Original\ Sort\ Count + QA/QC\ Re\text{-}sort\ Count} \times 100 \right]$$

In 2011 and 2012, more than 30% of the samples collected were resorted as part of the QA/QC program. EcoAnalysts' criterion for acceptable sorting was the recovery of 95% of the total number of organisms in the initial sort. The sorting recovery was calculated using the equation:

$$Sorting\ Recovery\ (\%) = \frac{Original\ Count + QA\ Count}{Original\ Count + \left[\frac{QA\ Count * QA\ Squares}{QT\ Squares} \right]} \times 100$$

where: Original Count = the number of organisms picked by the first sorter
QA Count = the number of organisms found in the QA sort
QA Squares = the number of grids sorted during the QA process
QT Squares = the total number of grids in the QA Caton

When the sorting recovery was less than 95% then a second re-sort was completed and the recovery calculated.

3.3.1.6 Tissue Metals

Sampling

In 2011 and 2012, periphyton samples were collected for tissue metal analysis (Table 3.3-1). Periphyton tissue samples were collected concurrently with periphyton taxonomy samples, using the methods described in Section 3.3.1.4. Single tissue samples were collected from six sites in 2011 and ten sites in 2012. To determine spatial variability, replicate samples were collected from two sites in 2011 and 2012.

In 2010 and 2012, benthic invertebrate samples were collected for tissue metal analysis concurrently with benthos taxonomy samples. Tissue samples in 2010 were composed of three composite Hess samples, collected from three sites (MR-REF, MR4, and MR6). Tissue samples in 2012 were composed of a single kick-net sample collected at ten sites, with one replicate (M19-01). Invertebrates were separated from debris material using forceps until a sample weighting 3 to 5 grams (wet weight) was obtained (Plate 3.3-1). Invertebrate samples were frozen until analyzed.

Plate 3.3-1. Invertebrates for tissue metal analysis, August 2010.

Analysis

Periphyton tissue samples were analyzed for dry weight metal content by Maxxam Analytics using Inductively Coupled Plasma Mass Spectrometry. The metal parameters analyzed and their realized detection limits are summarized in Table 3.3-5.

Table 3.3-5. Stream Periphyton Tissue Metal Parameters and Realized Detection Limits, 2011 and 2012

Parameter	Unit	2011	2012	Parameter	Unit	2011	2012
Total Metals				Manganese (Mn)	mg/kg	0.1	0.05 - 0.15
Aluminum (Al)	mg/kg	1	0.1 - 0.3	Mercury (Hg)	mg/kg	0.01	10 - 30
Antimony (Sb)	mg/kg	0.005	0.1 - 0.3	Molybdenum (Mo)	mg/kg	0.05	10 - 30
Arsenic (As)	mg/kg	0.05	0.1 - 0.3	Nickel (Ni)	mg/kg	0.05	0.05 - 0.15
Barium (Ba)	mg/kg	0.1	2 - 6	Phosphorus (P)	mg/kg	10	0.02 - 0.06
Beryllium (Be)	mg/kg	0.1	0.01 - 0.03	Potassium (K)	mg/kg	10	10 - 30
Bismuth (Bi)	mg/kg	0.1	10 - 30	Selenium (Se)	mg/kg	0.05	0.1 - 0.3
Boron (B)	mg/kg	2	0.2 - 0.6	Silver (Ag)	mg/kg	0.02	0.002 - 0.006
Cadmium (Cd)	mg/kg	0.01	0.02 - 0.06	Sodium (Na)	mg/kg	10	0.1 - 0.3
Calcium (Ca)	mg/kg	10	0.05 - 0.15	Strontium (Sr)	mg/kg	0.1	1 - 3
Chromium (Cr)	mg/kg	0.2	10 - 30	Thallium (Tl)	mg/kg	0.002	0.002 - 0.006
Cobalt (Co)	mg/kg	0.02	0.01 - 0.03	Tin (Sn)	mg/kg	0.1	0.2 - 0.6
Copper (Cu)	mg/kg	0.05	10 - 30	Titanium (Ti)	mg/kg	1	0.2 - 0.6
Iron (Fe)	mg/kg	10	0.1 - 0.3	Uranium (U)	mg/kg	0.002	0.002-0.006
Lead (Pb)	mg/kg	0.01	0.01 - 0.03	Vanadium (V)	mg/kg	0.2	0.2-0.6
Magnesium (Mg)	mg/kg	10	0.05 - 0.15	Zinc (Zn)	mg/kg	0.2	0.2-0.6

Note: Tissue metal units were dry weight

Benthic invertebrate tissues samples were analyzed for metal content by ALS laboratories in 2010 and Maxxam Analytics in 2012. Tissue samples were homogenized and digested before analysis (wet weight) by Inductively Coupled Plasma-Mass Spectrometry. The metal parameters analyzed and their realized detection limits are summarized in Table 3.3-6.

Table 3.3-6. Stream Benthic Invertebrate Tissue Metal Parameters and Realized Detection Limits, 2010 and 2012

Parameter	Unit	2010	2012	Parameter	Unit	2010	2012
Total Metals				***Total Metals (cont'd)***			
Aluminum (Al)	mg/kg	2.0	0.2 - 1.4	Manganese (Mn)	mg/kg	0.010	0.02 - 0.14
Antimony (Sb)	mg/kg	0.010	0.001 - 0.007	Mercury (Hg)	mg/kg	0.0020	0.002 - 0.014
Arsenic (As)	mg/kg	0.010	0.01 - 0.07	Molybdenum (Mo)	mg/kg	0.010	0.01 - 0.07
Barium (Ba)	mg/kg	0.010	0.02 - 0.14	Nickel (Ni)	mg/kg	0.10	0.01 - 0.07
Beryllium (Be)	mg/kg	0.10	0.02 - 0.14	Phosphorus (P)	mg/kg	-	2 - 14
Bismuth (Bi)	mg/kg	0.030	0.02 - 0.14	Potassium (K)	mg/kg	-	2 - 14
Boron (B)	mg/kg	-	0.4 - 2.8	Selenium (Se)	mg/kg	0.20	0.01 - 0.07
Cadmium (Cd)	mg/kg	0.0050	0.002 - 0.014	Silver (Ag)	mg/kg	-	0.004 - 0.028
Calcium (Ca)	mg/kg	2.0	2 - 14	Sodium (Na)	mg/kg	-	2 - 14
Chromium (Cr)	mg/kg	0.10	0.04 - 0.28	Strontium (Sr)	mg/kg	0.010	0.02 - 0.14
Cobalt (Co)	mg/kg	0.020	0.004 - 0.028	Thallium (Tl)	mg/kg	0.010	0.0004 - 0.0028
Copper (Cu)	mg/kg	0.010	0.01 - 0.07	Tin (Sn)	mg/kg	0.050	0.02 - 0.14
Iron (Fe)	mg/kg	-	2 - 14	Titanium (Ti)	mg/kg	-	0.2 - 1.4
Lead (Pb)	mg/kg	0.020	0.002 - 0.014	Uranium (U)	mg/kg	0.0020	0.0004 - 0.0028
Lithium (Li)	mg/kg	0.10	-	Vanadium (V)	mg/kg	0.10	0.04 - 0.28
Magnesium (Mg)	mg/kg	1.0	2 - 14	Zinc (Zn)	mg/kg	0.10	0.04 - 0.28

Note: Analysis was conducted by ALS Environmental in 2010 and by Maxxam Analytics in 2012
Tissue metal units were dry weight

Parameters that were identified as contaminants of potential concern (COPC) that bioaccumulate were graphed (arsenic, cadmium, mercury and selenium). Mercury (particularly methyl mercury) and selenium typically bioaccumulate and biomagnify in aquatic food webs primarily through diet, and can damage various bodily systems (BC MOE 2013). For graphing purposes, half the detection limit was used for samples with a result below the detection limit. Replicate samples collected were presented graphically as averages, with the error bars representing standard error.

Quality Assurance and Quality Control

COC forms were used for tissue samples as part of the QA/QC program. To examine the reproducibility of field techniques, replicate periphyton tissue samples were collected from two sites in 2011 (M20-03 and M20-05) and 2012 (M19-01 and M19-02). Replicate benthic invertebrate tissue samples were collected from a single site in 2012 (M19-01). The magnitude of variability between replicate samples was calculated using the relative percent differences (RPD) as described in Section 3.3.1.1.

3.3.2 Wetland Sampling Program

Wetland water quality, sediment quality, periphyton, benthic invertebrate, and tissue metal samples were collected at a total of six sites in 2010 and 2012 (Table 3.3-7).

Table 3.3-7. Wetland Samples Collected and Sampling Schedule, 2010 and 2012

Wetland Sampling Sites	August 2010				2012
	WQ	SQ	Biology	Tissue Metals	WQ
REF	A	A	A	A	-
LW4	A	-	A	A	-
LW11	A	A	A	A	-
RW3	A	A	A	A	-
W9.0	-	-	-	-	X
W9.3	-	-	-	-	X

Notes:
Biology: refers to phytoplankton and benthic invertebrate sampling
Dashes indicate sampling not conducted for that parameter at that sampling site
Tissue metal analysis performed on sedges
A = August
X = May, June, July, August, October, November. W9.0 was also sampled in December.

3.3.2.1 Water Quality

Sampling

Water quality samples were collected at four wetland sites (REF, LW4, LW11, and RW3) from August 17 to 19, 2010 as a single replicate from a depth of 1 m. In 2012, water quality samples were collected monthly (alongside stream samples) from May to December at two wetland sites (W9.0 and W9.3) as a single replicate from a depth of 1 m (Table 3.3.7). Water quality samples were handled and preserved as described in Section 3.3.1.1 and were analyzed by ALS (Burnaby, BC).

Analysis

Collected water samples were analyzed for parameters relevant to coal mining activity: such as sulphate, total suspended solids and turbidity, nitrogen compounds present in blasting agents (e.g., ammonia, nitrate), selenium, and organics such as polycyclic aromatic hydrocarbons. A complete list of the analyzed parameters and their realized detection limits are presented in Table 3.3-8. In 2011, following a recommendation from BC MOE, dissolved orthophosphate and total dissolved phosphorous were added to the list of water quality parameters measured. The detection limits were the lowest achievable by the laboratory to facilitate comparison with provincial and federal guidelines for the protection of aquatic life. In some cases, elevated chloride concentrations caused increased analytical detection limits.

For graphing purposes, half the detection value was used for samples with a result below the detection limit. This is an acceptable form of replacement for results below the detection limit (Croghan 2003). Ecologically important water quality parameters and those with comparable water quality guidelines were presented graphically. Water quality guidelines include BC MOE approved and working water quality guidelines (BC MOE 2006; Nagpal et al. 2006), and CCME water quality guidelines (CCME 2007) for the protection of freshwater aquatic life. Replicate samples were averaged for graphing. Error bars were used to indicate variability in sampling and was represented by the standard error of weekly or replicate values.

Table 3.3-8. Wetland Water Quality Parameters and Realized Detection Limits, 2010 and 2012

Parameter	Unit	Realized Detection Limit (RDL)	
		2010	2012
Physical Tests			
Colour, True	CU	5	5
Conductivity	µS/cm	2	2
Hardness (as $CaCO_3$)	mg/L	0.5	0.5
pH	pH	0.1	0.1
Total Suspended Solids	mg/L	3 - 5	3
Total Dissolved Solids	mg/L	10 - 20	
Turbidity	NTU	0.1	0.1
Anions and Nutrients			
Acidity (as $CaCO_3$)	mg/L	1	1
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1 - 2	1 - 2
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1 - 2	1 - 2
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1 - 2	1 - 2
Alkalinity, Total (as $CaCO_3$)	mg/L	1 - 2	1 - 2
Ammonia, Total (as N)	mg/L	0.005 - 0.025	0.005 - 0.025
Bromide (Br)	mg/L	0.05	0.05
Chloride (Cl)	mg/L	0.5	0.5
Fluoride (F)	mg/L	0.02	0.02
Nitrate (as N)	mg/L	0.005	0.005
Nitrite (as N)	mg/L	0.001	0.001
Total Kjeldahl Nitrogen	mg/L	0.05 - 0.5	0.05
Total Nitrogen	mg/L	0.05 - 0.5	0.05
Orthophosphate-Dissolved (as P)	mg/L	0.001	0.001
Phosphorus (P)-Total Dissolved	mg/L	0.002	0.002
Phosphorus (P)-Total	mg/L	0.002 - 0.02	0.002 - 0.02
Sulphate (SO_4)	mg/L	0.5 - 5	0.5
Cyanides			
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.001
Cyanide, Total	mg/L	0.001	0.001
Organic Carbon			
Total Organic Carbon	mg/L	0.5 - 1	0.5 - 1
Metals (Total and Dissolved)			
Aluminum (Al)	mg/L	0.001 - 0.003	0.003
Antimony (Sb)	mg/L	0.0001	0.0001
Arsenic (As)	mg/L	0.0001	0.0001
Barium (Ba)	mg/L	0.00005	0.00005
Beryllium (Be)	mg/L	0.0001 - 0.0005	0.0001
Bismuth (Bi)	mg/L	0.0005	0.0005

(continued)

Table 3.3-8. Wetland Water Quality Parameters and Realized Detection Limits, 2010 and 2012 (completed)

Parameter	Unit	Realized Detection Limit (RDL)	
		2010	2012
Metals (Total and Dissolved; cont'd)			
Boron (B)	mg/L	0.01	0.01
Cadmium (Cd)	mg/L	0.00001	0.00001
Calcium (Ca)	mg/L	0.02	0.02
Chromium (Cr)	mg/L	0.0001	0.0001
Cobalt (Co)	mg/L	0.0001	0.0001
Copper (Cu)	mg/L	0.0001 - 0.0005	0.0005
Iron (Fe)	mg/L	0.03	0.03
Lead (Pb)	mg/L	0.00005	0.00005
Lithium (Li)	mg/L	0.0005 - 0.005	0.0005
Magnesium (Mg)	mg/L	0.005	0.005
Manganese (Mn)	mg/L	0.00005	0.00005
Mercury (Hg)	mg/L	0.00001	0.00001
Molybdenum (Mo)	mg/L	0.00005	0.00005
Nickel (Ni)	mg/L	0.0005	0.0005
Phosphorus (P)	mg/L	0.3	0.3
Potassium (K)	mg/L	0.05	0.05
Selenium (Se)	mg/L	0.0001	0.0001
Silicon (Si)	mg/L	0.05	0.05
Silver (Ag)	mg/L	0.00001	0.00001
Sodium (Na)	mg/L	2	2
Strontium (Sr)	mg/L	0.0001 - 0.0002	0.0002
Thallium (Tl)	mg/L	0.00001 - 0.0001	0.00001
Tin (Sn)	mg/L	0.0001	0.0001
Titanium (Ti)	mg/L	0.01	0.01
Uranium (U)	mg/L	0.00001	0.00001
Vanadium (V)	mg/L	0.001	0.001
Zinc (Zn)	mg/L	0.001 - 0.003	0.003

Notes:
Some detection limits were elevated due to sample matrix interference.

Each parameter value was compared to CCME and BC water quality guidelines for the protection of freshwater aquatic life. For each water quality parameter, the percentage of samples above the guideline and the average factor by which concentrations were higher than the guideline were calculated and presented in tabular format. In some cases, parameter values were below the detection limit and the detection limit was greater than the guideline. These values could not be conclusively determined as above or below the guideline, and thus, were not included in the calculations.

Quality Assurance and Quality Control

The 2010 and 2012 QA/QC programs were conducted as describe in Section 3.3.1.1. The wetland water quality QA/QC program included the use of COC forms, sample blanks, and sample replication. In 2010, separate sample blanks and sample replication (one replicate) was conducted for wetlands.

3.3.2.2 Sediment Quality

Sampling

Sediment quality samples were collected at REF, LW4, and RW3 wetland sites in August, 2010 using an Ekman grab sampler (Table 3.3-7). Sediment quality samples could not be collected at LW4 due to submerged macrophytes covering the substrate (Plate 3.3-2). At each sampling site, three replicate Ekman grab samples were collected a minimum of 5 to 25 m apart (depending on the size of the wetland). Each sediment sample was carefully transferred onto a white tray, photographed and described (colour, texture, and organic content). The top 2 cm of sediment was collected and placed into a clean, pre-labelled Whirl-Pak bags, sealed (no air bubbles), and kept cold and dark until the samples were analyzed by ALS (Burnaby, BC).

Plate 3.3-2. Macrophytes at site LW4, August 2010.

Analysis

Half of the sample was analyzed for particle size and half was analyzed for sediment chemistry. A list of physical and chemical sediment quality variables and realized detection limits is presented in Table 3.3-9. For analysis and graphing purposes, values below the detection limit were replaced with half of the detection limit.

Table 3.3-9. Wetland Sediment Quality Parameters and Realized Detection Limits, 2010

Parameter	Unit	2010	Parameter	Unit	2010
Physical Tests			***Metals (cont'd)***		
Moisture	%	0.1	Cobalt (Co)	mg/kg	0.3
Particle Size			Copper (Cu)	mg/kg	0.5
Gravel (>2 mm)	%	0.1	Iron (Fe)	mg/kg	100
Sand (2 mm - 0.063 mm)	%	0.1	Lead (Pb)	mg/kg	0.1
Silt (0.063 mm - 4 µm)	%	0.1	Magnesium (Mg)	mg/kg	10
Clay (<4 µm)	%	0.1	Manganese (Mn)	mg/kg	0.2
Nutrients			Mercury (Hg)	mg/kg	0.005
Total Nitrogen	%	0.02	Molybdenum (Mo)	mg/kg	0.1
Organic Carbon			Nickel (Ni)	mg/kg	0.8
Total Organic Carbon	%	0.1	Phosphorus (P)	mg/kg	10
Plant Available Nutrients			Potassium (K)	mg/kg	100
Available Phosphate	mg/kg	2	Selenium (Se)	mg/kg	0.1
Available Sulfate	mg/kg	2	Silver (Ag)	mg/kg	0.05
Metals			Sodium (Na)	mg/kg	100
Aluminum (Al)	mg/kg	100	Strontium (Sr)	mg/kg	0.1
Antimony (Sb)	mg/kg	0.1	Sulphur (S)	mg/kg	100
Arsenic (As)	mg/kg	0.2	Thallium (Tl)	mg/kg	0.1
Barium (Ba)	mg/kg	1	Tin (Sn)	mg/kg	0.2
Beryllium (Be)	mg/kg	0.1	Titanium (Ti)	mg/kg	1
Bismuth (Bi)	mg/kg	0.1	Uranium (U)	mg/kg	0.05
Cadmium (Cd)	mg/kg	0.05	Vanadium (V)	mg/kg	2
Calcium (Ca)	mg/kg	100	Zinc (Zn)	mg/kg	2
Chromium (Cr)	mg/kg	1			

Ecologically important sediment quality parameters and those with comparable sediment quality guidelines were presented graphically. Guidelines include the CCME sediment quality guidelines (CCME 2002) and BC MOE working sediment quality guidelines (BC MOE 2006) for the protection of freshwater aquatic life. BC has adopted the established CCME sediment quality guidelines. The CCME sediment guidelines include the interim sediment quality guidelines (ISQGs) and the probable effect levels (PELs) which provide a flexible interpretive tool to evaluate the toxicological significance of sediment chemistry data. A sediment parameter concentration below the ISQG is not expected to be associated with any adverse biological effects, while concentrations above the PEL are expected to be frequently associated with adverse biological effects. BC sediment quality guidelines are analogous to the ISQG and PEL, and consist of a Lower Effects Level (LEL) and Severe Effects Level (SEL). These screening levels provide practical means to characterize sites that may have minimal, potential, or significant toxicological concern.

For graphing purposes, half the detection limit was used for samples with a result below the detection limit. Replicate samples collected were presented graphically as averages, with the error bars representing standard error.

Each parameter value was compared to CCME and BC sediment quality guidelines for the protection of freshwater aquatic life. For each sediment quality parameter, the percentage of samples above the guideline and the average factor by which concentrations were higher than the guideline were calculated and presented in tabular format. In some cases, parameter values were below the detection limit and the detection limit was greater than the guideline. These values could not be conclusively determined as above or below the guideline, and thus, were not included in the calculations.

Quality Assurance and Quality Control

As part of the QA/QC program, COC forms were used for all wetland sediment quality samples. To evaluate sample homogenization in the laboratory, ALS split samples to create a replicate.

3.3.2.3 Phytoplankton

Sampling

Phytoplankton samples were collected in 2010 from the four wetland sites, concurrent with water quality and sediment quality sampling (Table 3.3-7). Three replicate 1 L samples were collected from 1 m depth at each site for both phytoplankton biomass (as chlorophyll *a*) and community taxonomic composition and abundance. The phytoplankton biomass samples were field-filtered through a GF/C filter, wrapped in foil, frozen and kept in the dark until analyzed by ALS (Vancouver, BC) for chlorophyll *a* content. Phytoplankton taxonomy samples were preserved with Lugol's iodine solution and sent to Fraser Environmental Services (Surrey, BC) for taxonomic identification and enumeration.

Analysis

Phytoplankton biomass for each sample was estimated as µg chl *a*/L at each wetland site. Phytoplankton taxonomy samples were identified to the lowest taxonomic level practicable. Phytoplankton density and diversity (richness and Simpson's Diversity Index) were calculated for each sample as described in Section 3.3.1.4. For richness and diversity calculations, taxa were grouped by genus. Individuals of unknown taxa were excluded from the analysis.

Quality Assurance and Quality Control

COC forms were used for all phytoplankton samples as part of the QA/QC program. To account for within-site variability three replicate samples were collected at each site in 2010.

3.3.2.4 Benthic Invertebrates

Sampling

Benthic invertebrate samples were collected using an Ekman grab sampler with a surface area of 0.0225 m^2 from three wetland sites (REF, LW11, and RW3; Table 3.3-2). At each wetland site, five replicate samples comprised of three subsamples per replicate were collected. Benthic invertebrate samples could not be collected at LW4 due to submerged macrophytes covering the sediments. Each replicate was collected approximately 20 m apart. Invertebrate samples were preserved in to a final concentration of 10% buffered formalin. Preserved samples were shipped to Cordillera Consulting (Summerland, BC) for identification and enumeration.

Analysis

Invertebrates were sorted and identified to the lowest practicable taxonomic level (genus or species). Benthic invertebrate density and diversity (richness and Simpson's Diversity Index) were calculated for each sample as described in Section 3.3.1.4. For richness and diversity calculations, taxa were grouped

by family. Individuals of unknown taxa were excluded from the analysis. Due to uncertainty of what the data represents, benthic invertebrates in the 2-4 mm fraction were excluded from all analyses and graphing.

Quality Assurance and Quality Control

Chain of custody forms were used for all benthic invertebrate samples as part of the QA/QC program. To account for within-site variability three replicate samples were collected at each site.

3.3.2.5 Tissue Metals

Sampling

In 2010, sedge samples were collected for tissue metal analysis alongside water and sediment quality samples. The above ground portion of sedges (*Carex* sp.; Plate 3.3-3) were collected in triplicate at four wetland sites (REF, LW4, LW11 and RW3). Sedge samples were kept cool until analyzed by ALS (Burnaby, BC).

Plate 3.3-3. Wetland Sedge for tissue metal analysis, August 2010.

Analysis

Sedge tissue samples were homogenized and digested before metals analysis (wet weight) by Inductively Coupled Plasma-Mass Spectrometry. The metal parameters analyzed and their realized detection limits are summarized in Table 3.3-10.

Parameters that were identified as contaminants of potential concern (COPC) that bioaccumulate were graphed (arsenic, cadmium, mercury and selenium). For graphing purposes, half the detection limit was used for samples with a result below the detection limit. Replicate samples collected were presented graphically as averages, with the error bars representing standard error.

Table 3.3-10. Wetland Sedge Tissue Metal Parameters and Realized Detection Limits, 2010

Parameter	Unit	2010	Parameter	Unit	2010
% Moisture	%	0.1	***Total Metals (cont'd)***		
Total Metals			Lithium (Li)	mg/kg	0.1
Aluminum (Al)	mg/kg	2	Magnesium (Mg)	mg/kg	1
Antimony (Sb)	mg/kg	0.01	Manganese (Mn)	mg/kg	0.01
Arsenic (As)	mg/kg	0.01	Mercury (Hg)	mg/kg	0.001
Barium (Ba)	mg/kg	0.01	Molybdenum (Mo)	mg/kg	0.01
Beryllium (Be)	mg/kg	0.1	Nickel (Ni)	mg/kg	0.1
Bismuth (Bi)	mg/kg	0.03	Selenium (Se)	mg/kg	0.2
Cadmium (Cd)	mg/kg	0.005	Strontium (Sr)	mg/kg	0.01
Calcium (Ca)	mg/kg	2	Thallium (Tl)	mg/kg	0.01
Chromium (Cr)	mg/kg	0.1	Tin (Sn)	mg/kg	0.05
Cobalt (Co)	mg/kg	0.02	Uranium (U)	mg/kg	0.002
Copper (Cu)	mg/kg	0.01	Vanadium (V)	mg/kg	0.1
Lead (Pb)	mg/kg	0.02	Zinc (Zn)	mg/kg	0.1

Quality Assurance and Quality Control

Chain of custody forms were used for all tissue samples as part of the QA/QC program. To account for within-site variability three replicate samples were collected at each site.

4. Stream Sampling Results

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4. Stream Sampling Results

Stream data collected by EDI in 2010 and 2011 is included in this report, and the 2011 EDI Aquatic Life Data Report is included for reference in Appendix 4-1.

4.1 WATER QUALITY

Water quality parameters of importance and those with CCME or BC MOE guidelines were graphed and presented in Figures 4.1-1 to 4.1-47. Stream water quality data are presented in Appendix 1-1.

4.1.1 General Parameters and Anions

Overall, streams in the Project area had alkaline waters (pH range: 7.30 to 8.55) that were well buffered (total alkalinity range: 30 to 354 mg $CaCO_3$/L), and had a typical hardness range of 32 to 222 mg $CaCO_3$/L (Figures 4.1-1 to 4.1-3). M17 and M19 creeks had extremely hard waters that ranged from 145 to 1,130 mg $CaCO_3$/L (Figure 4.1-3). Total dissolved solids (TDS) concentrations ranged from 61 to 275 mg/L, excluding the high total alkalinity and hardness sites on M17 and M19 creeks where TDS was not measured (Figure 4.1-4). Seasonally, alkalinity, hardness, and TDS were lower from spring (May) through the summer (September) with levels increasing from October to April. Inter-year variability was low for pH, alkalinity, hardness, and TDS.

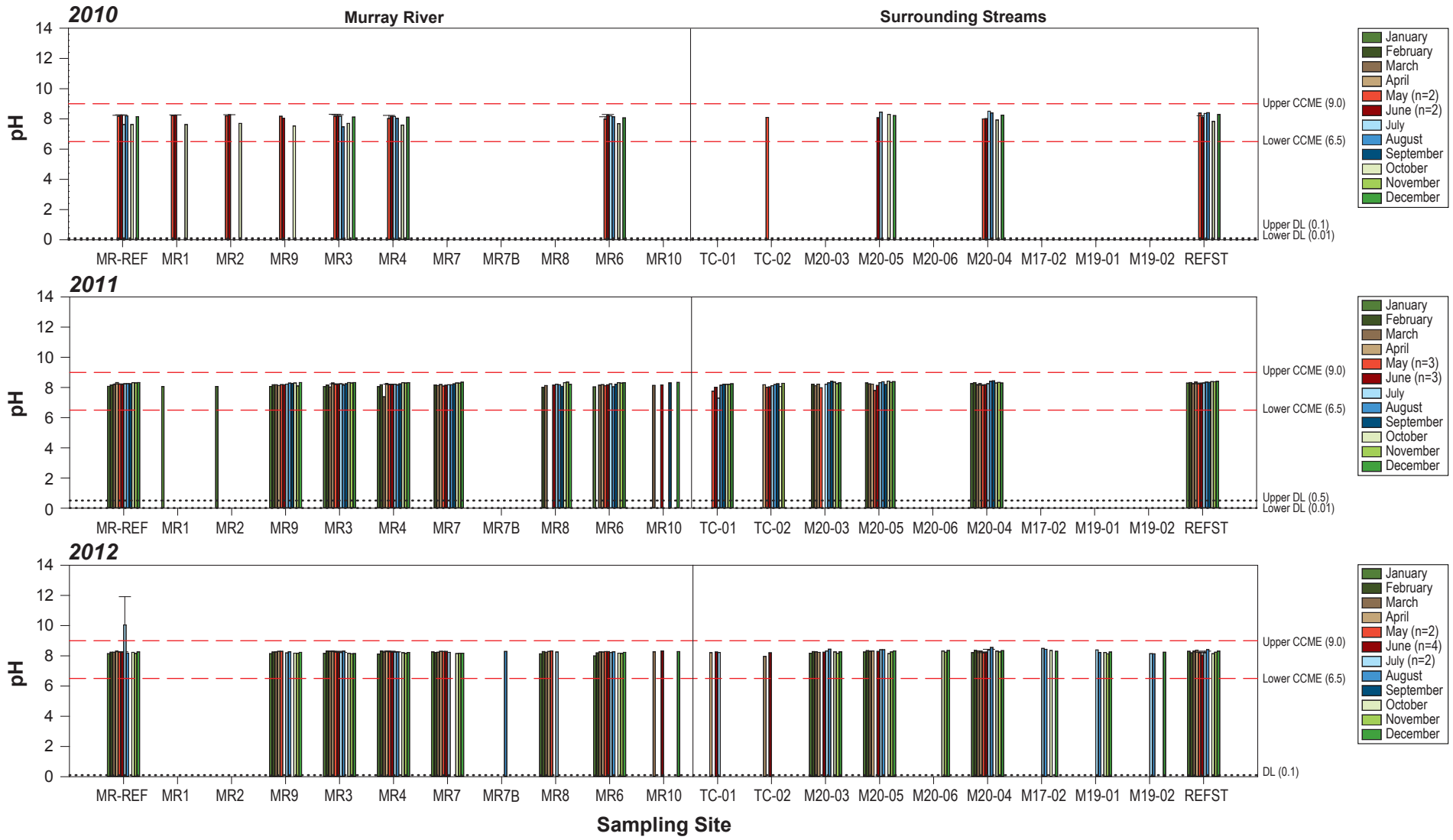
Chloride concentrations were typically low and ranged from 0.18 to 5 mg/L, except at M17 and M19 creeks where concentrations ranged from 0.25 to 17.4 mg/L (Figure 4.1-5). Sulphate concentrations were low in the Murray River and Twenty Creek (range: 2.15 to 35.9 mg/L) and higher in Camp Creek (range: 0.94 to 86.9 mg/L). Sulphate concentrations were elevated in M17 Creek (mean: 220 mg/L) and during the August sampling date at M19-02 (887 mg/L). Fluoride concentrations were lowest in the Murray River (range: <0.02 to 0.064 mg/L) and were modestly higher in its tributaries (range 0.022 to 0.167 mg/L; Figure 4.1-7). Seasonally, anion concentrations (chloride, sulphate, and fluoride) were typically lowest from spring (May) through the summer (September) with concentrations increasing from October to April. Annually, anion concentrations were similar between years, although 2012 sulphate concentrations in Camp Creek were lower during the winter months and higher during the autumn months compared 2011 concentrations.

4.1.2 Suspended Material

Turbidity and TSS were spatially variable throughout LSA streams and temporally variable within Project stream sites (Figures 4.1-8 and 4.1-9). Turbidity and TSS levels were generally lowest during the low flow period (October to April), before increasing sharply during freshet in May and June when flow is greatest. Overall, turbidity ranged from 0.17 to 1,310 NTU and TSS ranged from 0.5 to 2,070 mg/L (Figures 4.1-8 and 4.1-9, respectively). Turbidity and TSS in Twenty and Camp creeks were more variable than that in the other streams and Murray River. Mean turbidity and TSS levels were greater in 2011 compared to 2010 and 2012, particularly during freshet.

4.1.3 Nutrients and Total Organic Carbon

Overall, nitrogen concentrations in LSA streams were low (Figures 4.1-10 to 4.1-13). Total nitrogen concentrations ranged from 0.03 to 1.43 mg/L, except at TC-02 on May 17, 2011 when the concentration was 3.73 mg/L (Figure 4.1-10). This elevated total nitrogen measurement at TC-02 corresponded with an elevated TSS level. Generally, total nitrogen concentrations in Murray River and its tributaries streams peaked during freshet (May). Total nitrogen concentrations were higher in 2011 compared to 2010 and 2012.



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2010 and 2011).
Red dashed lines represent the CCME guidelines (upper and lower).

Figure 4.1-1

hd Mining

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pH Levels in Streams, 2010 to 2012

Figure 4.1-1

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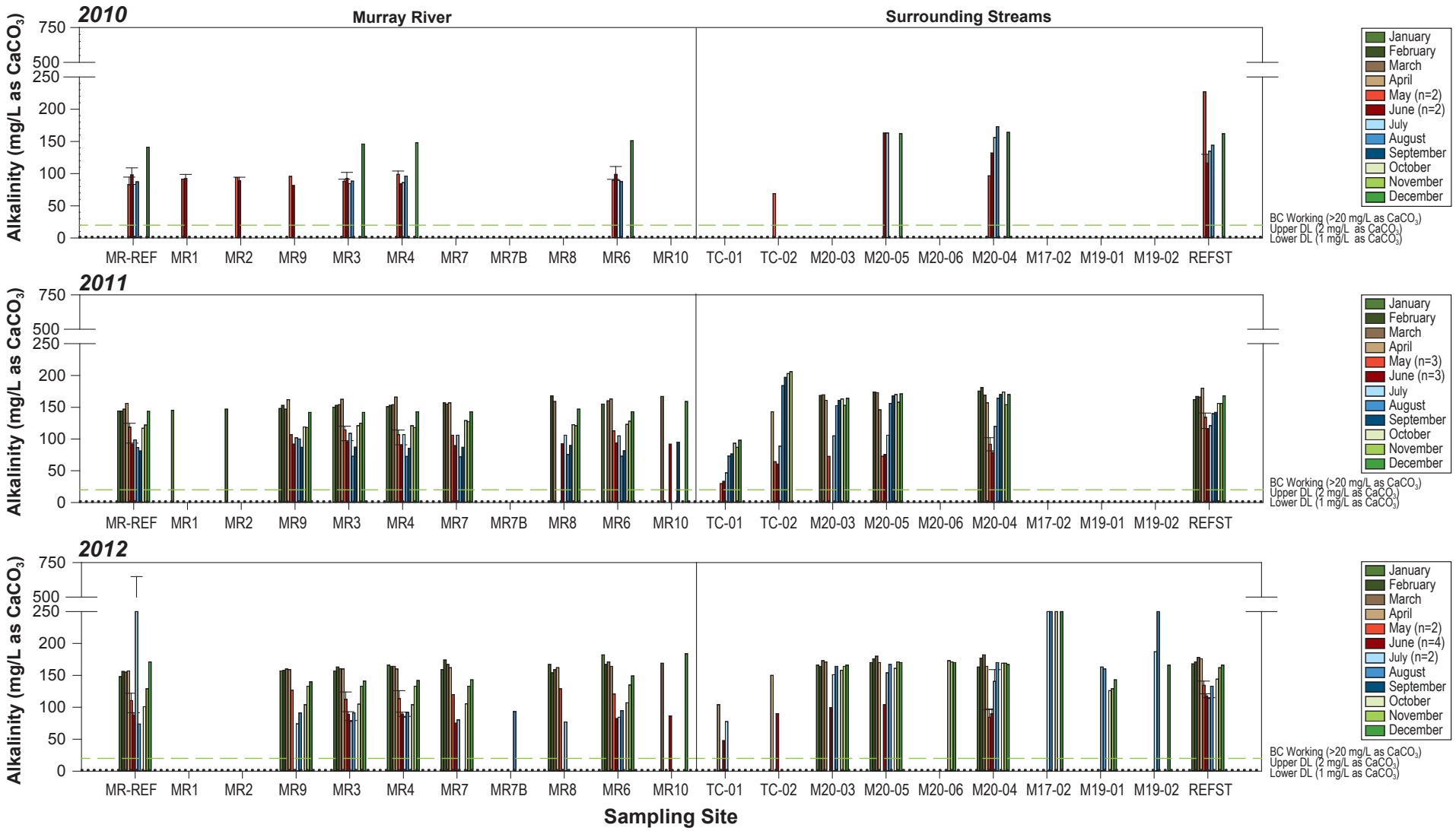


Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2010 and 2011).
Green dashed lines represent the BC Working guideline, where water with alkalinities >20 mg/L of $CaCO_3$ have a low sensitivity to acid inputs.

Figure 4.1-2

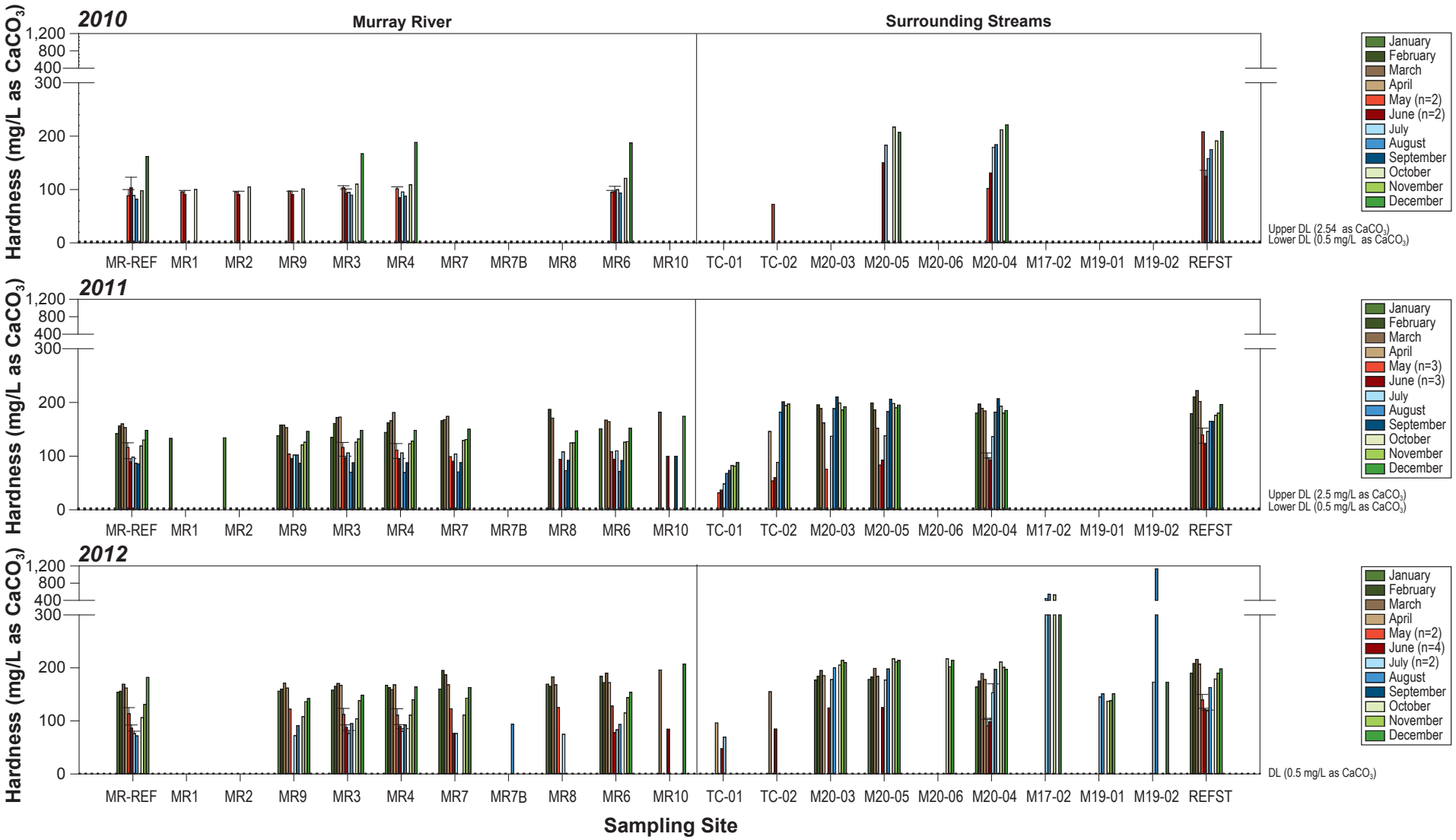
hd Mining

MURRAY RIVER COAL PROJECT

Total Alkalinity Levels in Streams, 2010 to 2012

Figure 4.1-2

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2010 and 2011).

Figure 4.1-3

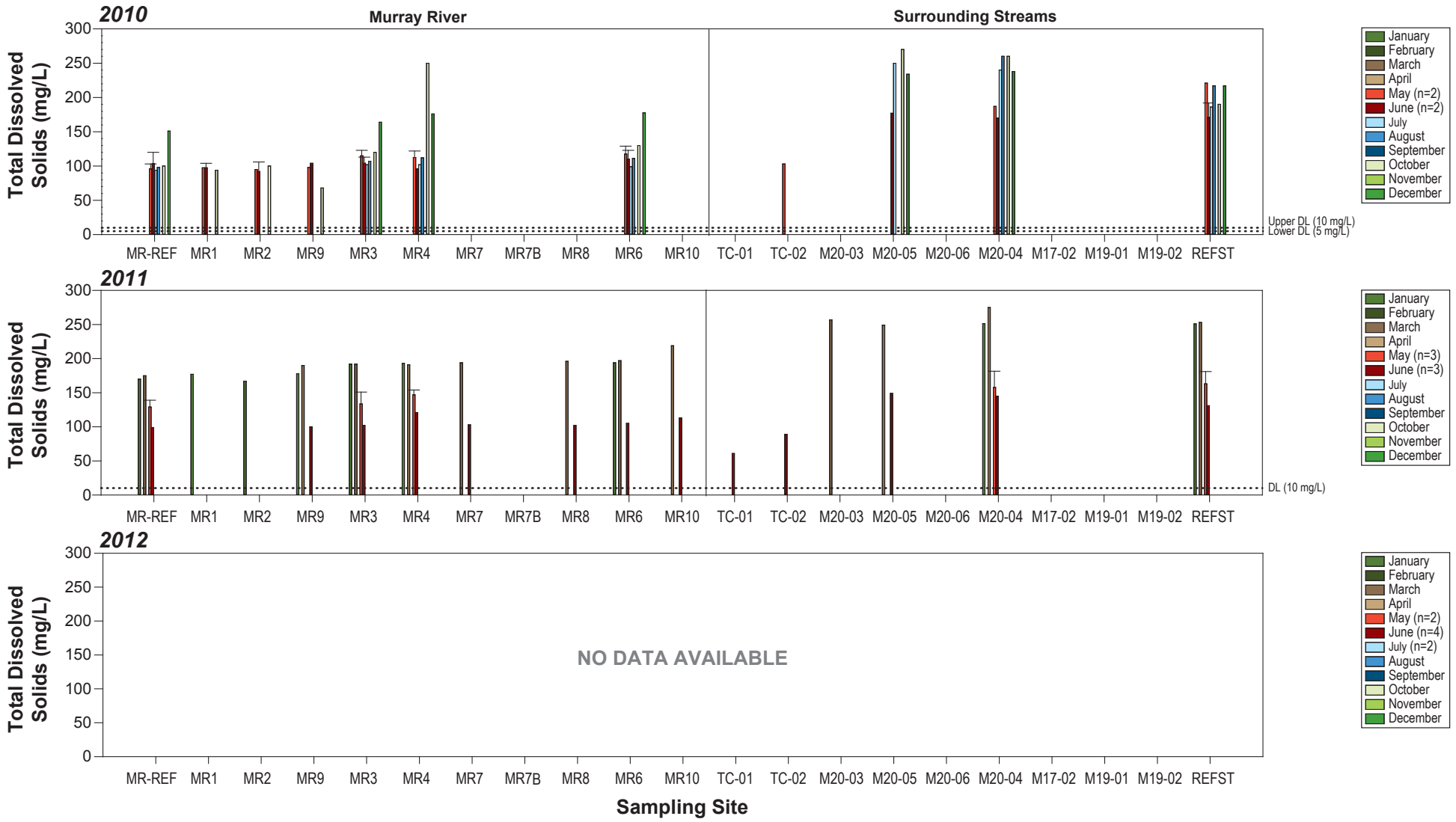
hd Mining

MURRAY RIVER COAL PROJECT

Total Hardness Levels in Streams, 2010 to 2012

Figure 4.1-3

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2010).

Figure 4.1-4

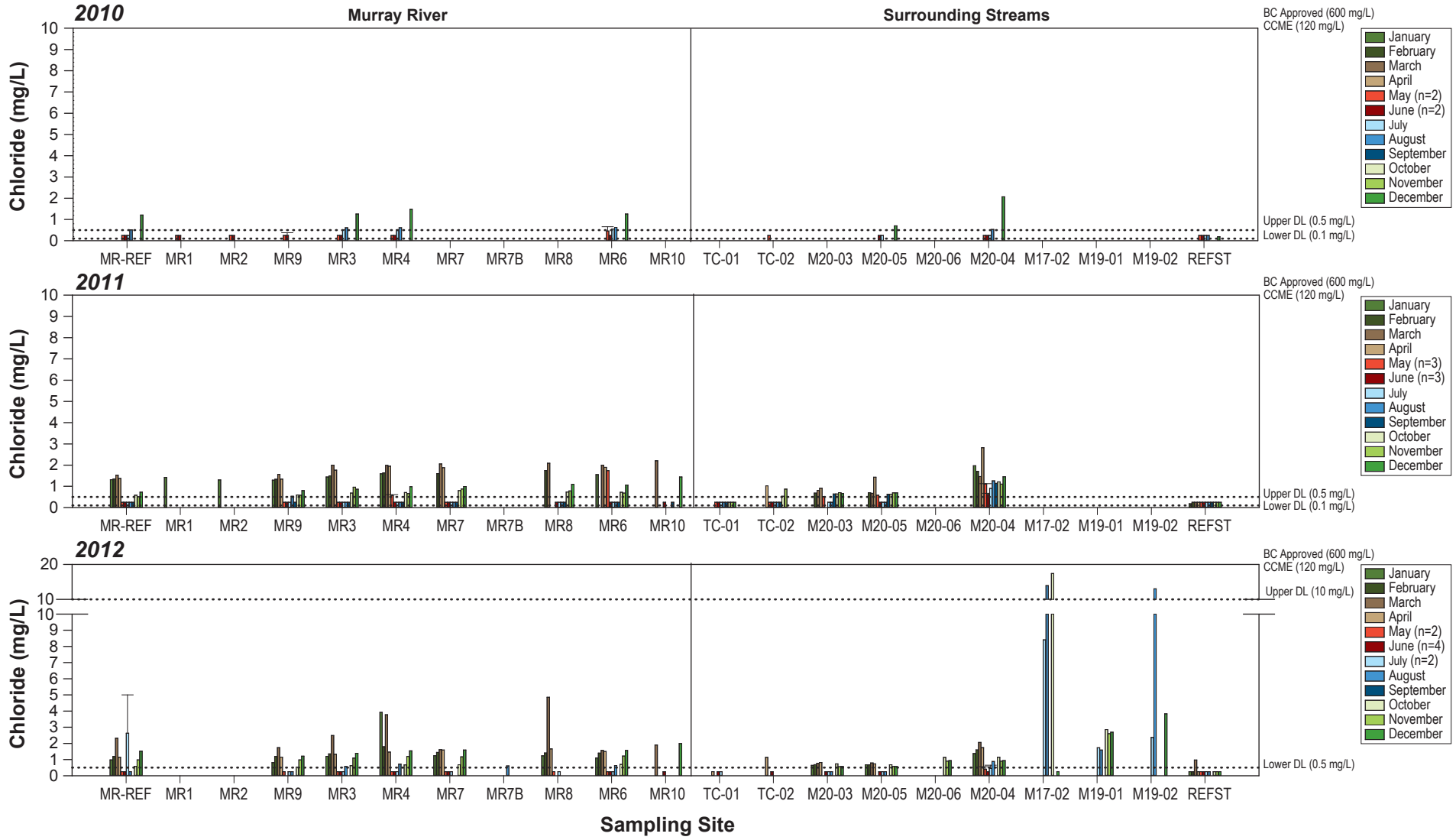
hd Mining

MURRAY RIVER COAL PROJECT

Total Dissolved Solids in Streams, 2010 to 2012

Figure 4.1-4

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (600 mg/L) and CCME guideline (120 mg/L) are greater than graph scales.

Figure 4.1-5

hd Mining

MURRAY RIVER COAL PROJECT

Chloride Concentrations in Streams, 2010 to 2012

Figure 4.1-5

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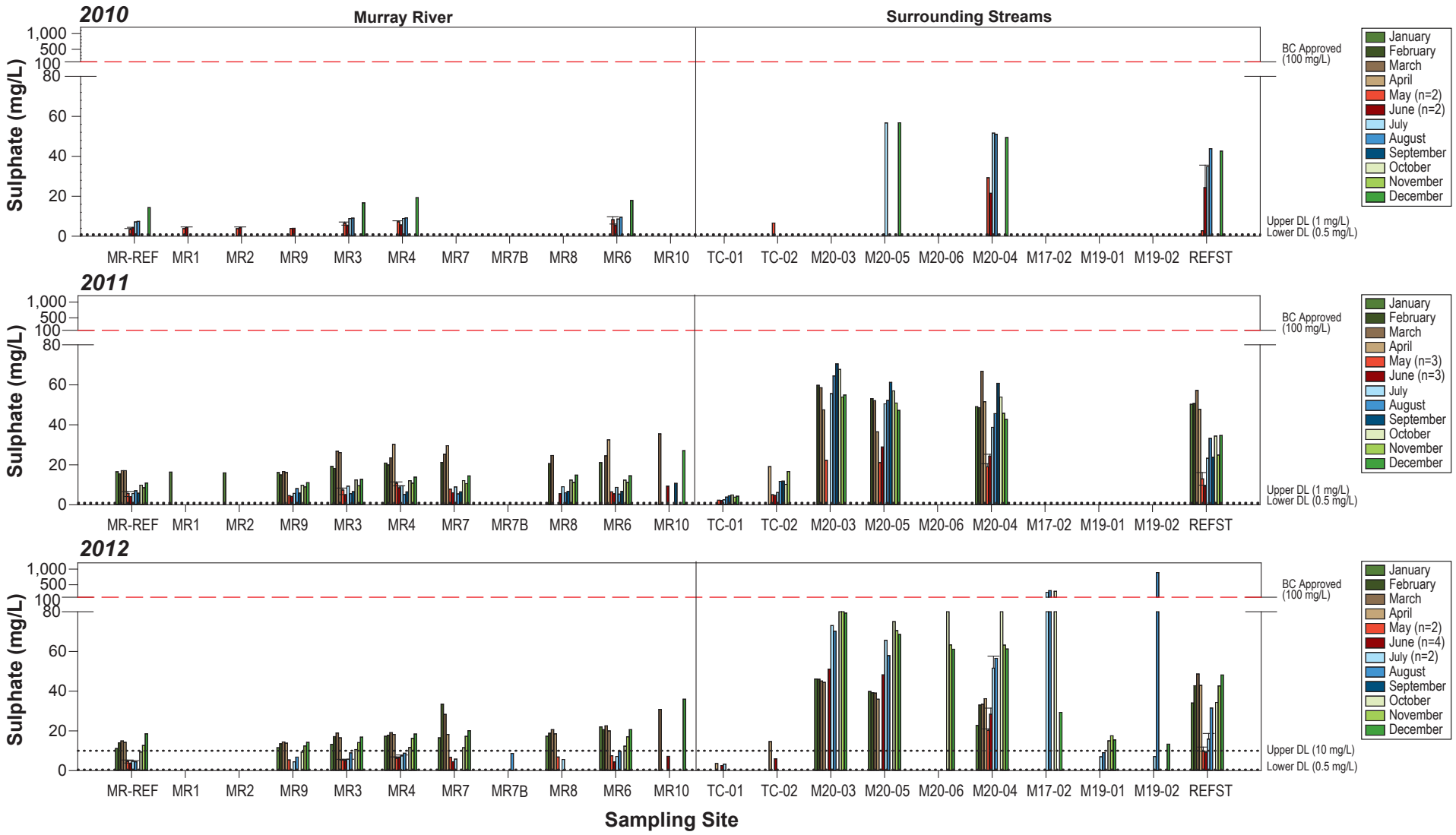

Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Red dashed lines represent BC Approved guideline (100 mg/L).

Figure 4.1-6

hd Mining

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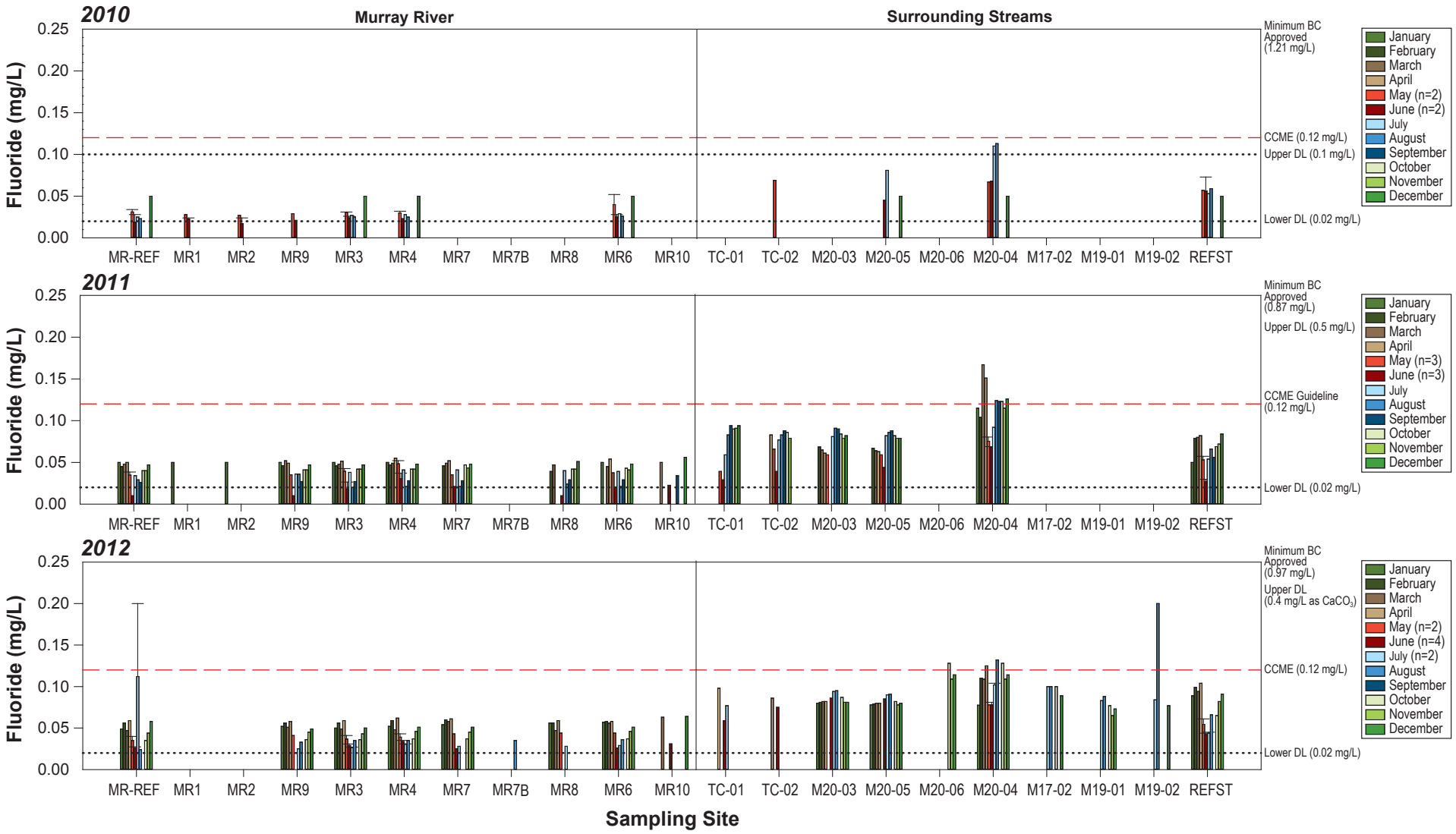
Sulphate Concentrations in Streams, 2010 to 2012

Figure 4.1-6

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent the realized detection limits (DL; upper and lower).
Red dashed lines represent the CCME guideline (0.12 mg/L).
*Minimum BC Approved guideline (hardness dependent; fluoride equation (mg/L) = -51.73 + 92.57*log$_{10}$(hardness)*0.01) is greater than graph scales.*

Figure 4.1-7

hd Mining

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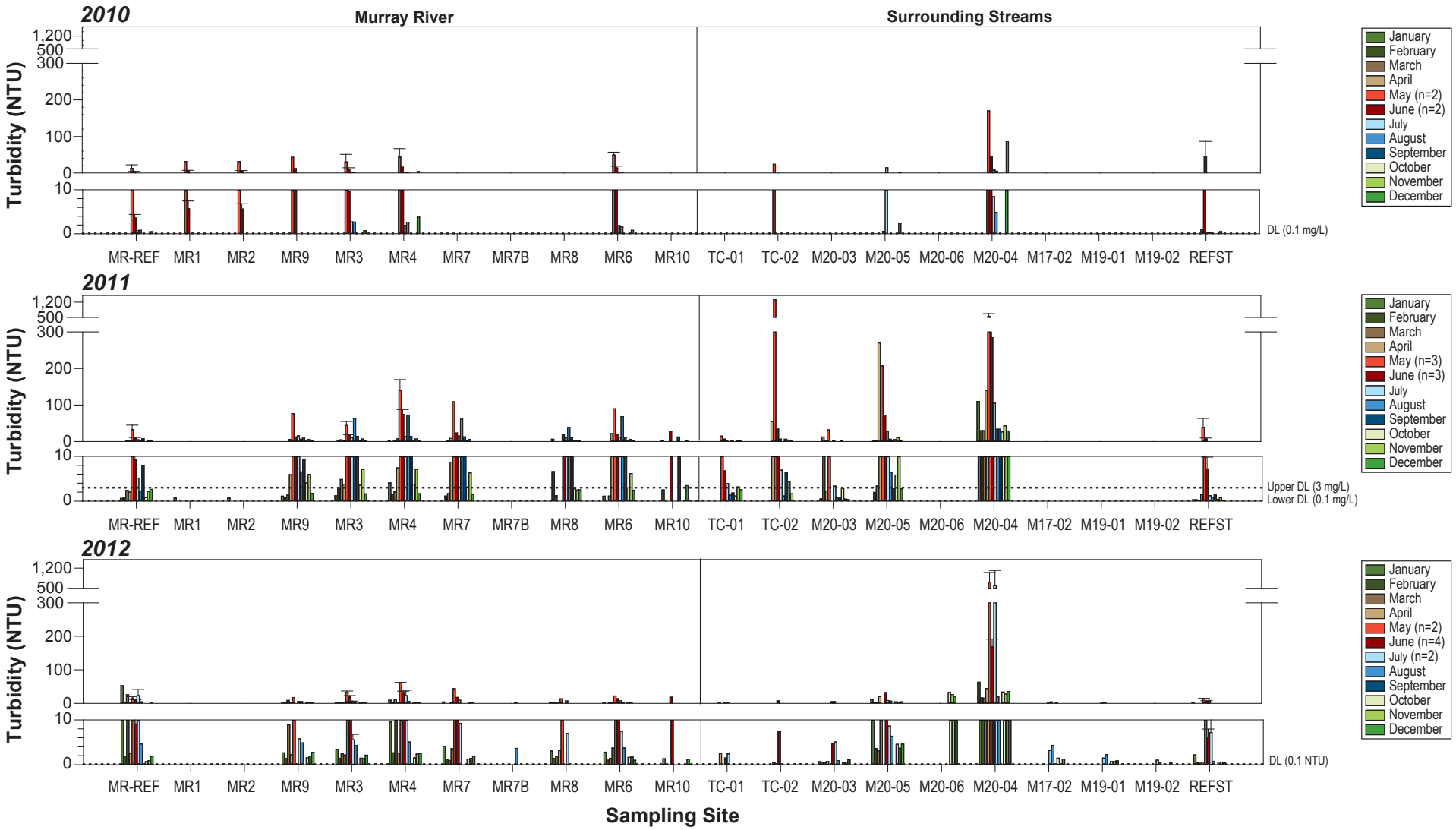
Fluoride Concentrations in Streams, 2010 to 2012

Figure 4.1-7

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2011).

Figure 4.1-8

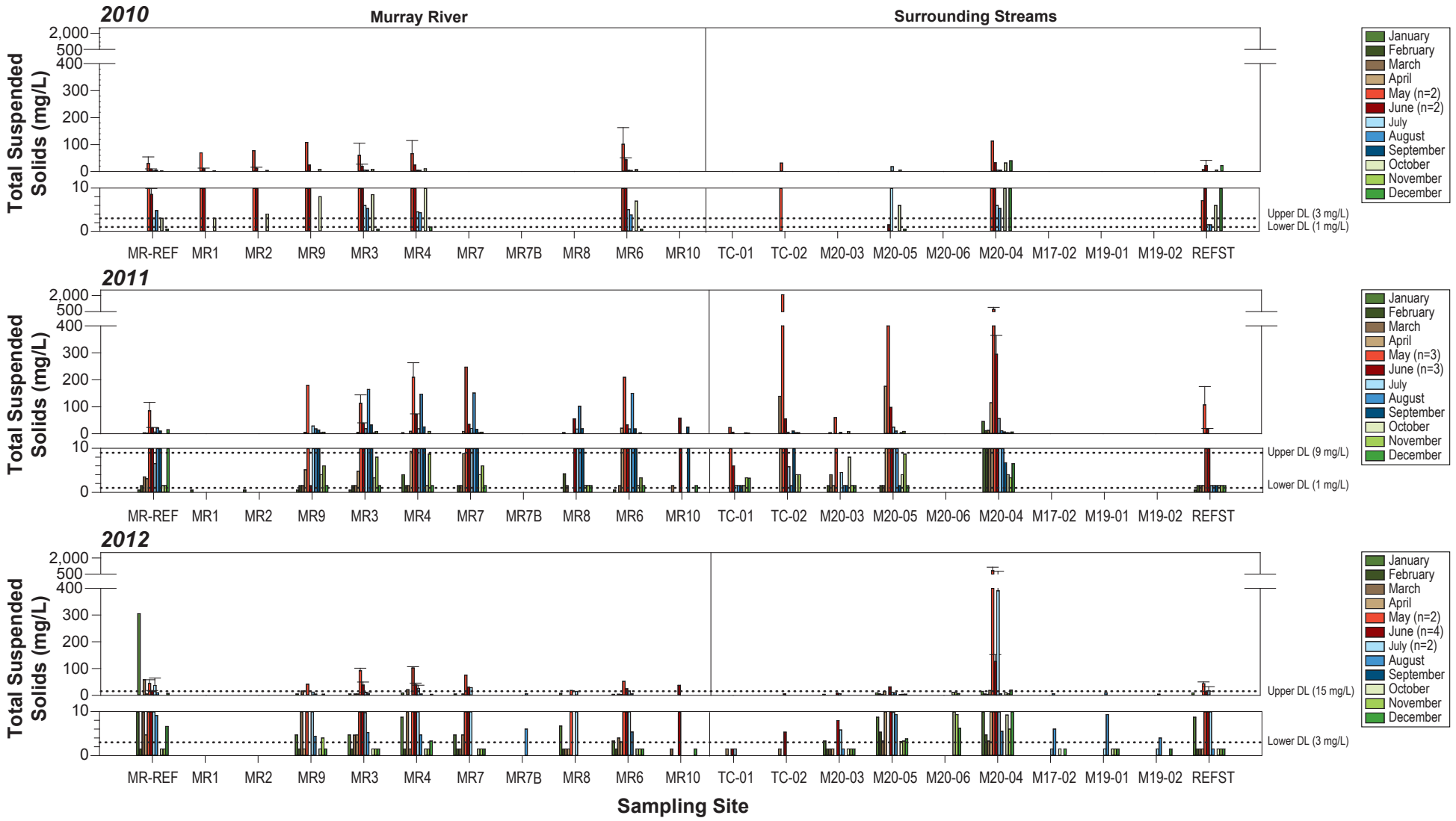
hd Mining

MURRAY RIVER COAL PROJECT

Turbidity Levels in Streams, 2010 to 2012

Figure 4.1-8

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).

Figure 4.1-9

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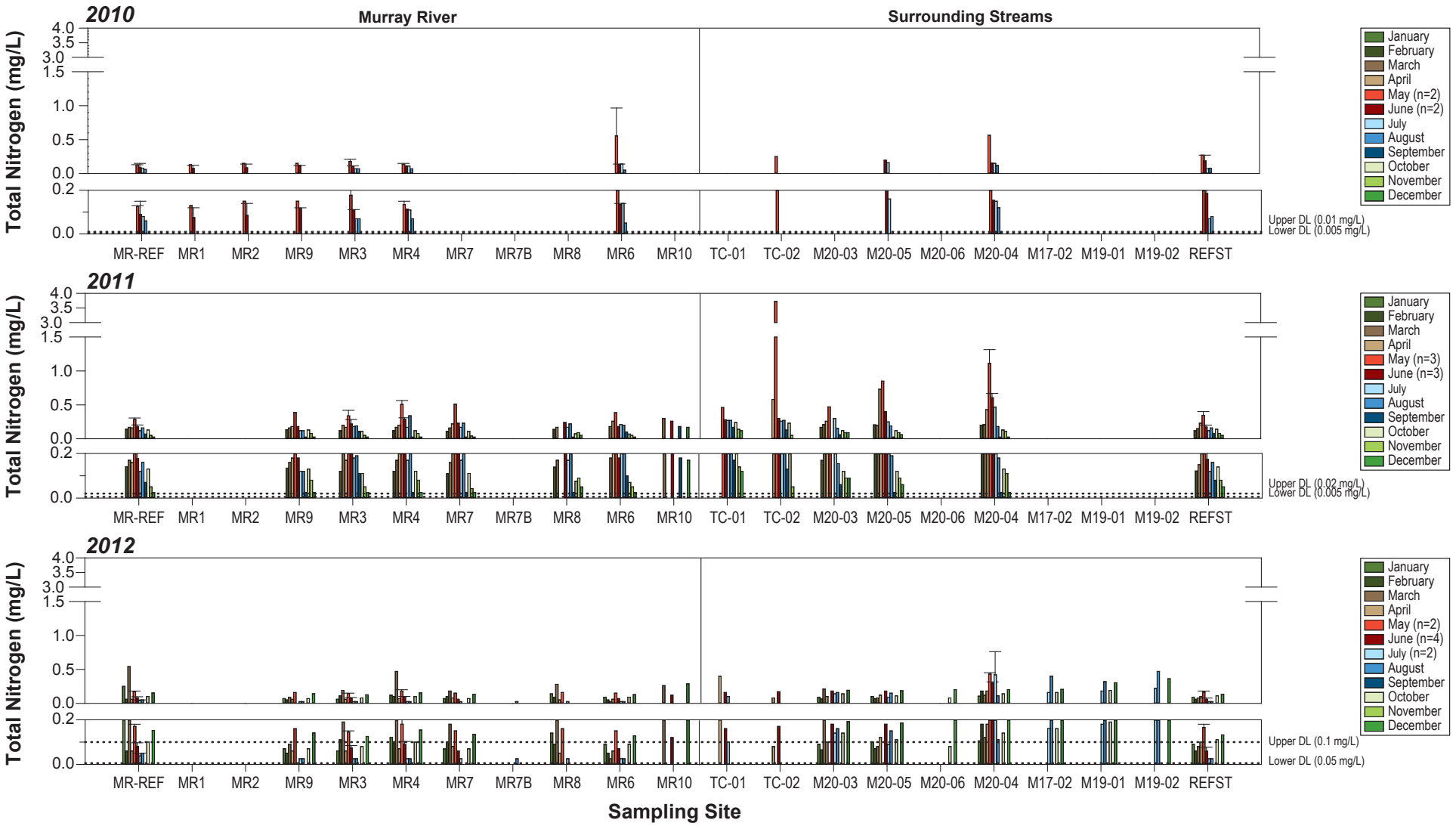
MURRAY RIVER COAL PROJECT

Total Suspended Solids in Streams, 2010 to 2012

Figure 4.1-9

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits(upper and lower).

Figure 4.1-10

hd Mining

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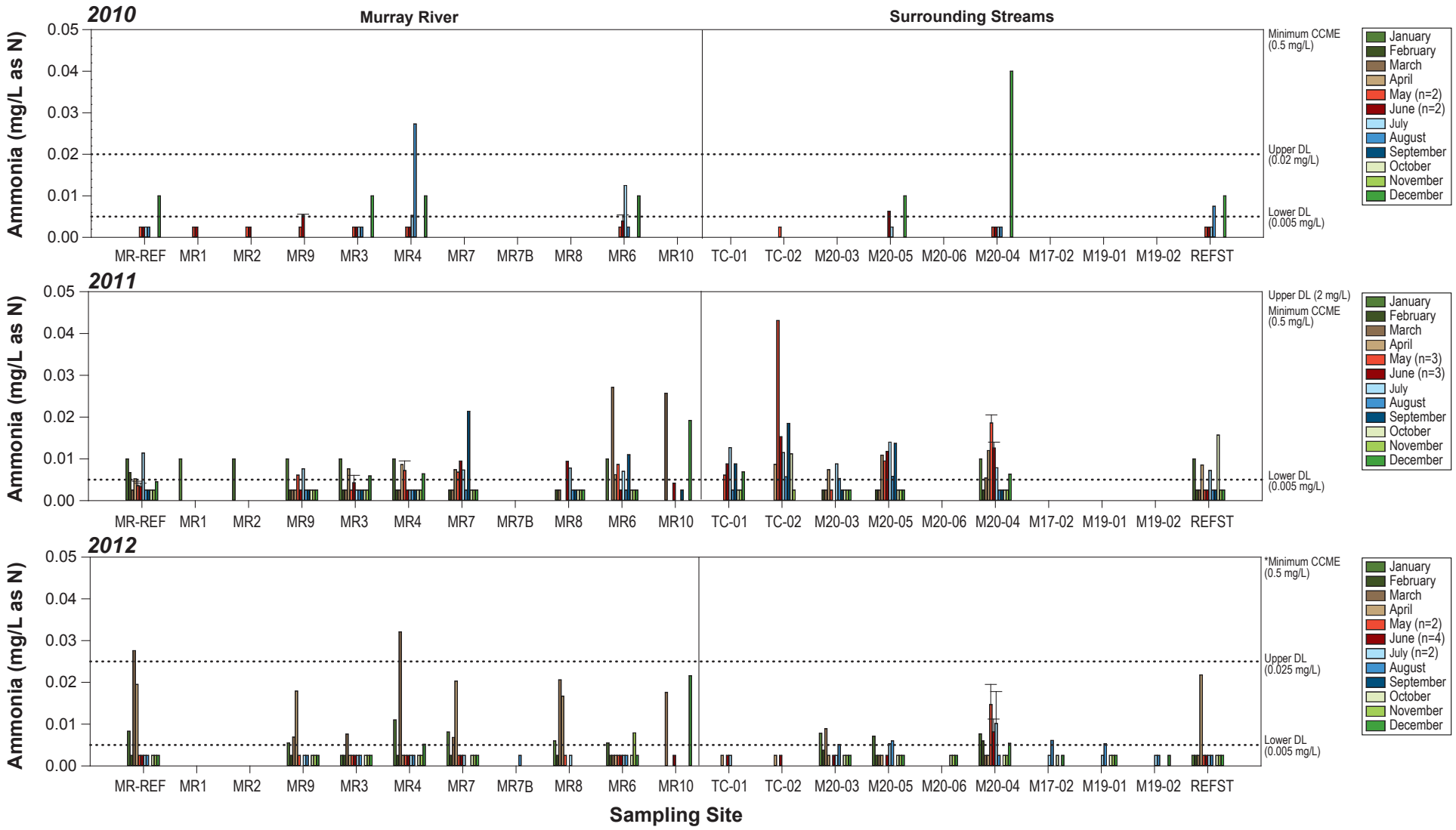
Total Nitrogen Concentrations in Streams, 2010 to 2012

Figure 4.1-10

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
*Minimum CCME guideline lines (temperature and pH dependant; 0.5 mg/L) are greater than graph scales. * In 2012 a single sample had pH ~12 which corresponds to CCME guideline of 0.25 mg/L.*

Figure 4.1-11

hd Mining

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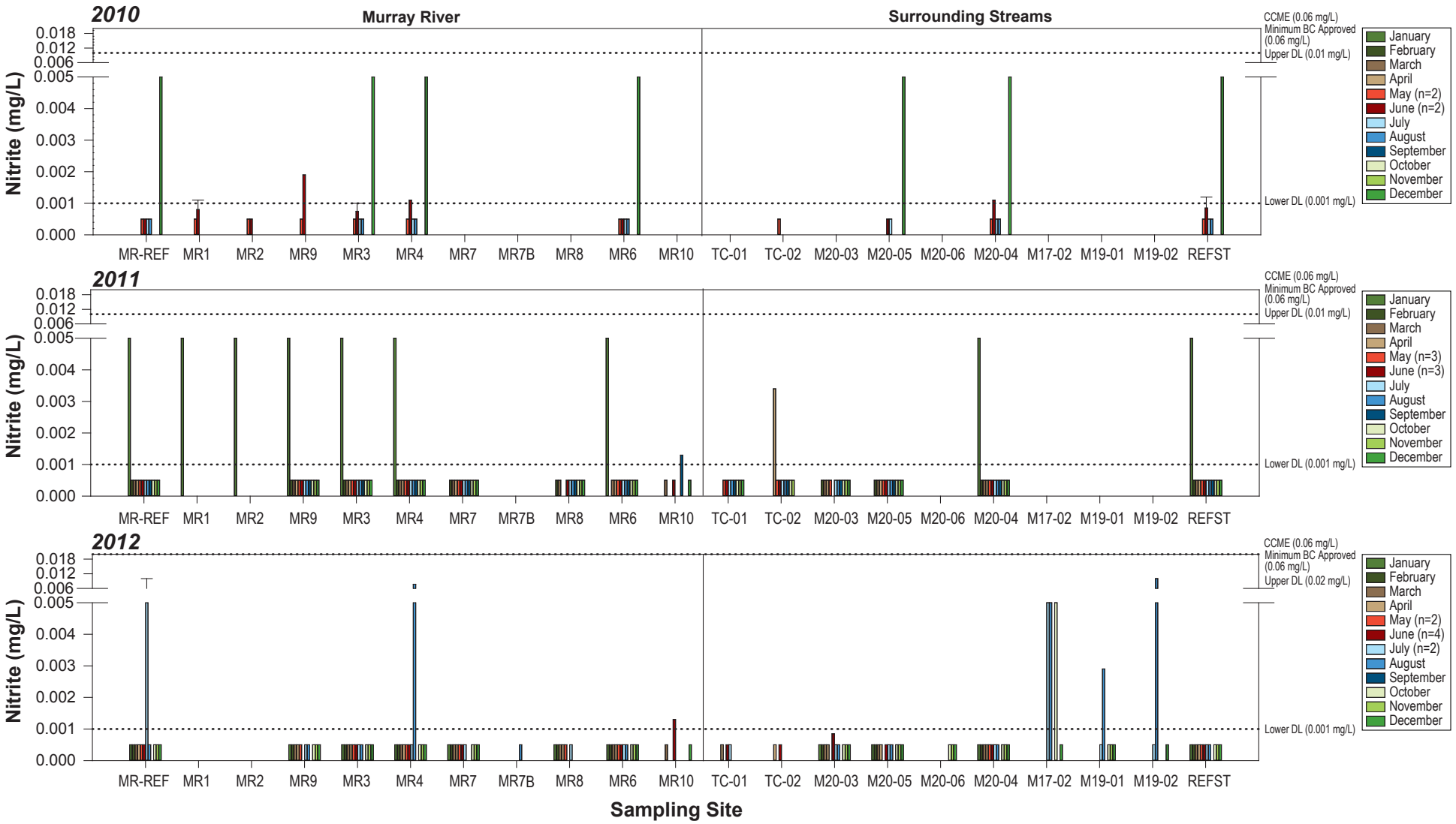
Ammonia Concentrations in Streams, 2010 to 2012

Figure 4.1-11

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
CCME guideline (0.06 mg/L) is greater than graph scales.
BC Approved guideline (chloride dependent; minimum = 0.06 mg/L when Cl < 2mg/L) is greater than graph scales.

Figure 4.1-12

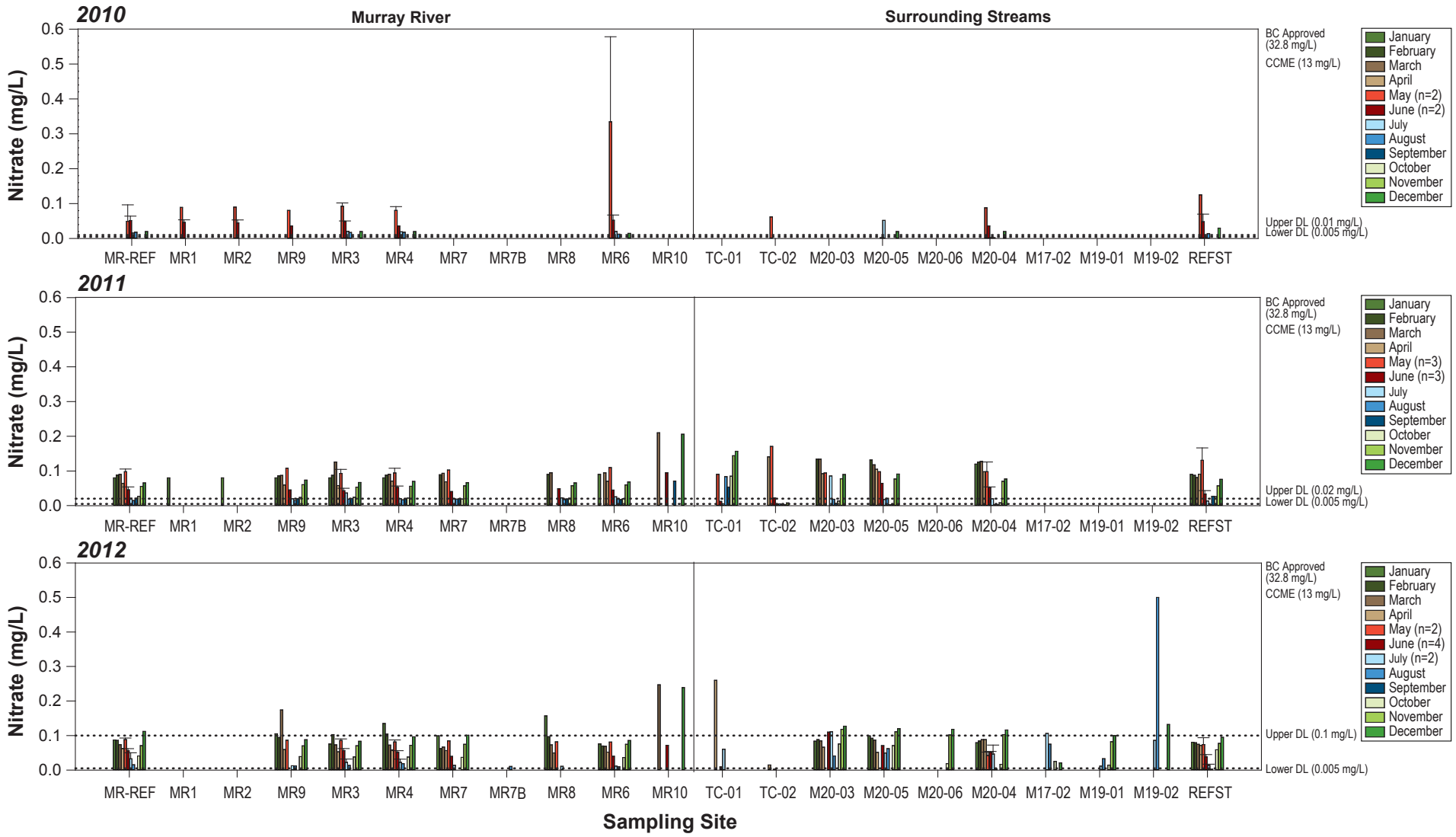
hd Mining

MURRAY RIVER COAL PROJECT

Nitrite Concentrations in Streams, 2010 to 2012

Figure 4.1-12

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (32.8 mg/L) and CCME guideline (13 mg/L) are greater than graph scales.

Figure 4.1-13

hd Mining

MURRAY RIVER COAL PROJECT

Nitrate Concentrations in Streams, 2010 to 2012

Figure 4.1-13

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Ammonia-nitrogen concentrations were often below the detection limit (0.005 mg/L as N) and peaked at TC-02 in May 2011 (0.04 mg/L as N; Figure 4.1-11). There were no clear seasonal or annual patterns of ammonia concentrations.

Nitrite-nitrogen concentrations were almost always (97% of samples) below the detection limit which was variable (0.001 - 0.02 mg/L; Figure 4.1-12). Nitrate was the primary form of inorganic nitrogen and concentrations were low, ranging from below the detection limit (0.005 mg/L as N) to 0.58 mg/L (Figure 4.1-13). Generally, nitrate concentrations were greater during freshet and winter months, than summer months.

Total phosphorus concentrations ranged from below the detection limit (0.001 mg/L) to 1.31 mg/L and were always greatest during freshet, though the mean concentration was variable between years (2010: 0.045 mg/L; 2011: 0.157 mg/L; and 2012: 0.08 mg/L; Figure 4.1-14). Seasonal patterns in total phosphorus concentrations were similar to those observed for turbidity and TSS. Thus, the increased total phosphorus concentrations during freshet are likely due to increases in suspended sediment and associated particle-bound phosphorus. Orthophosphate concentrations in the Murray River were typically below the detection limit (0.001 mg/L as P; Figure 4.1-15). Concentrations were higher in the surrounding tributaries (maximum of 0.05 mg/L as P) and there was a very high measurement at M20-04 in 2010 (0.1 mg/L as P).

Total organic carbon (TOC) followed a similar pattern as TSS and had greater concentrations during the high flow freshet period and lower concentrations during the low flow winter period (Figures 4.1-9 and 4.1-16). Overall, TOC ranged from 0.8 to 60.3 mg/L, with the greatest levels corresponding to elevated TSS levels measured in 2011 at Twenty and M20 Creeks.

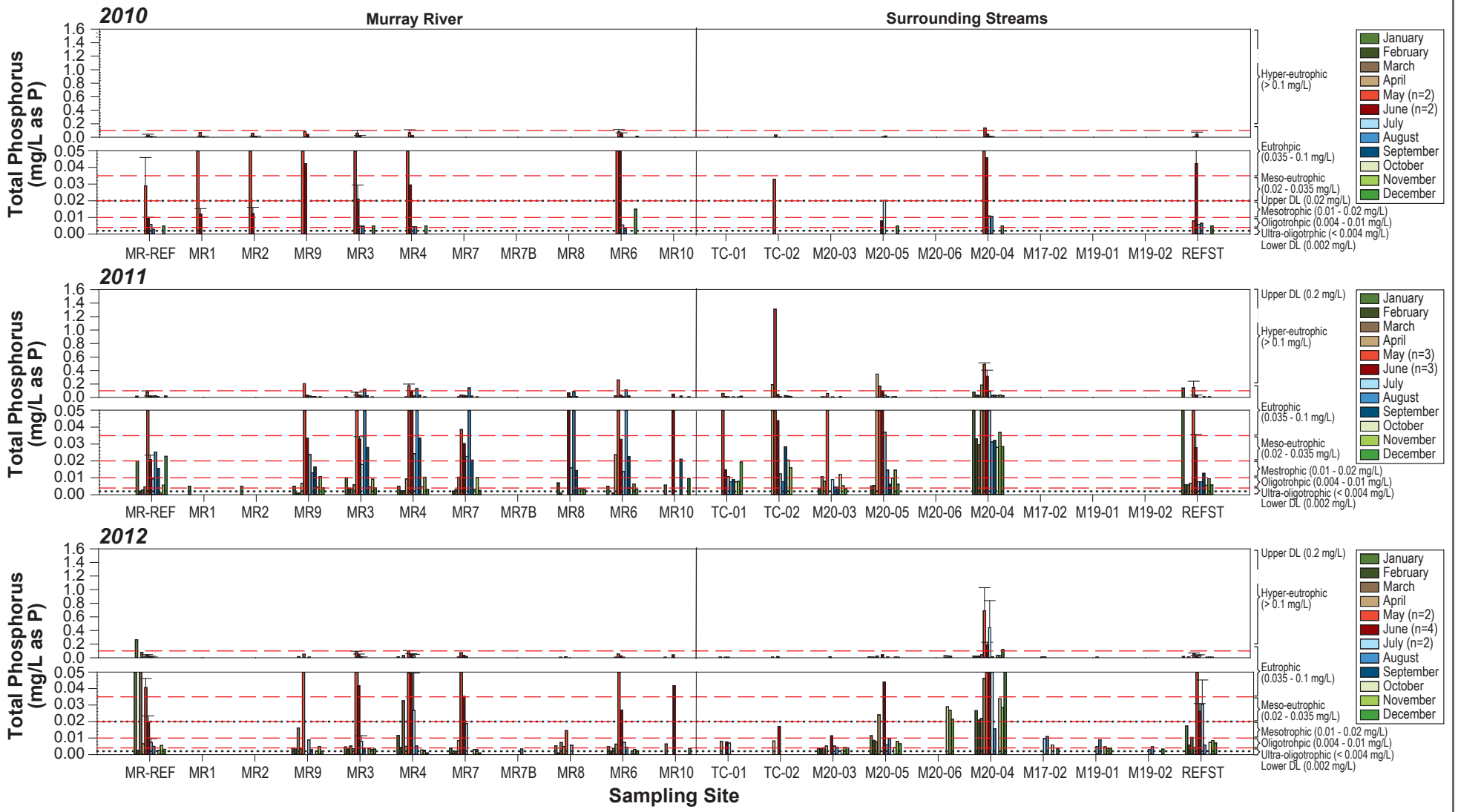
4.1.4 Cyanide

Total cyanide concentrations in 2010 and 2011 roughly followed the pattern of TOC and TSS and ranged from below the lower detection limit of 0.001 mg/L to 0.0303 mg/L (Figures 4.1-9, 4.1-16, and 4.1-17). In May 2012, ALS changed their total cyanide method, resulting in lower detection limits and fewer false positive results that can occur due to the presence of dissolved organic carbon. From May to December 2012, all total cyanide concentrations were below the detection limit (0.001 mg/L). Weak-acid dissociable (WAD) cyanide concentrations were below the detection limit in 95% of samples (Figure 4.1-18).

4.1.5 Total Metals

Total and dissolved metals with CCME and BC MOE guidelines are presented in Figures 4.1-19 to 4.1-47. The greatest metal concentrations were typically measured during freshet at Camp Creek site M20-04, though Twenty Creek site TC-02 had high metal concentrations in May 2011. Many metals of interest paralleled the seasonal trends observed for TSS (Figure 4.1-9), with higher concentrations recorded during freshet in association with increased terrestrial run-off caused by snowmelt. Total and dissolved aluminum, total arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, potassium, titanium, vanadium, and zinc concentrations followed this seasonal pattern.

Some metals had different patterns depending on the site. For example, total barium concentrations were often greatest during the low flow winter months in the Murray River, but peaked during freshet or late summer in the smaller tributaries (Figure 4.1-23). Total boron, lithium, molybdenum, selenium, and uranium also followed this pattern. Total molybdenum concentrations at REFST were elevated compared to other streams where concentrations were typically 3-fold lower (Figure 4.1-37). Dissolved calcium was always greatest during the winter or late summer months and lowest during the higher flow freshet period. Total antimony, beryllium, mercury, silver, thallium, and tin concentrations were largely below their detection limits.



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits(upper and lower).
Red dashed lines represent CCME trigger ranges for total phosphorus (mg/L): ultraoligotrophic (<0.004); oligotrophic (0.004 - 0.01); mesotrophic (0.01 - 0.02); meso-eutrophic (0.02 - 0.035); eutrophic (0.035 - 0.1); hyper-eutrophic (>0.1).

Figure 4.1-14

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Total Phosphorus Concentrations in Streams, 2010 to 2012

Figure 4.1-14

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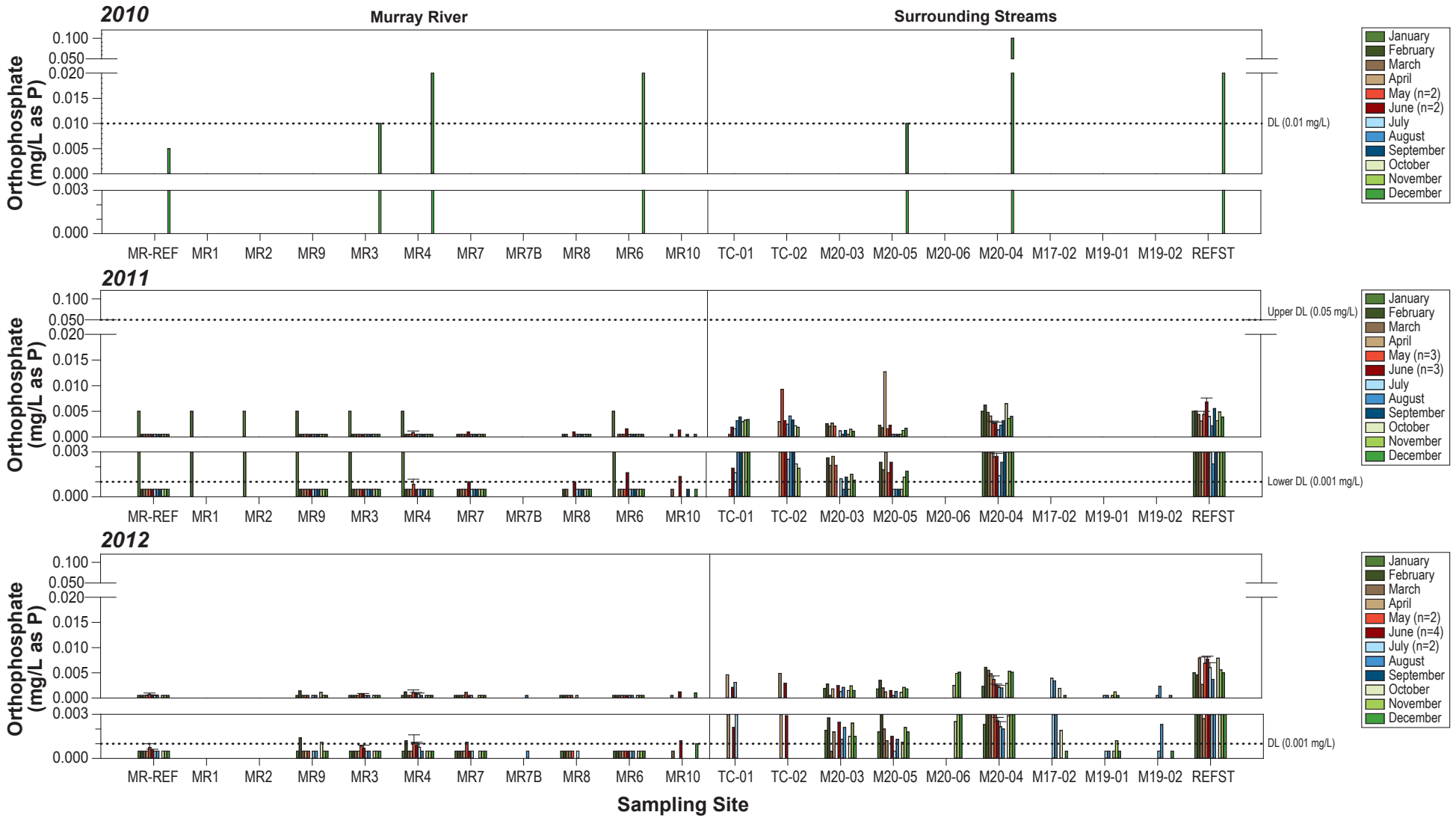

Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits.

Figure 4.1-15

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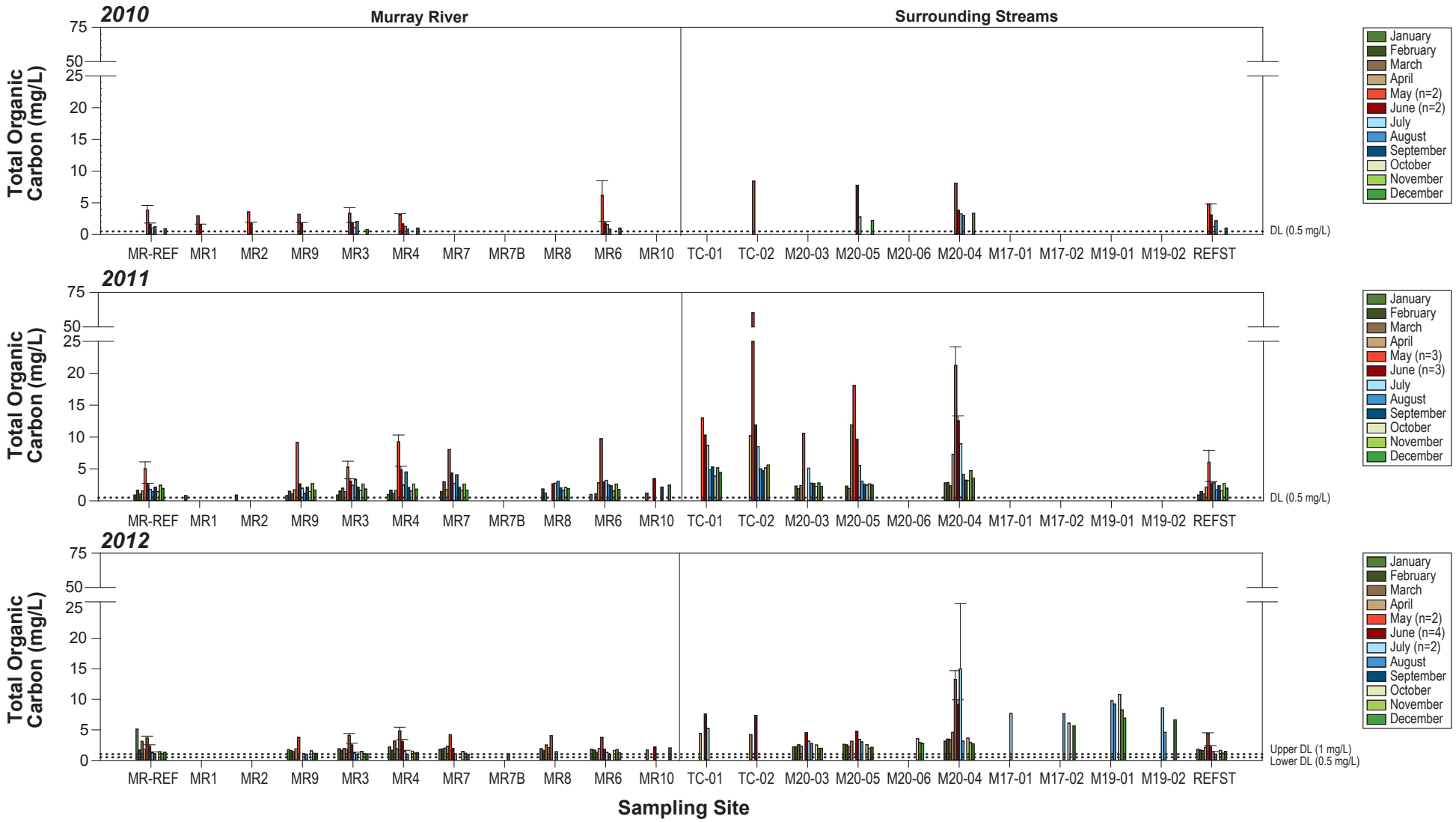
Dissolved Orthophosphate Concentrations in Streams, 2010 to 2012

Figure 4.1-15

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2010 and 2011).

Figure 4.1-16

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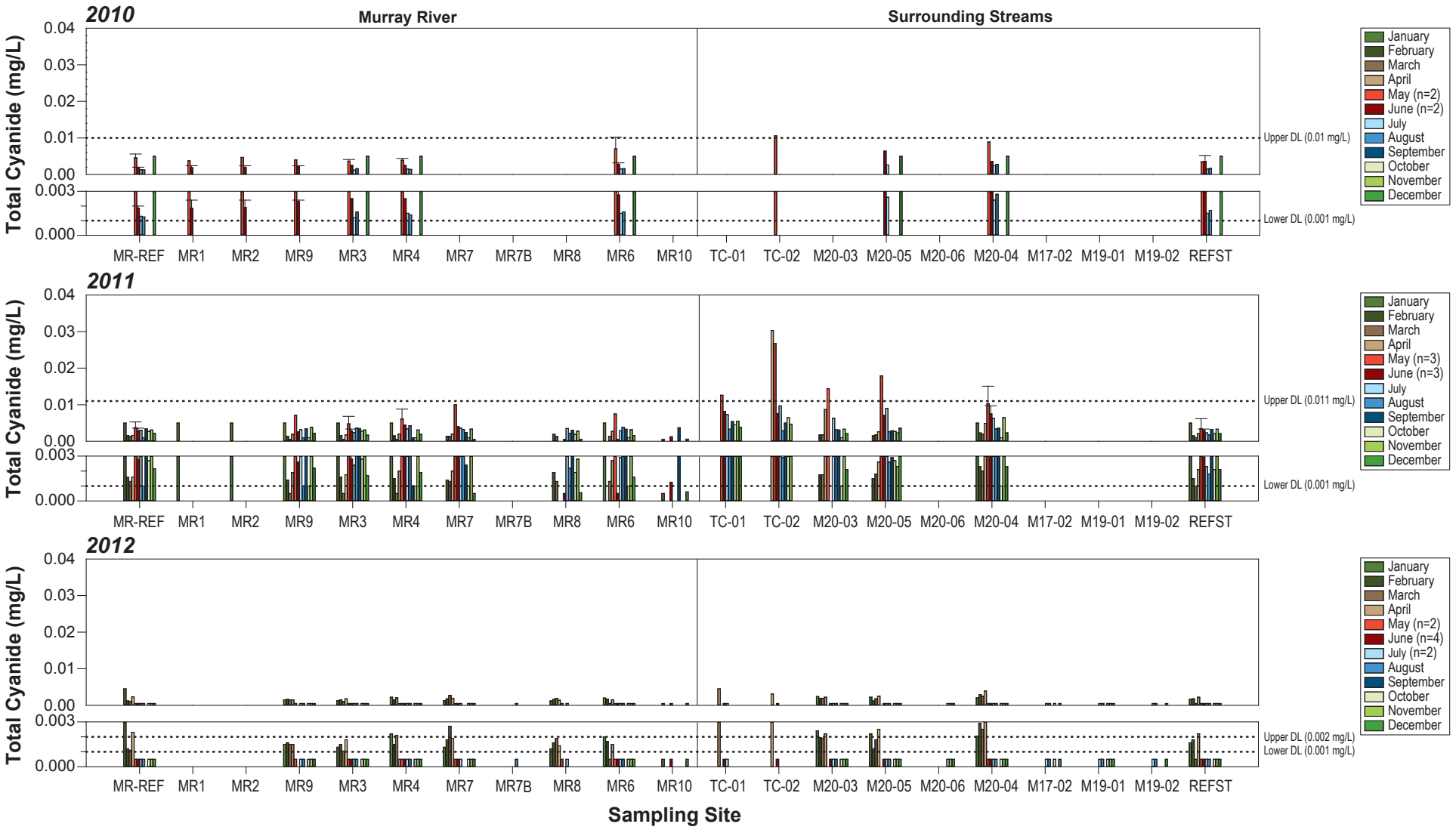
Total Organic Carbon Concentrations in Streams, 2010 to 2012

Figure 4.1-16

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).

Figure 4.1-17

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Total Cyanide Concentrations in Streams, 2010 to 2012

Figure 4.1-17

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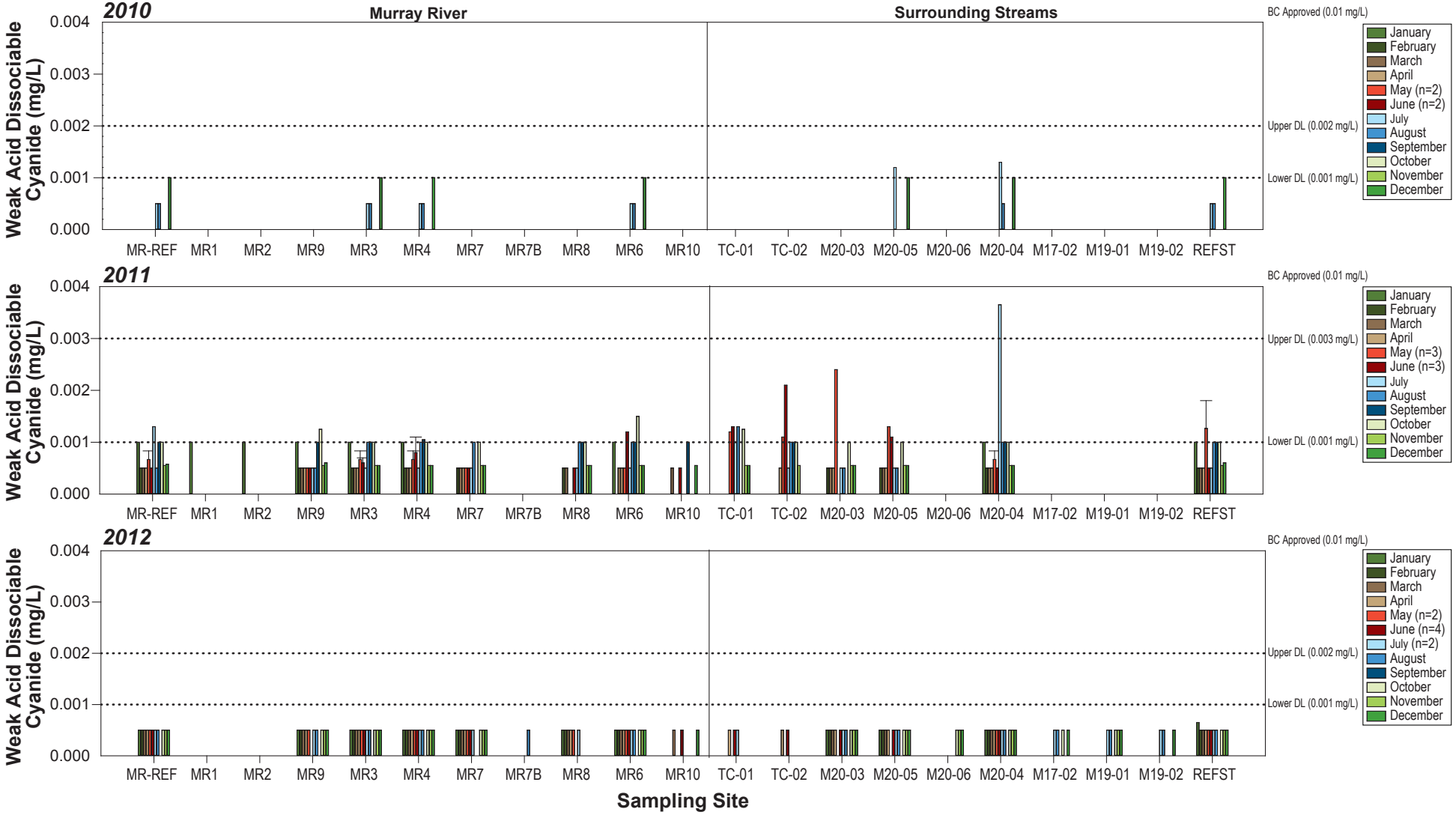

Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (0.010 mg/L) is greater than graph scales.

Figure 4.1-18

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Weak Acid Dissociable Cyanide Concentrations in Streams, 2010 to 2012

Figure 4.1-18

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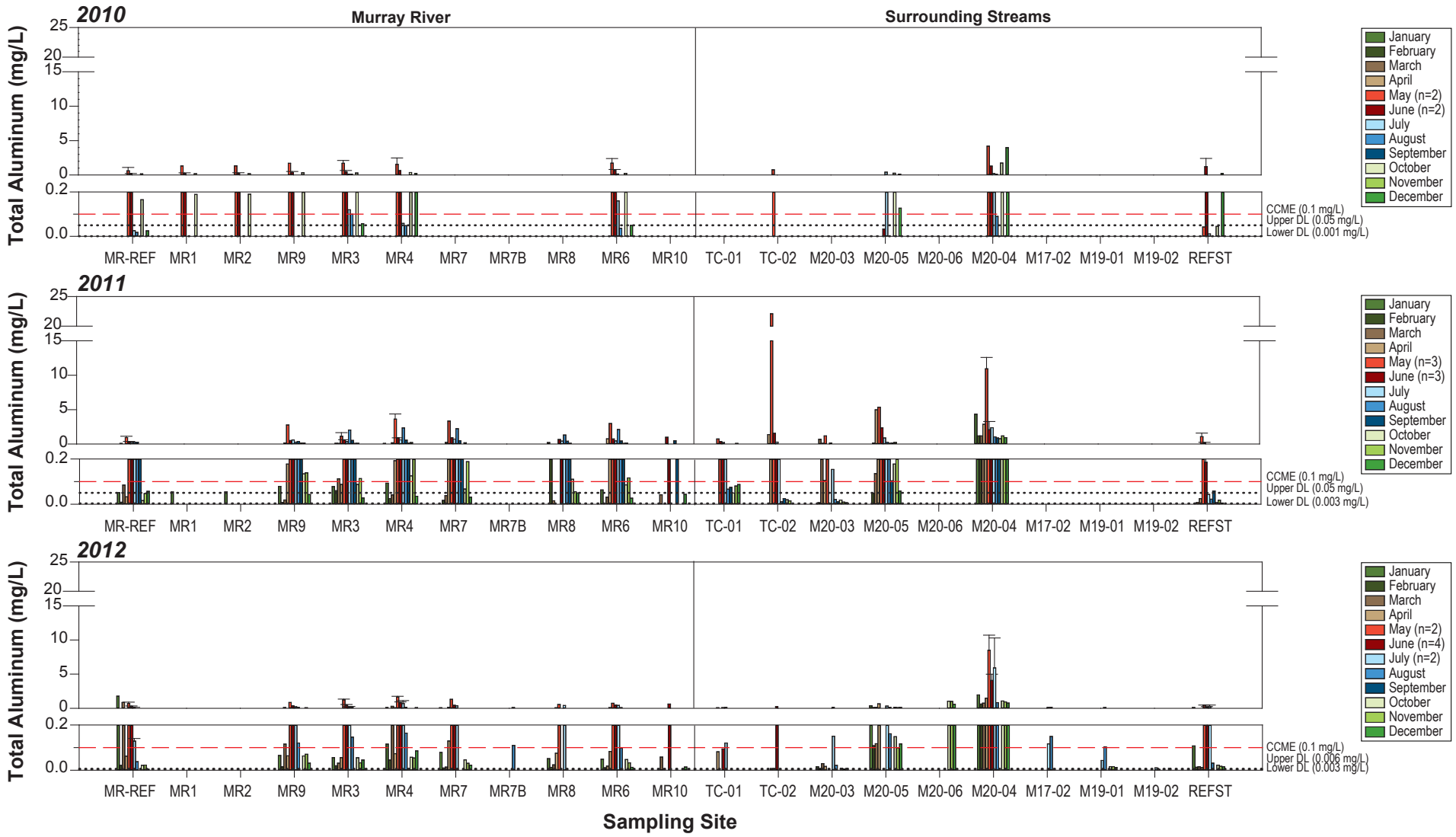

Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (upper and lower).
Red dashed lines represent CCME guideline (pH dependent; 0.1 mg/L when pH > 6.5).

Figure 4.1-19

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MURRAY RIVER COAL PROJECT

Total Aluminum Concentrations in Streams, 2010 to 2012

Figure 4.1-19

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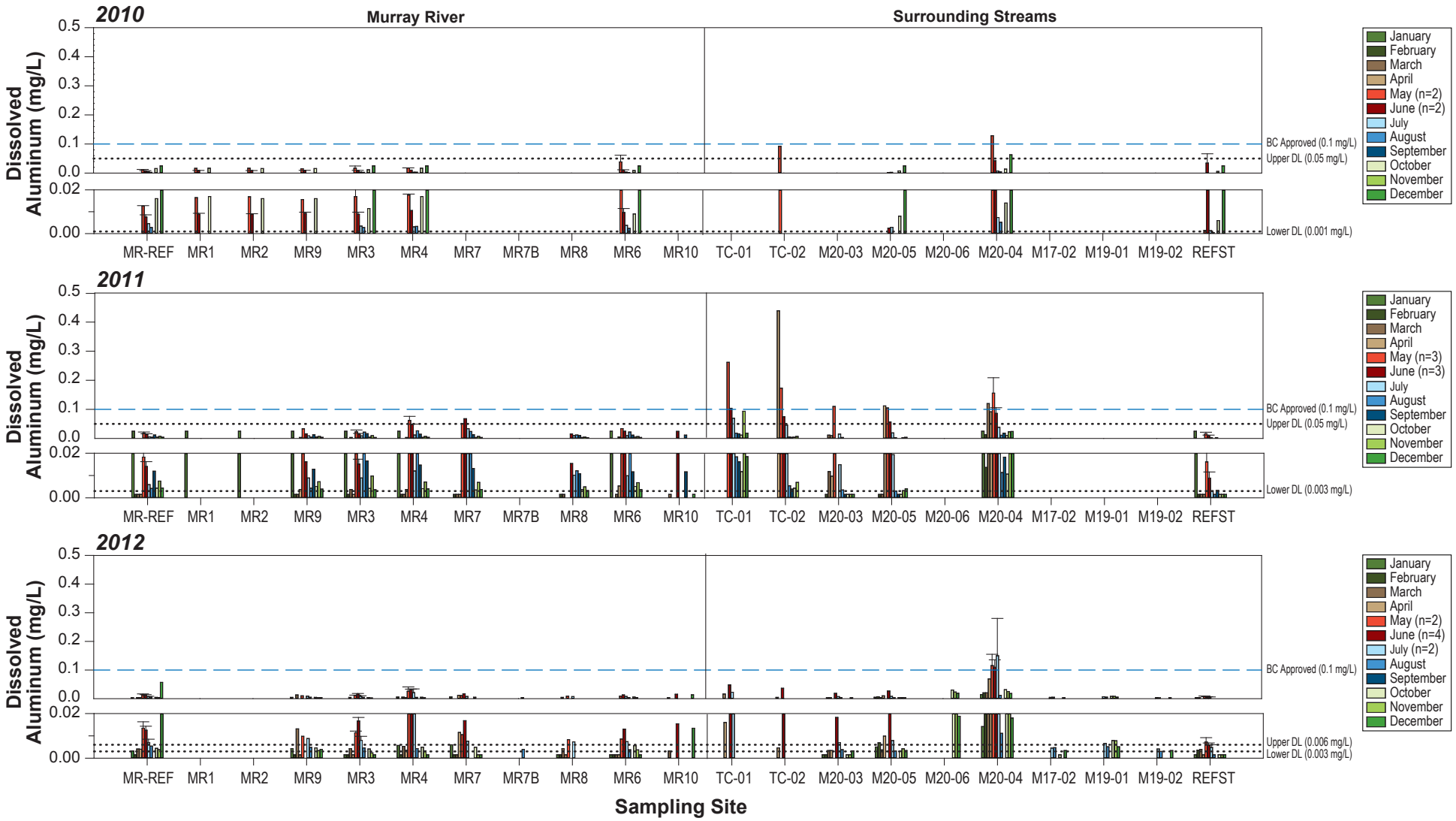

Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (upper and lower).
Blue dashed lines represent BC Approved guideline (pH dependent; 0.1 mg/L when pH < 6.5).

Figure 4.1-20

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Dissolved Aluminum Concentrations in Streams, 2010 to 2012

Figure 4.1-20

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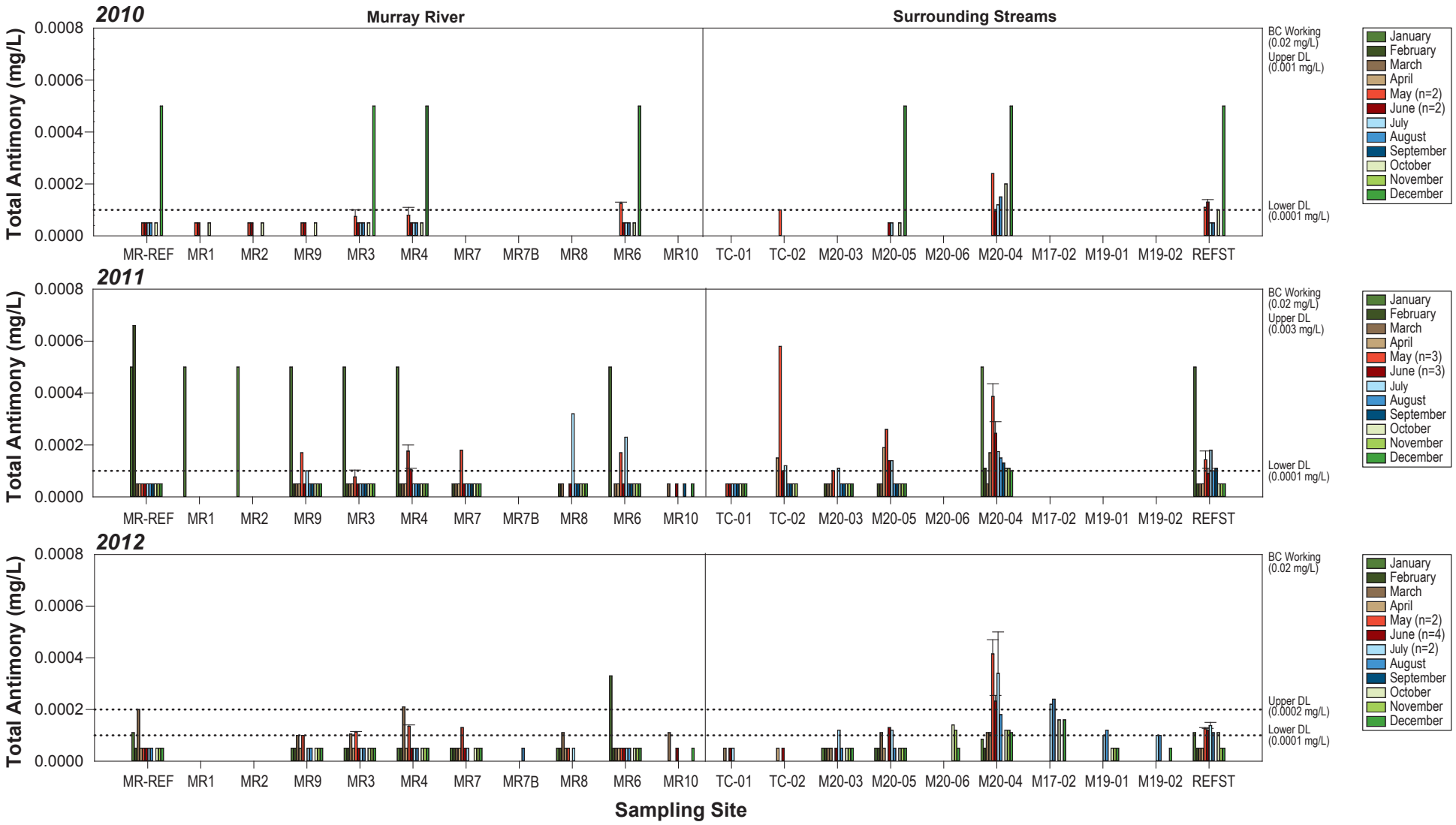


Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (proposed Ontario guideline; 0.02 mg/L) is greater than graph scales.

Figure 4.1-21

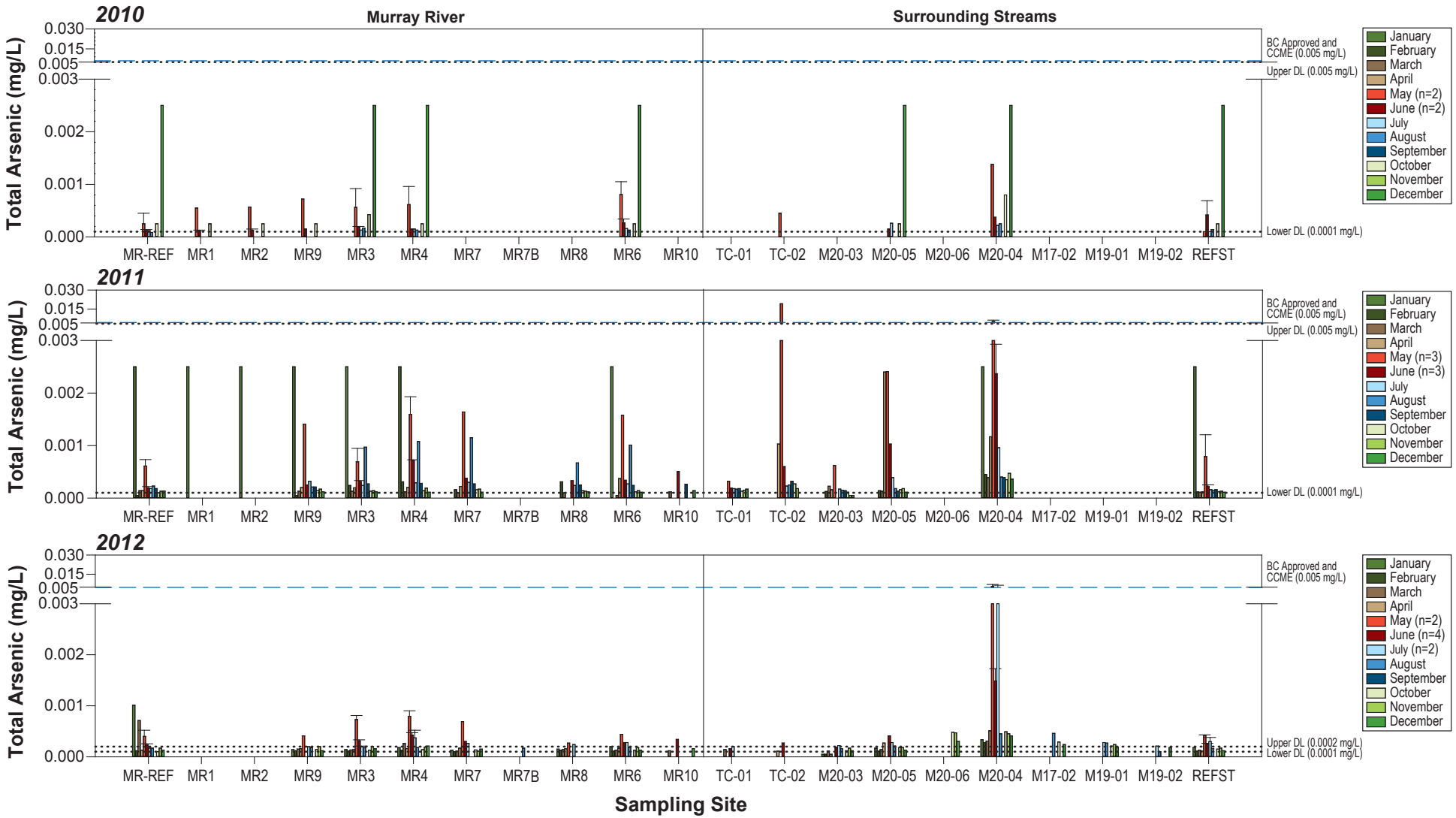
hd Mining

MURRAY RIVER COAL PROJECT

Total Antimony Concentrations in Streams, 2010 to 2012

Figure 4.1-21

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guideline and CCME guideline (0.005 mg/L).

Figure 4.1-22

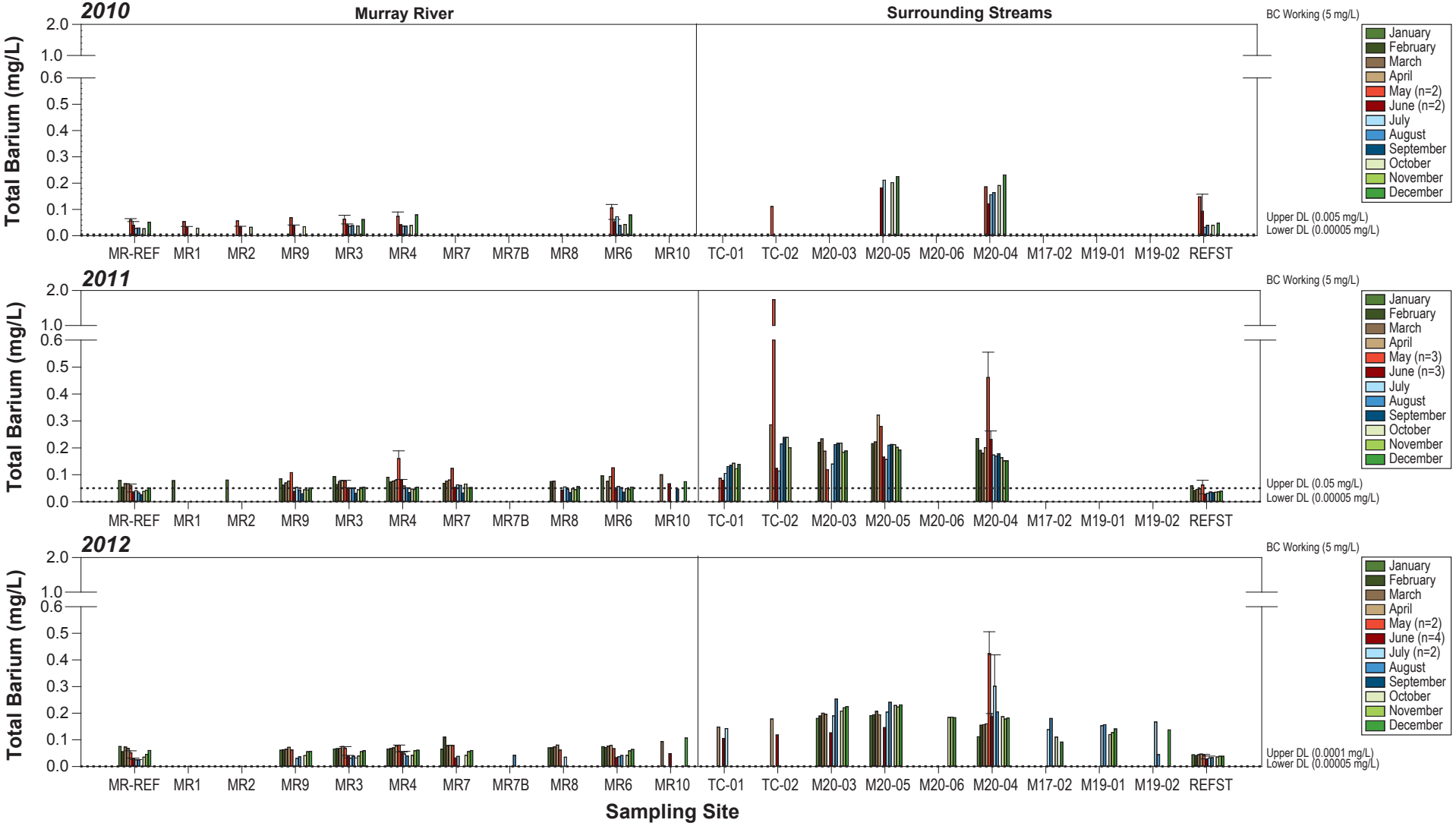
hd Mining

MURRAY RIVER COAL PROJECT

Total Arsenic Concentrations in Streams, 2010 to 2012

Figure 4.1-22

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (under Ministry review; 5 mg/L) is greater than graph scales.

Figure 4.1-23

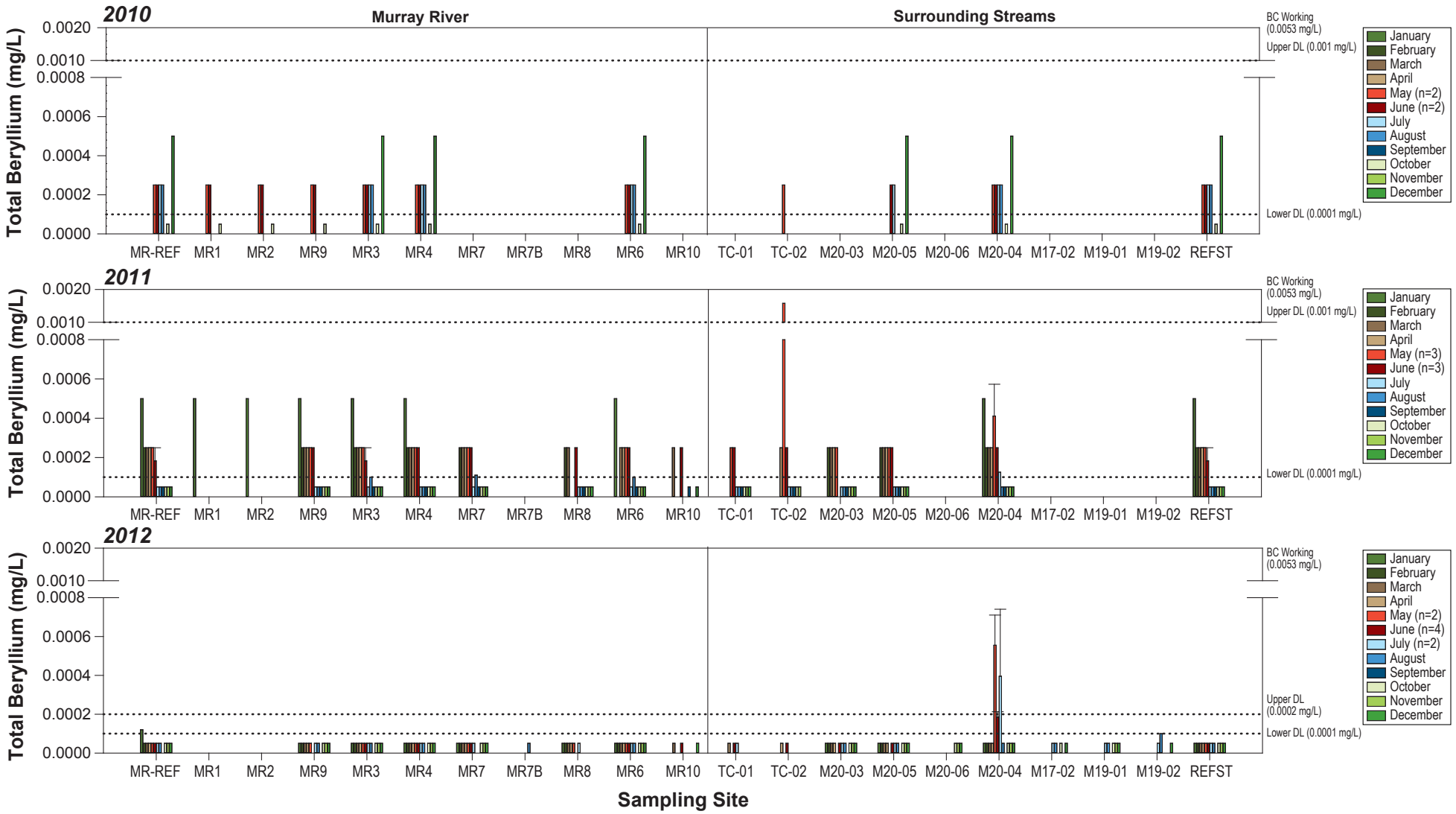
hd Mining

MURRAY RIVER COAL PROJECT

Total Barium Concentrations in Streams, 2010 to 2012

Figure 4.1-23

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (under Ministry review; 0.0053 mg/L) is greater than graph scales.

Figure 4.1-24

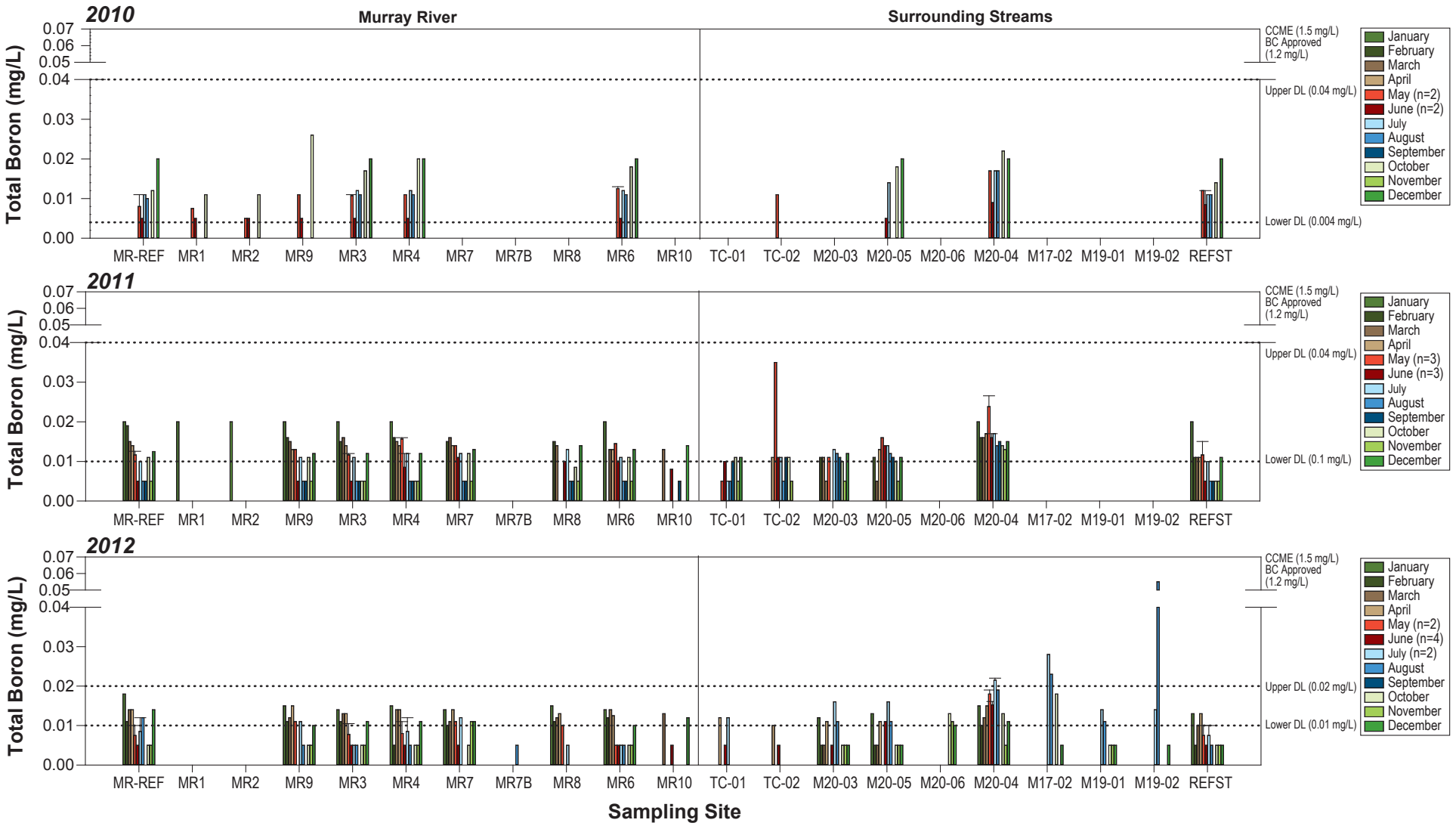
hd Mining

MURRAY RIVER COAL PROJECT

Total Beryllium Concentrations in Streams, 2010 to 2012

Figure 4.1-24

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (1.2 mg/L) and CCME guideline (1.5 mg/L) are greater than graph scales.

Figure 4.1-25

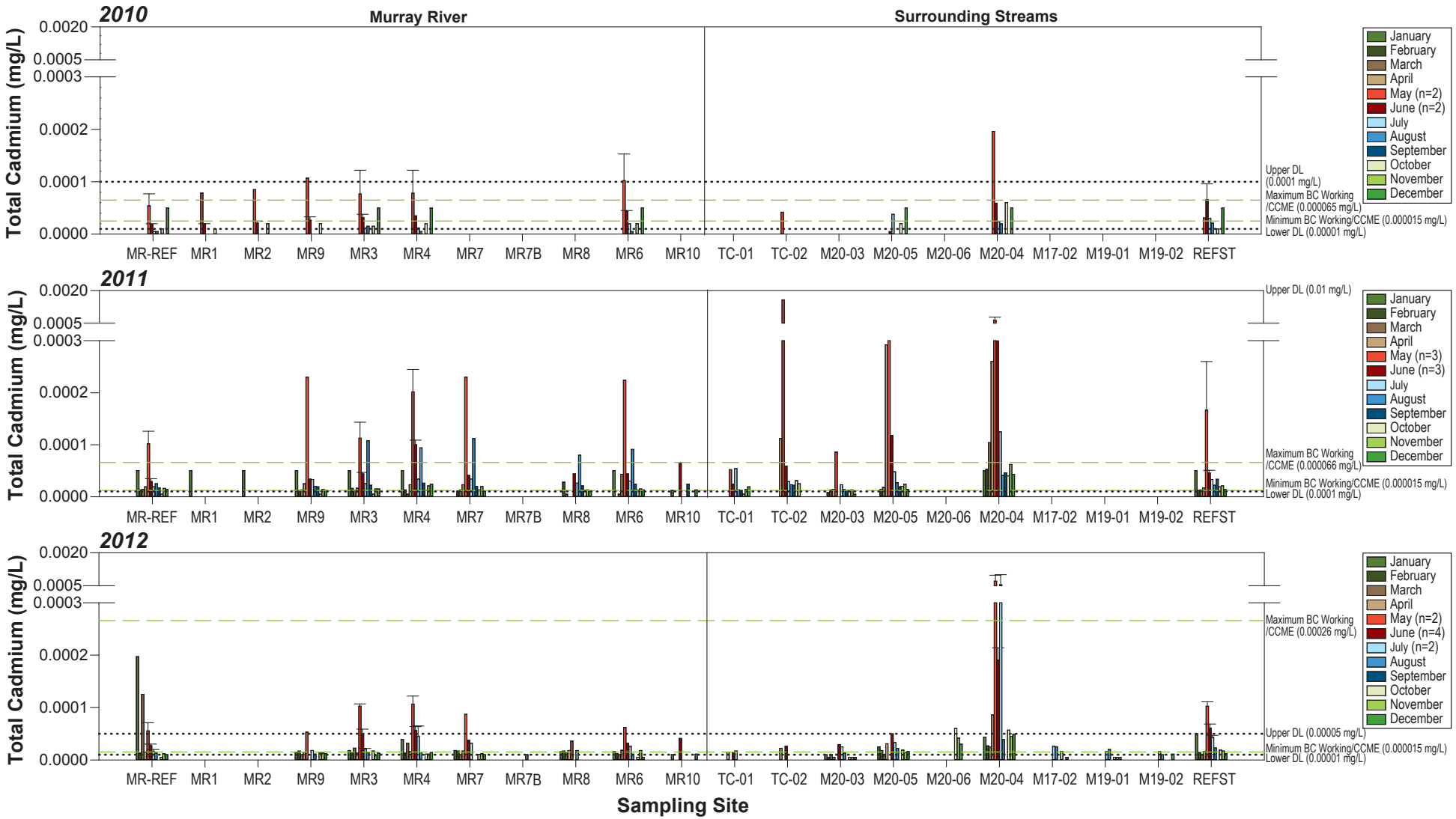
hd Mining

MURRAY RIVER COAL PROJECT

Total Boron Concentrations in Streams, 2010 to 2012

Figure 4.1-25

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Working/CCME guidelines (hardness dependent; cadmium equation (mg/L) = $10^{0.86[\log10(\text{hardness})]-3.2}$ / 1000).

Figure 4.1-26

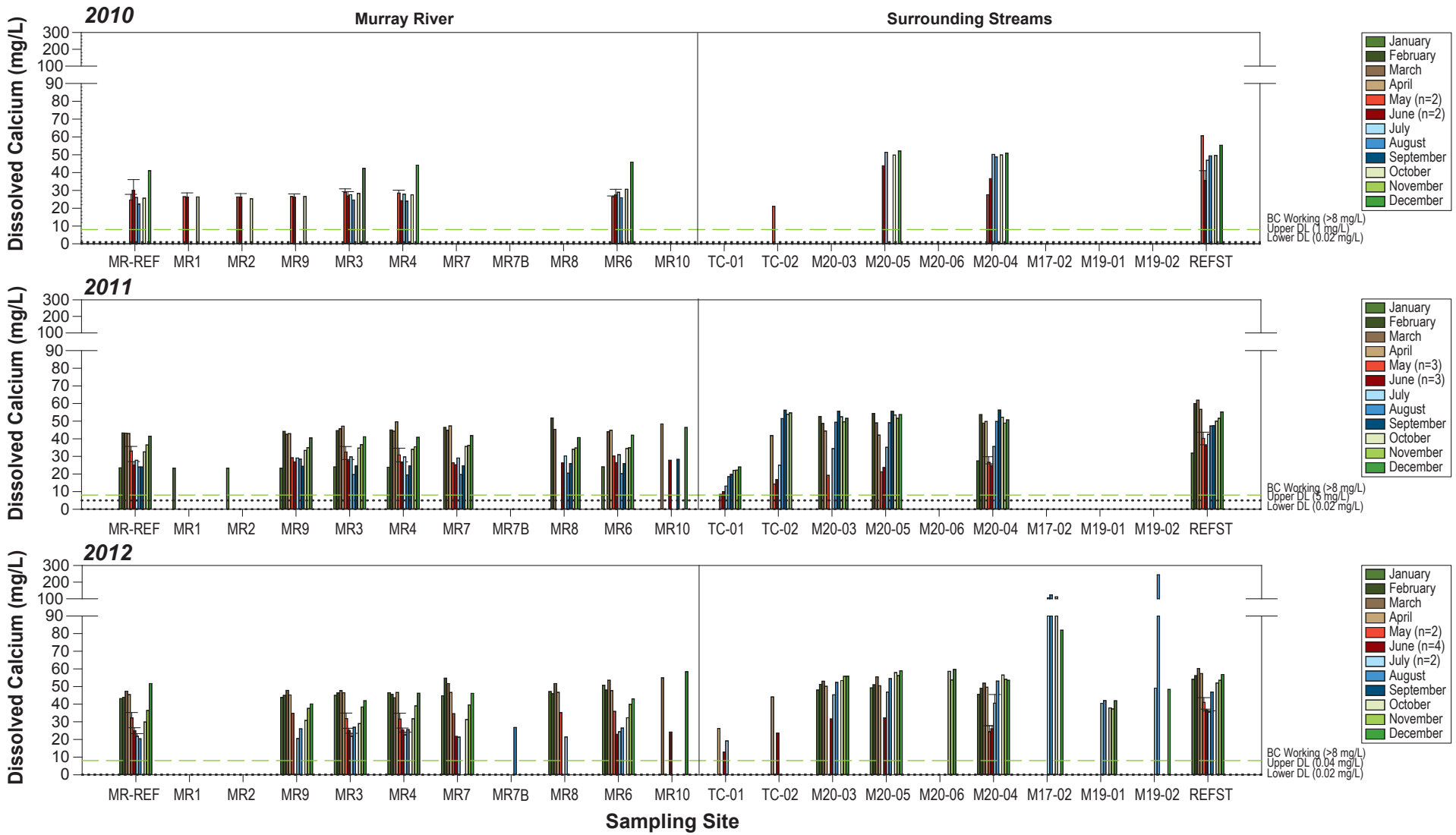
hd Mining

MURRAY RIVER COAL PROJECT

Total Cadmium Concentrations in Streams, 2010 to 2012

Figure 4.1-26

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent the BC Working guideline, where water with concentrations >8 mg/L dissolved calcium have a low sensitivity to acid inputs.

Figure 4.1-27

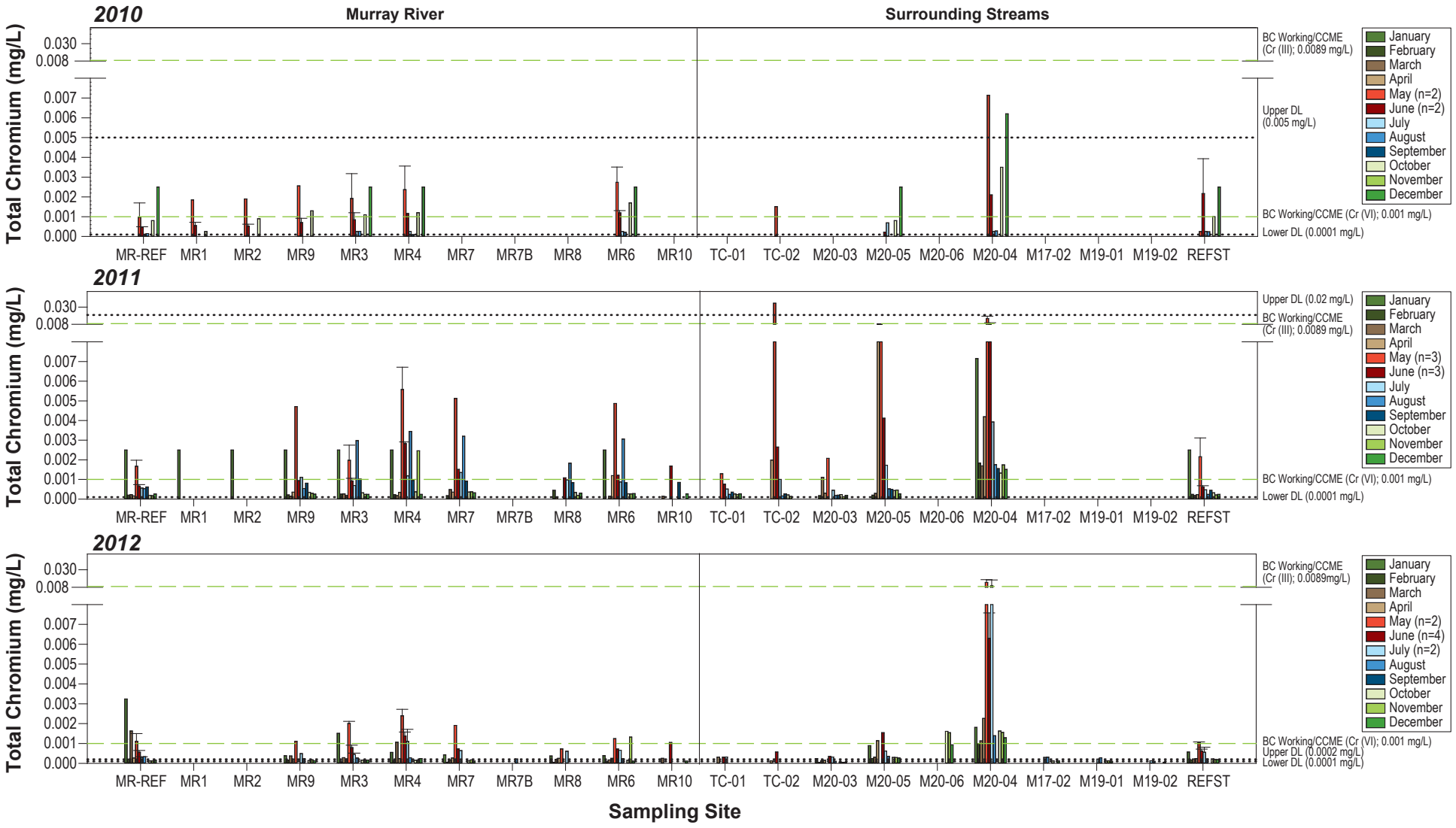
hd Mining

MURRAY RIVER COAL PROJECT

Dissolved Calcium Concentrations in Streams, 2010 to 2012

Figure 4.1-27

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Working and CCME guidelines for chromium (VI: 0.001 mg/L; III: 0.0089 mg/L).

Figure 4.1-28

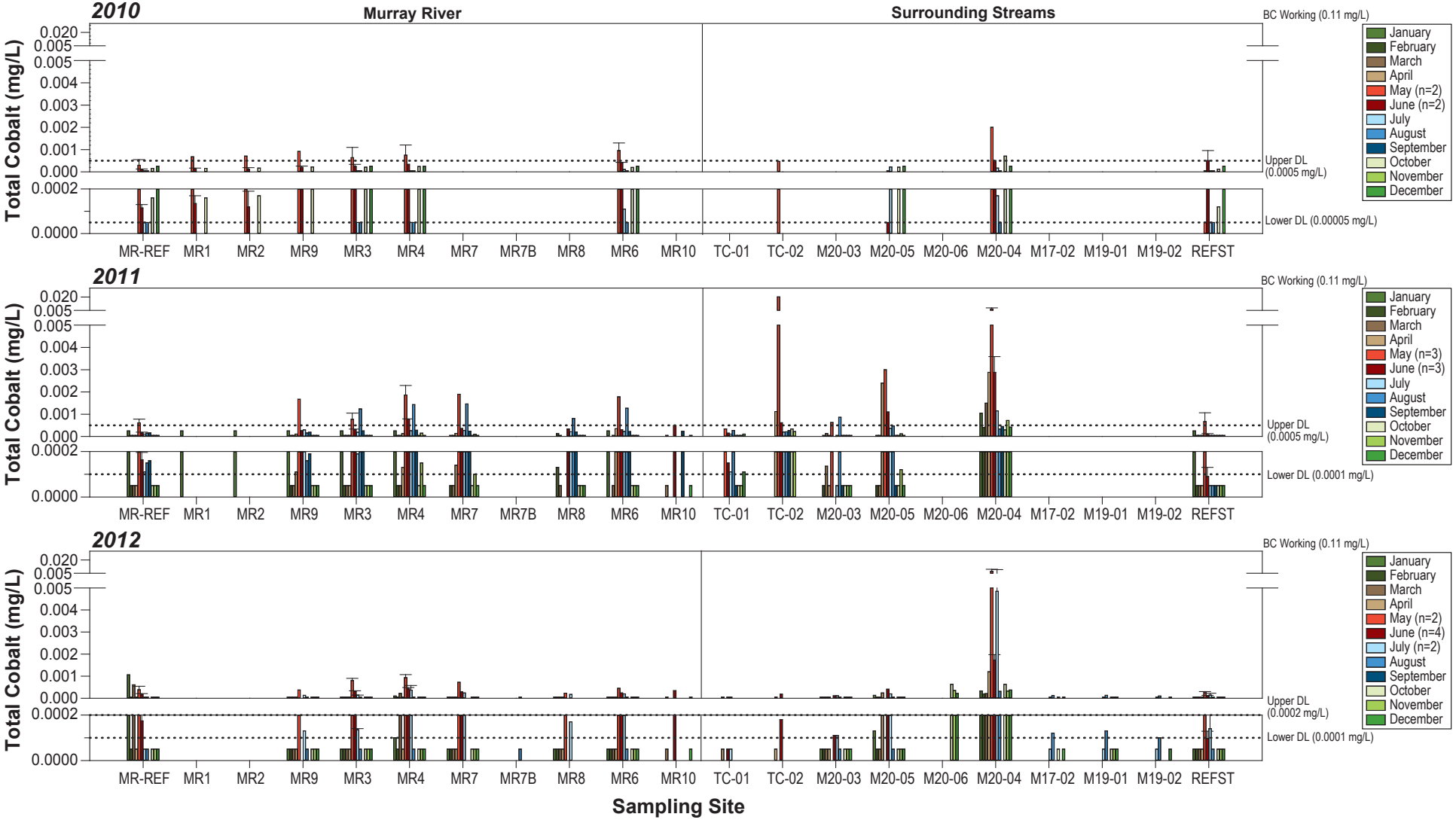
hd Mining

MURRAY RIVER COAL PROJECT

Total Chromium Concentrations in Streams, 2010 to 2012

Figure 4.1-28

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (0.11 mg/L) is greater than graph scales.

Figure 4.1-29

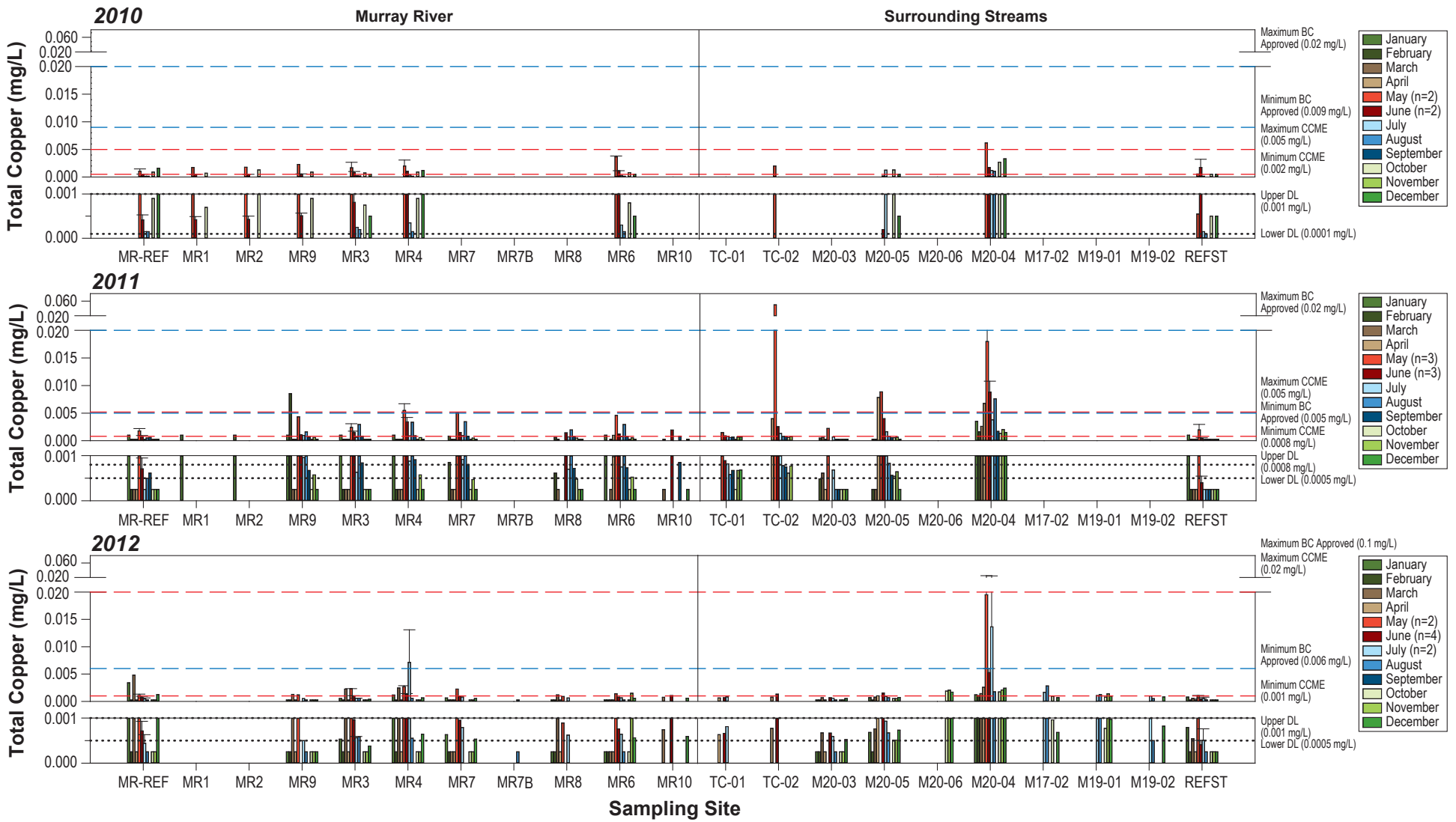
hd Mining

MURRAY RIVER COAL PROJECT

Total Cobalt Concentrations in Streams, 2010 to 2012

Figure 4.1-29

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent the BC Approved guideline (hardness dependent; copper equation (mg/L) = (0.094 x hardness)+2)/1000), 2011 maximum value exceeds graph scale.
Red dashed lines represent the CCME guideline (hardness dependent; copper equation (mg/L) = $e^{0.8545(\ln(\text{hardness}))-1.465}$ x 0.0002).

Figure 4.1-30

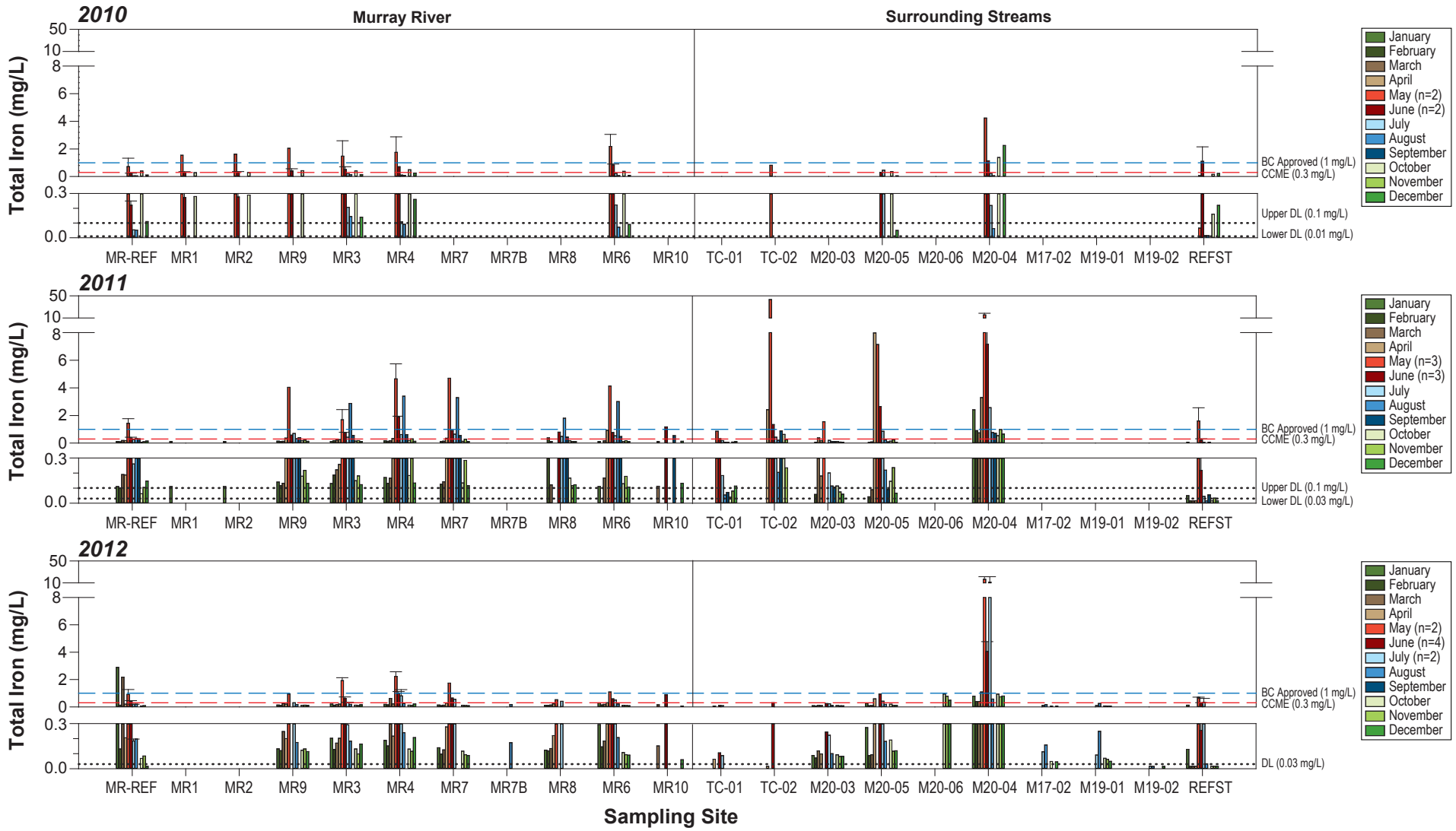
hd Mining

MURRAY RIVER COAL PROJECT

Total Copper Concentrations in Streams, 2010 to 2012

Figure 4.1-30

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower 2010 and 2011).
Blue dashed lines represent the BC Approved guideline (1 mg/L).
Red dashed lines represent the CCME guideline (0.3 mg/L).

Figure 4.1-31

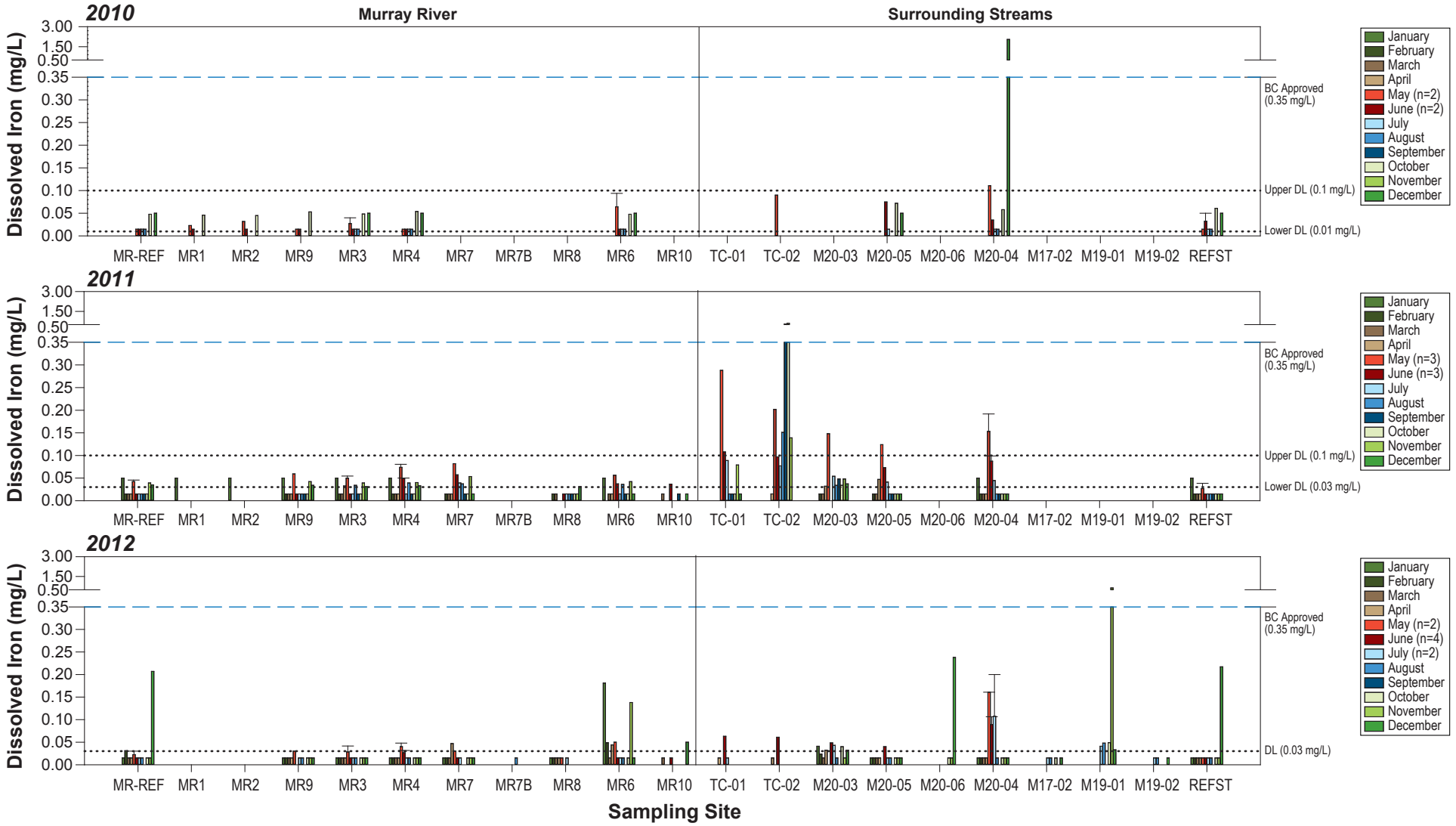
hd Mining

MURRAY RIVER COAL PROJECT

Total Iron Concentrations in Streams, 2010 to 2012

Figure 4.1-31

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent the BC Approved guideline (0.35 mg/L).
Red dashed lines represent the CCME guideline (0.3 mg/L).

Figure 4.1-32

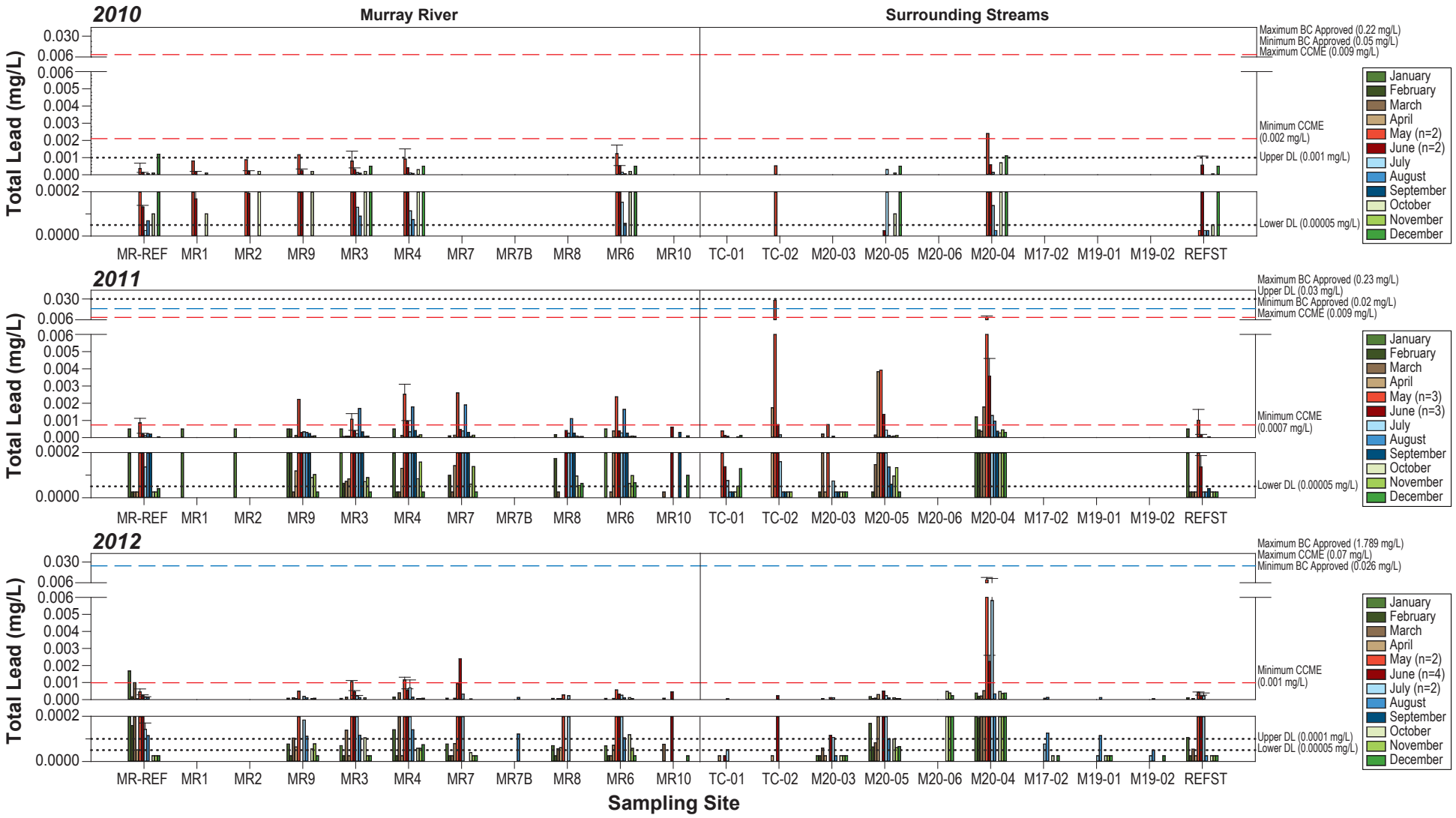
hd Mining

MURRAY RIVER COAL PROJECT

Dissolved Iron Concentrations in Streams, 2010 to 2012

Figure 4.1-32

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guideline (hardness dependent; lead equation (mg/L) = $e^{1.273(\ln(\text{hardness}))-1.460}/1000$), maximum values exceed scales.
Red dashed lines represent CCME guideline (hardness dependent; lead equation (mg/L) = $e^{1.273(\ln(\text{hardness}))-4.705}/1000$).

Figure 4.1-33

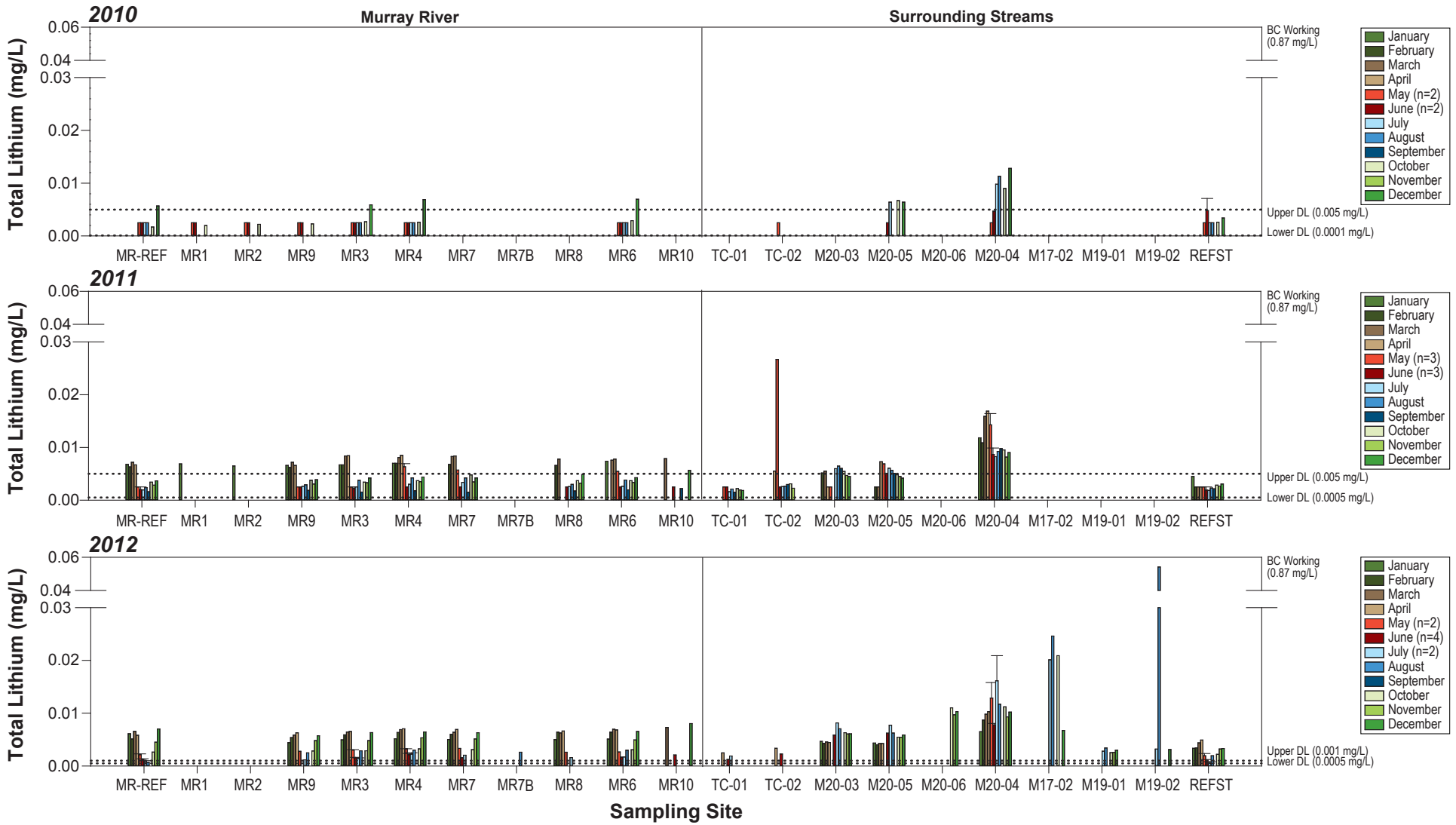
hd Mining

MURRAY RIVER COAL PROJECT

Total Lead Concentrations in Streams, 2010 to 2012

Figure 4.1-33

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (0.87 mg/L) is greater than graph scales.

Figure 4.1-34

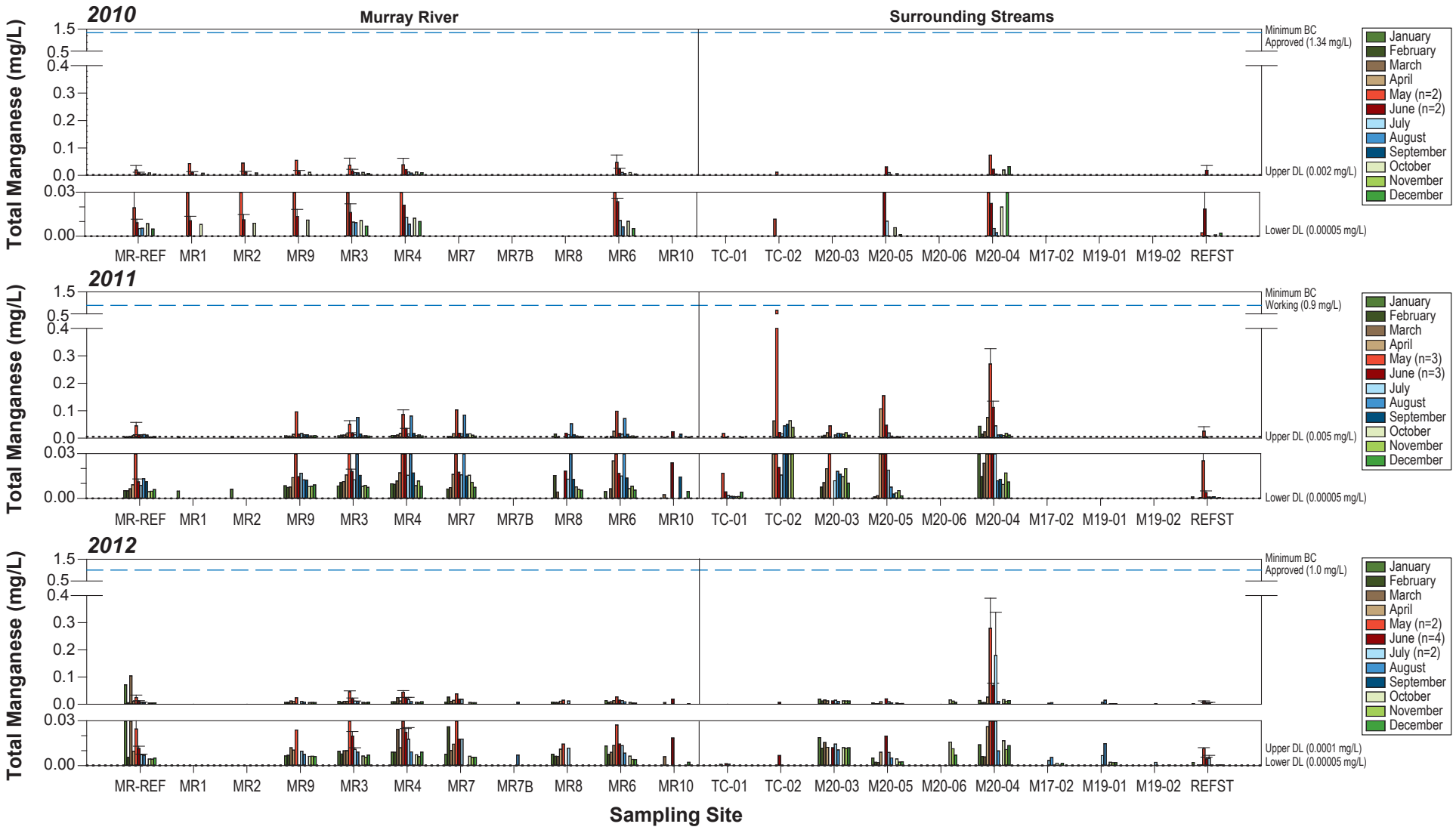
hd Mining

MURRAY RIVER COAL PROJECT

Total Lithium Concentrations in Streams, 2010 to 2012

Figure 4.1-34

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guideline (hardness dependent; manganese equation (mg/L) = 0.01102(hardness)+0.54).

Figure 4.1-35

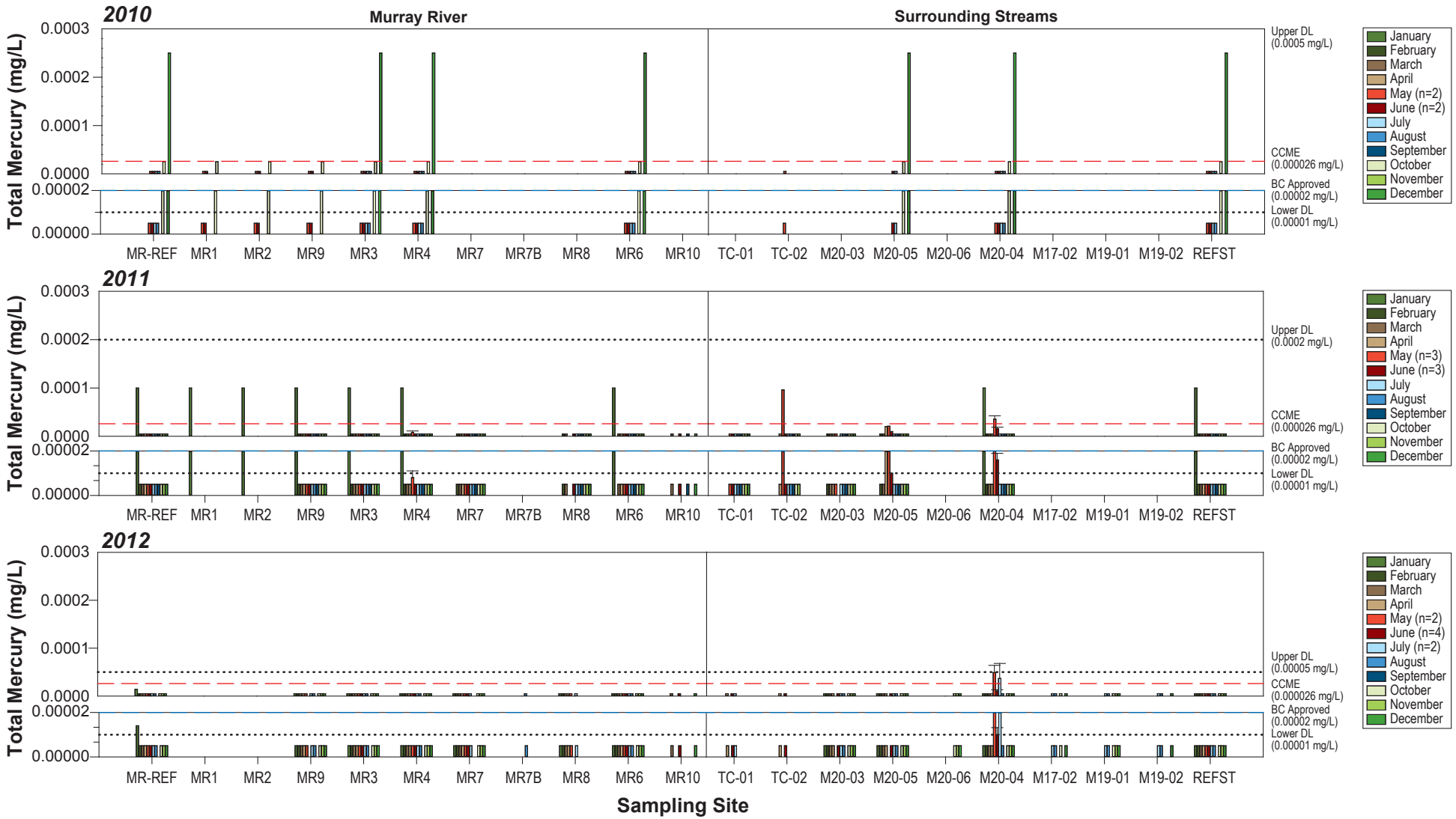
hd Mining

MURRAY RIVER COAL PROJECT

Total Manganese Concentrations in Streams, 2010 to 2012

Figure 4.1-35

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guideline (0.00002 mg/L).
Red dashed lines represent CCME guideline (0.000026 mg/L).

Figure 4.1-36

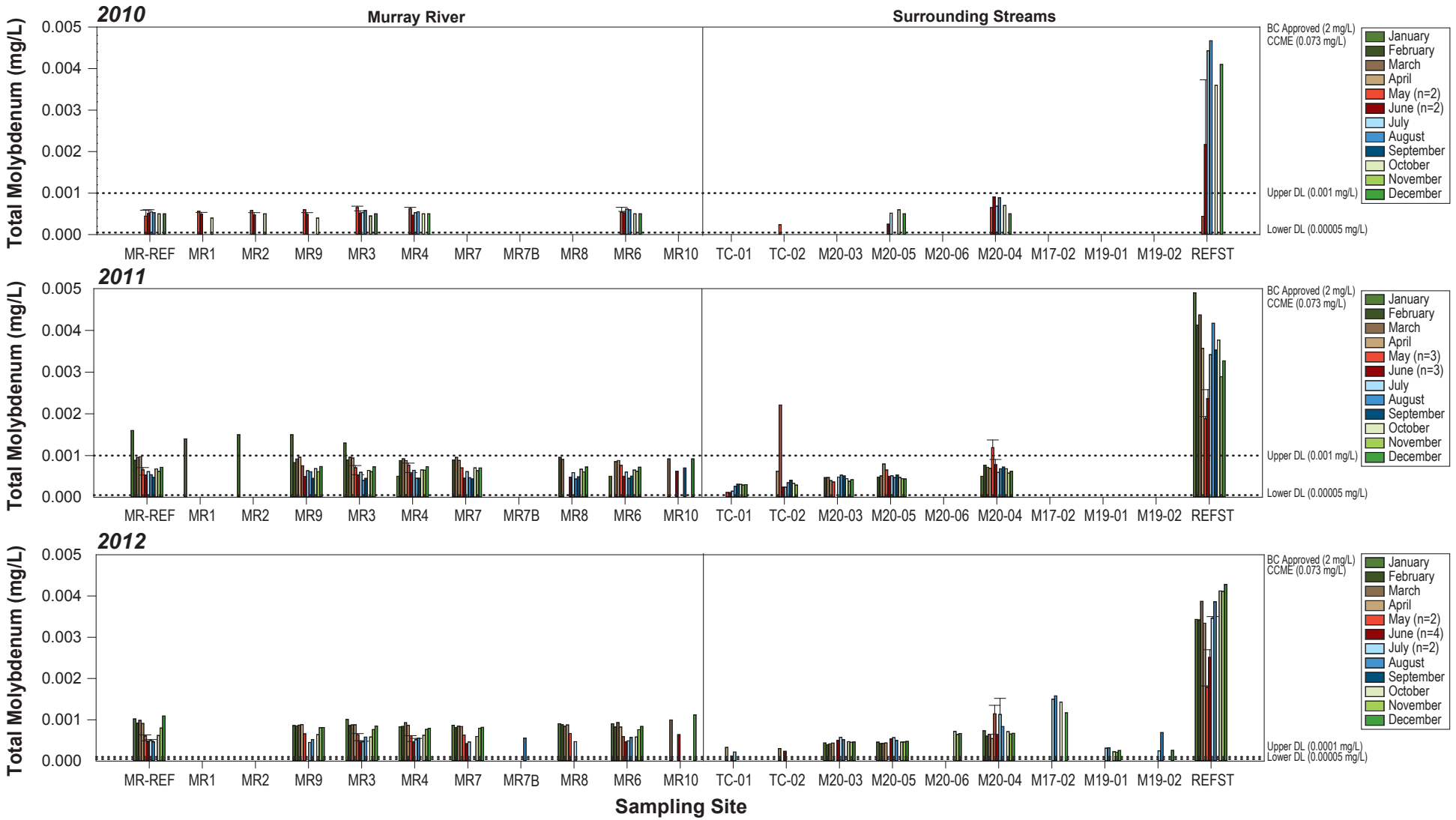
hd Mining

MURRAY RIVER COAL PROJECT

Total Mercury Concentrations in Streams, 2010 to 2012

Figure 4.1-36

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (2 mg/L) and CCME guideline (0.073 mg/L) are greater than graph scales.

Figure 4.1-37

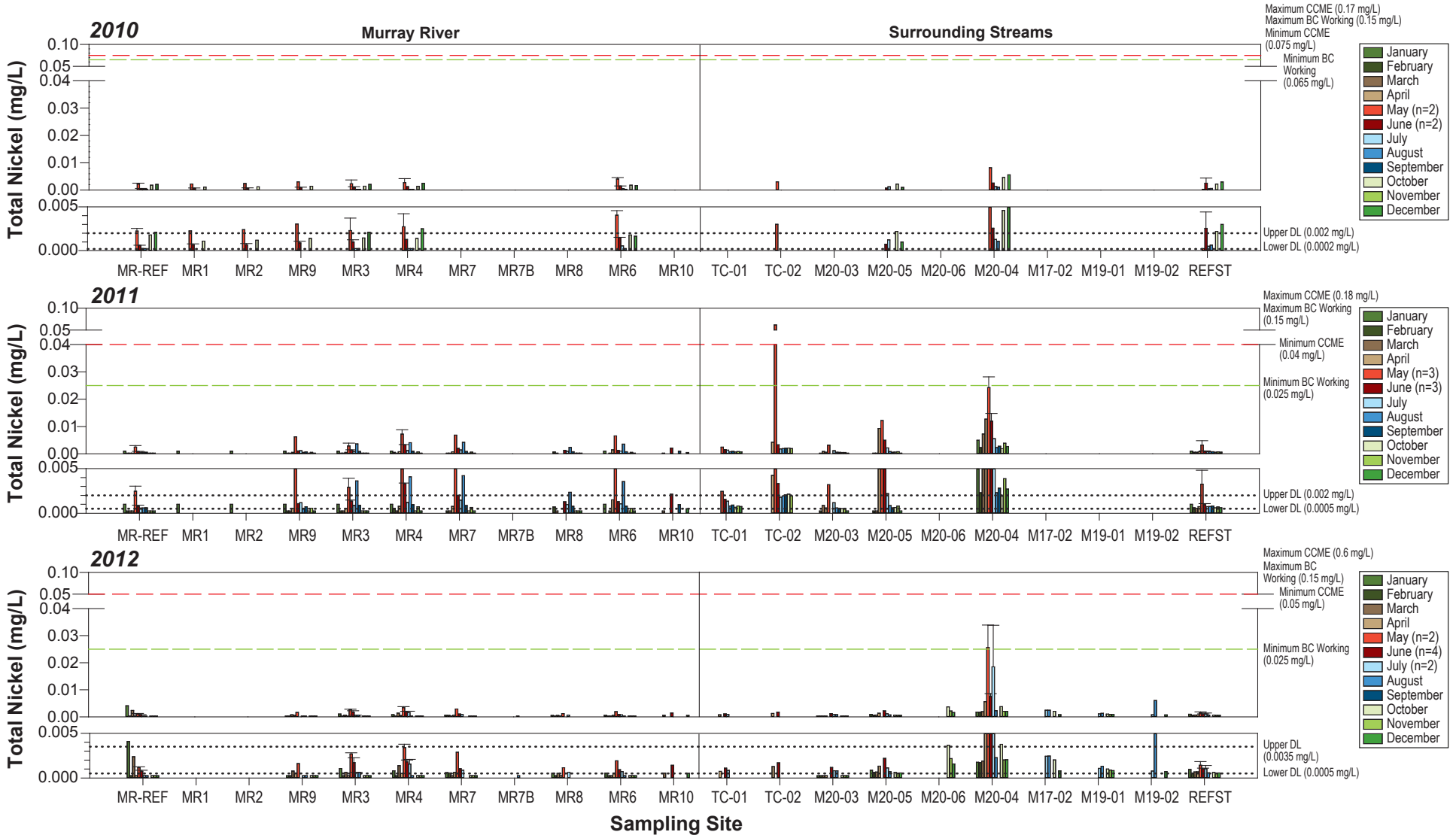
hd Mining

MURRAY RIVER COAL PROJECT

Total Molybdenum Concentrations in Streams, 2010 to 2012

Figure 4.1-37

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Working guideline (hardness dependent; 0.025 mg/L (hardness 0-60), 0.065 mg/L (hardness 60-120), 0.11 mg/L (hardness 120-180), and 0.15 mg/L (hardness >180)).
Red dashed lines represent CCME guideline (hardness dependent; nickel equation (mg/L) = $e^{0.76(\ln(\text{hardness}))+1.06}/1000$).

Figure 4.1-38

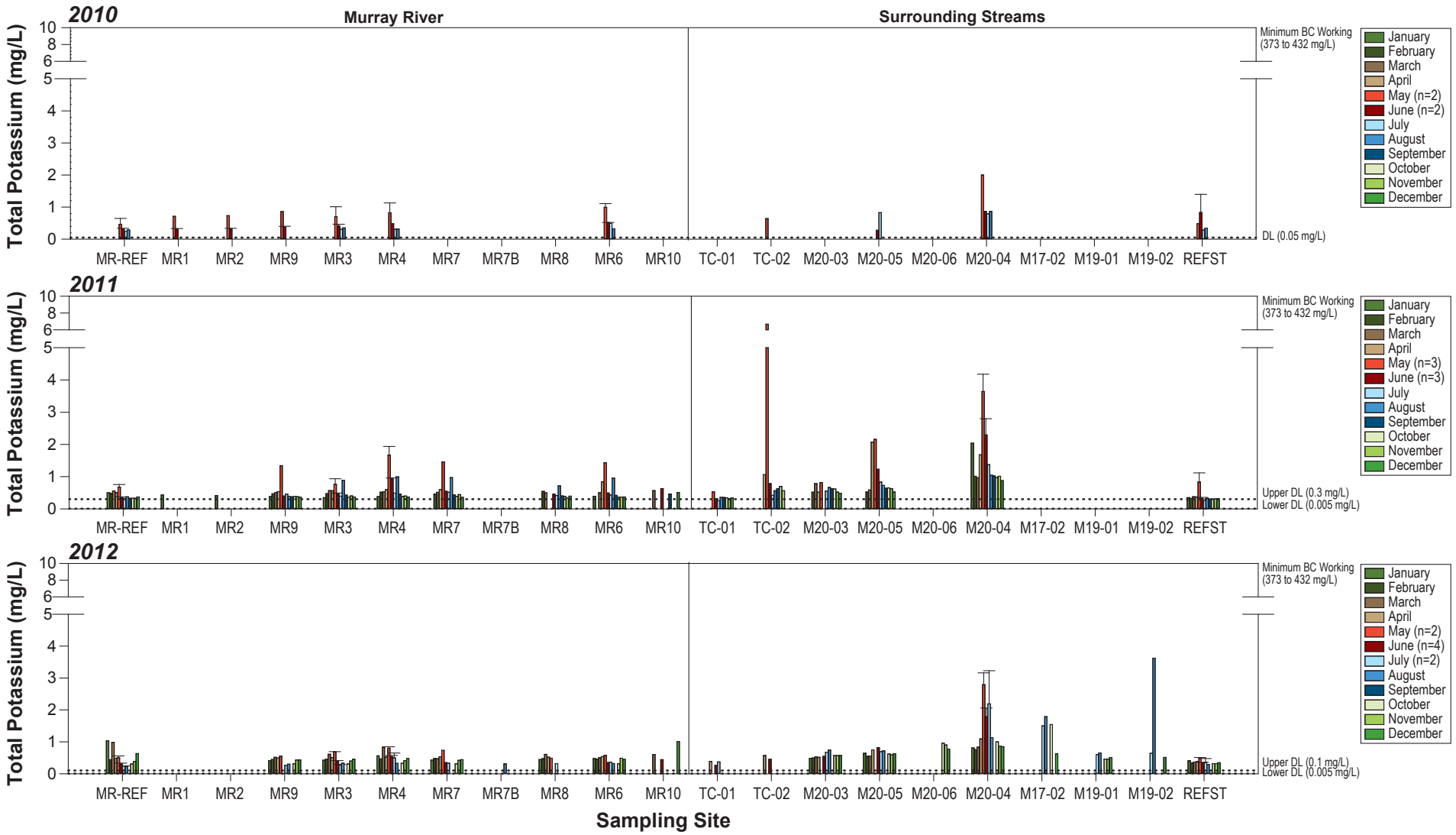
hd Mining

MURRAY RIVER COAL PROJECT

Total Nickel Concentrations in Streams, 2010 to 2012

Figure 4.1-38

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2011 and 2012).
BC Working guideline (373 to 432 mg/L) is greater than graph scales.

Figure 4.1-39

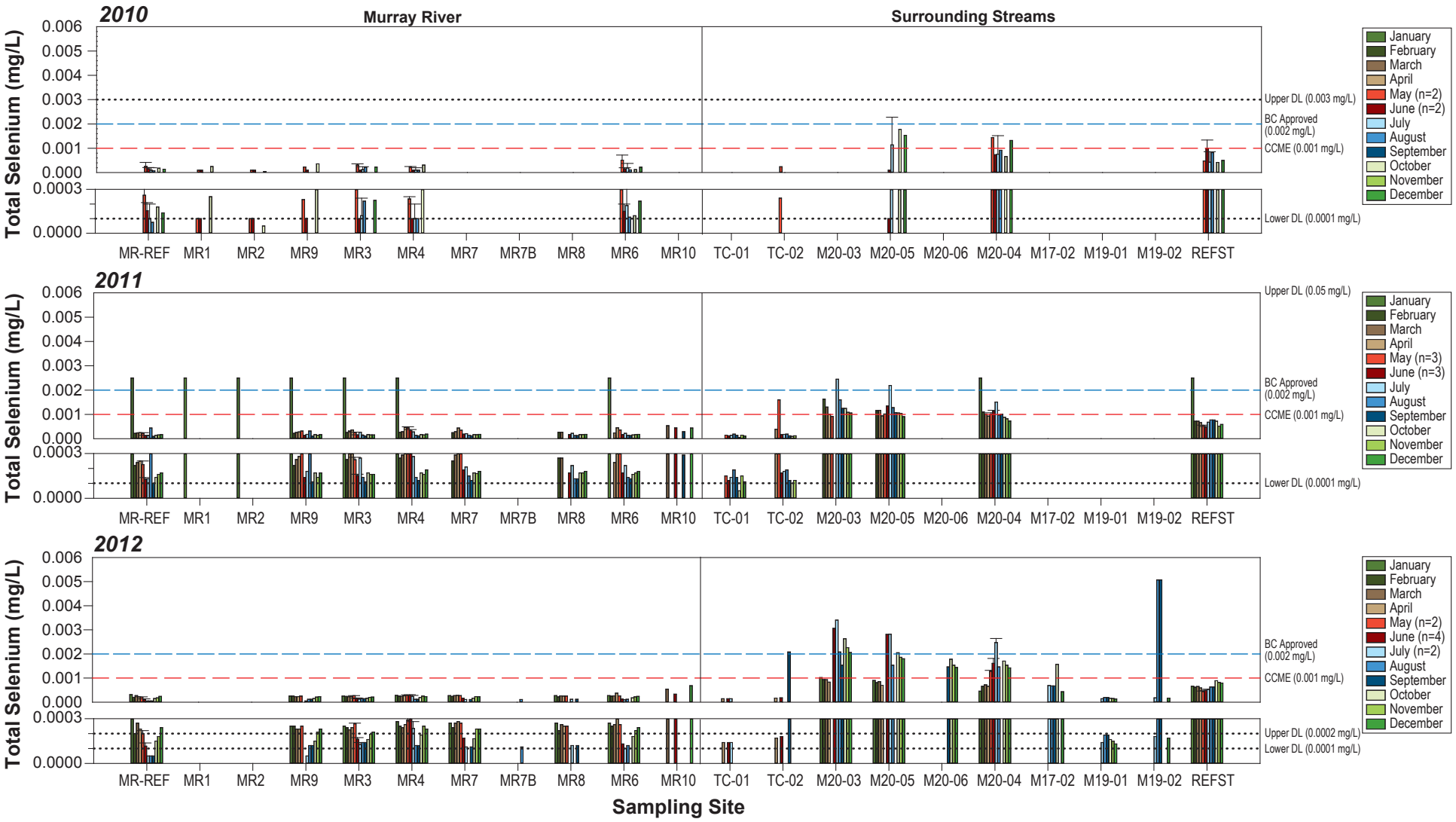
hd Mining

MURRAY RIVER COAL PROJECT

Total Potassium Concentrations in Streams, 2010 to 2012

Figure 4.1-39

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guideline (0.002 mg/L).
Red dashed lines represent CCME guideline (0.001 mg/L).

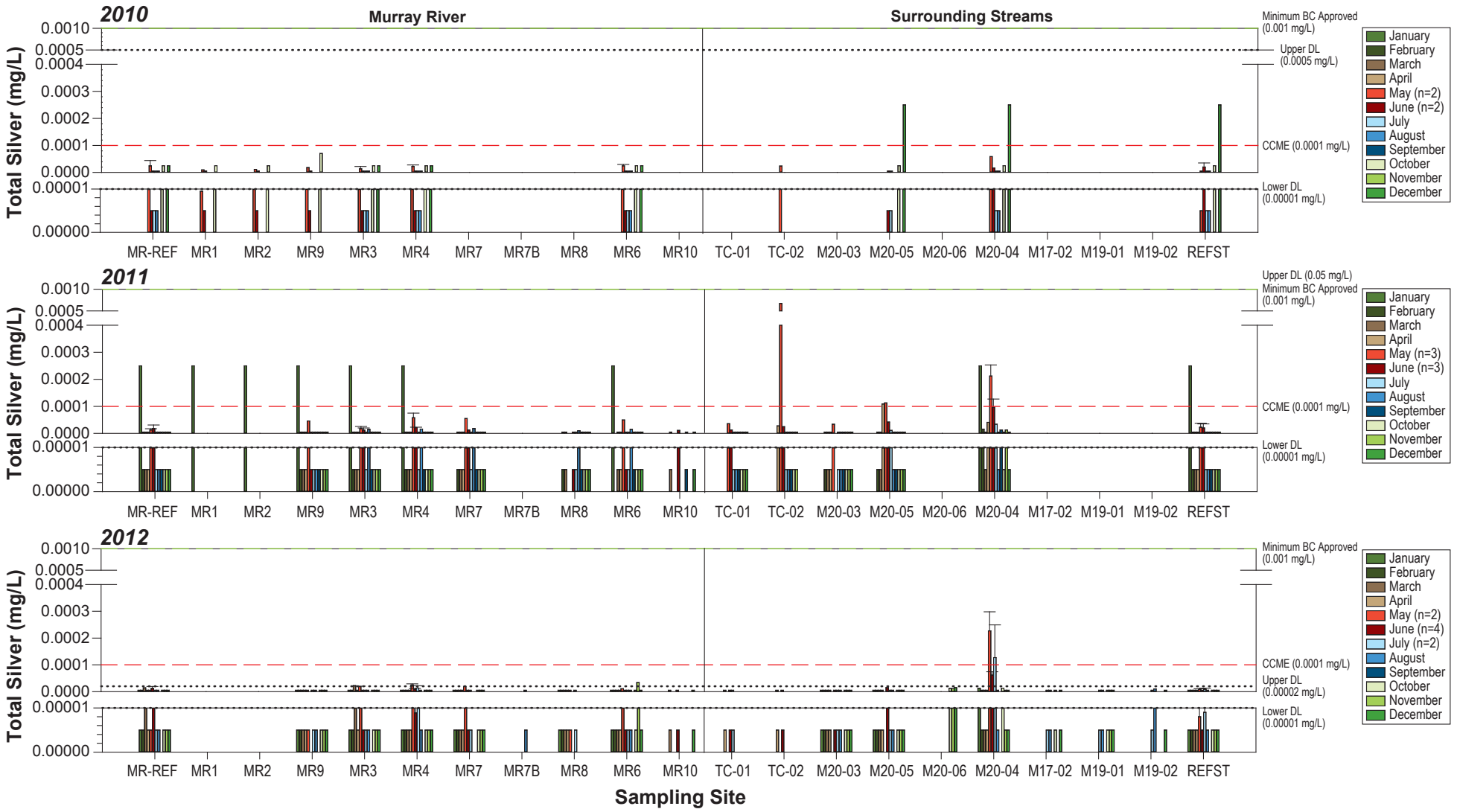
Figure 4.1-40

hd Mining | MURRAY RIVER COAL PROJECT

Total Selenium Concentrations in Streams, 2010 to 2012

Figure 4.1-40

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Approved guideline (hardness dependent; 0.001 mg/L (hardness ≤ 100), 0.003 mg/L (>100)).
Red dashed lines represent CCME guideline (0.0001 mg/L).

Figure 4.1-41

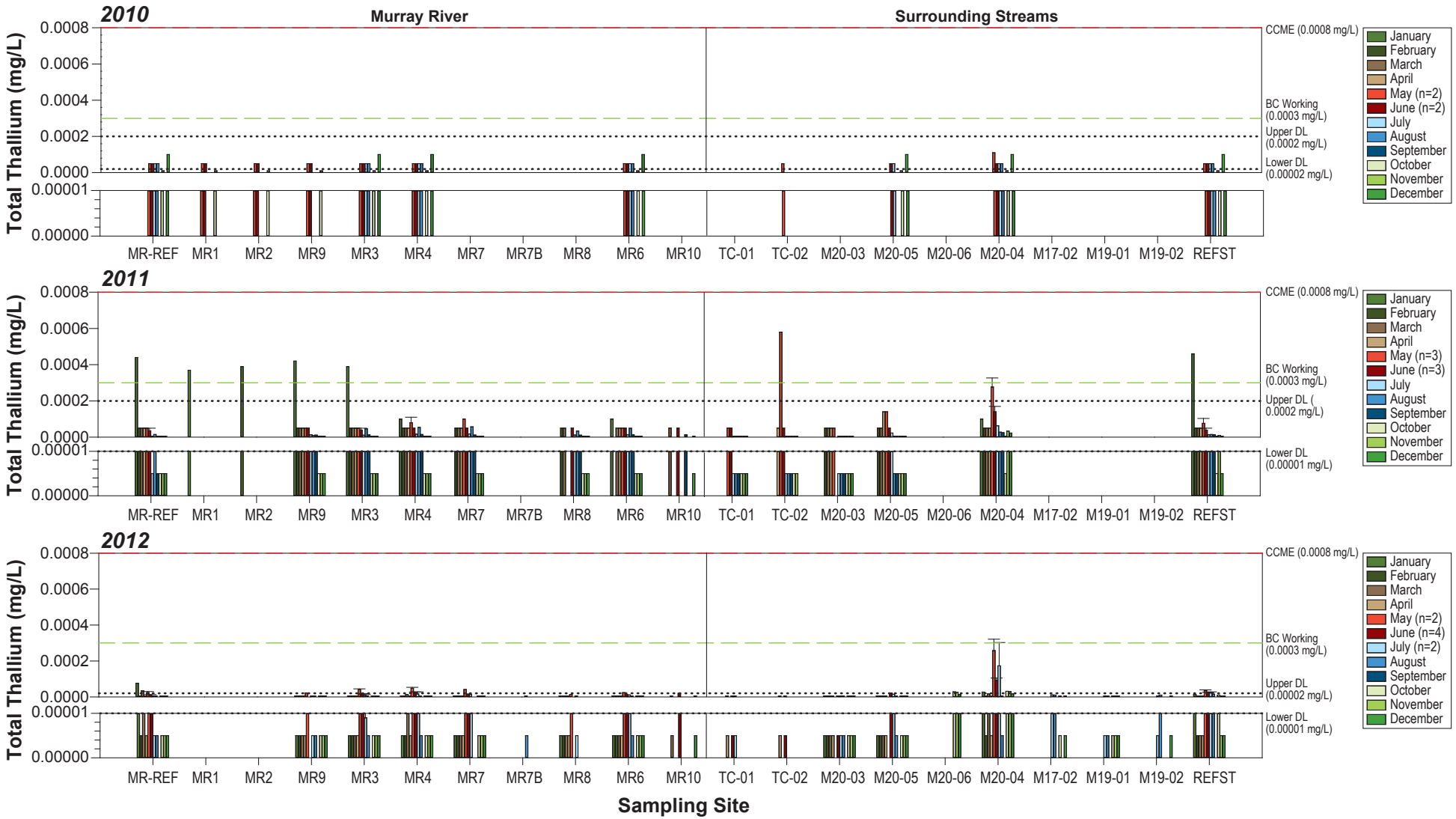
hd Mining

MURRAY RIVER COAL PROJECT

Total Silver Concentrations in Streams, 2010 to 2012

Figure 4.1-41

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Working guideline (Ontario objective; 0.0003 mg/L).
Red dashed lines represent CCME guideline (0.0008 mg/L).

Figure 4.1-42

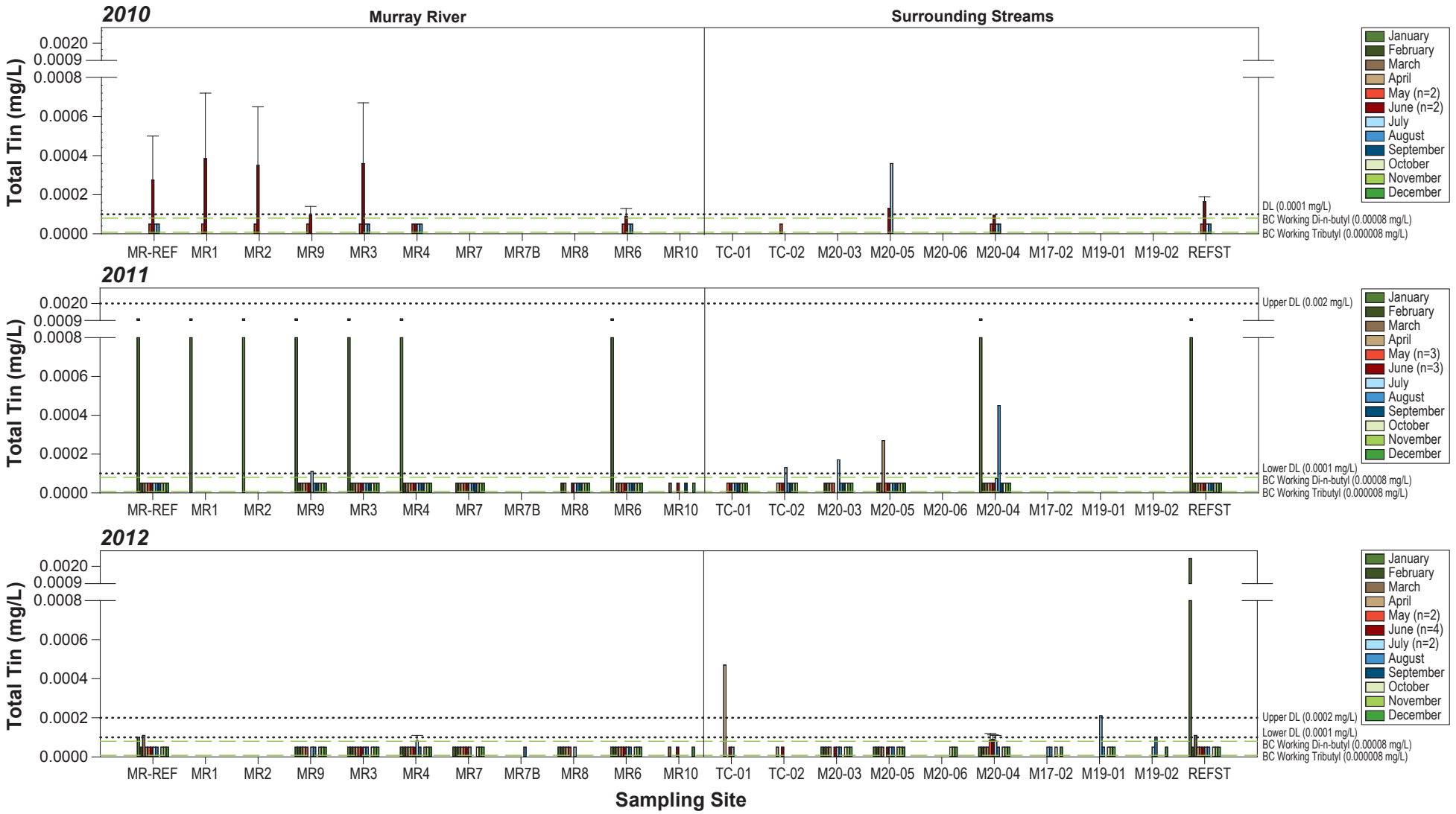
hd Mining

MURRAY RIVER COAL PROJECT

Total Thallium Concentrations in Streams, 2010 to 2012

Figure 4.1-42

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2011 and 2012).
Green dashed lines represent BC Working guidelines (tributyl: 0.000008 mg/L; di-n-butyl: 0.00008 mg/L).

Figure 4.1-43

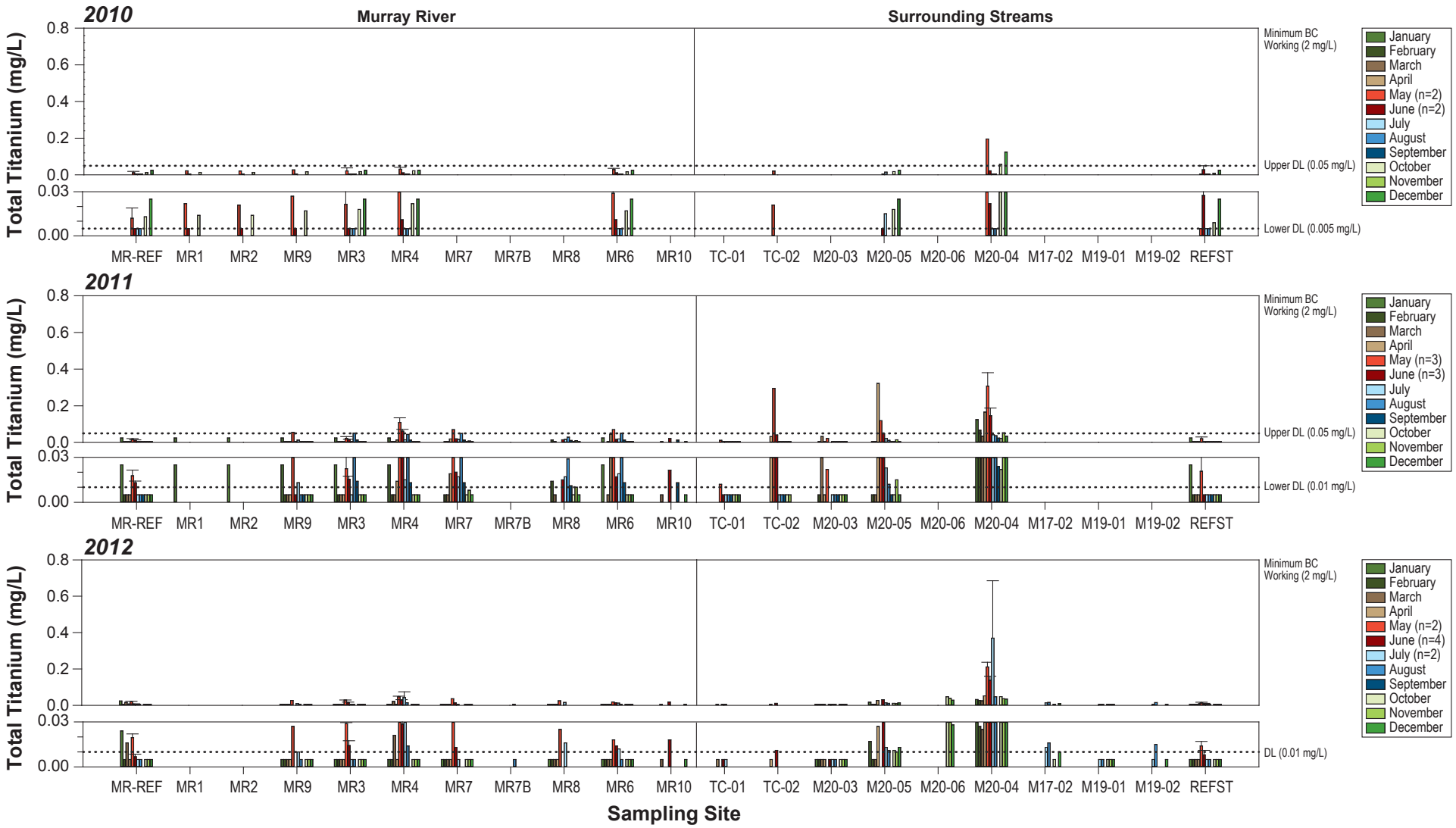
hd Mining

MURRAY RIVER COAL PROJECT

Total Tin Concentrations in Streams , 2010 to 2012

Figure 4.1-43

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Working guideline (median threshold for Scenedesmus (2 mg/L) and for Daphnia (4.6 mg/L)) is greater than graph scales.

Figure 4.1-44

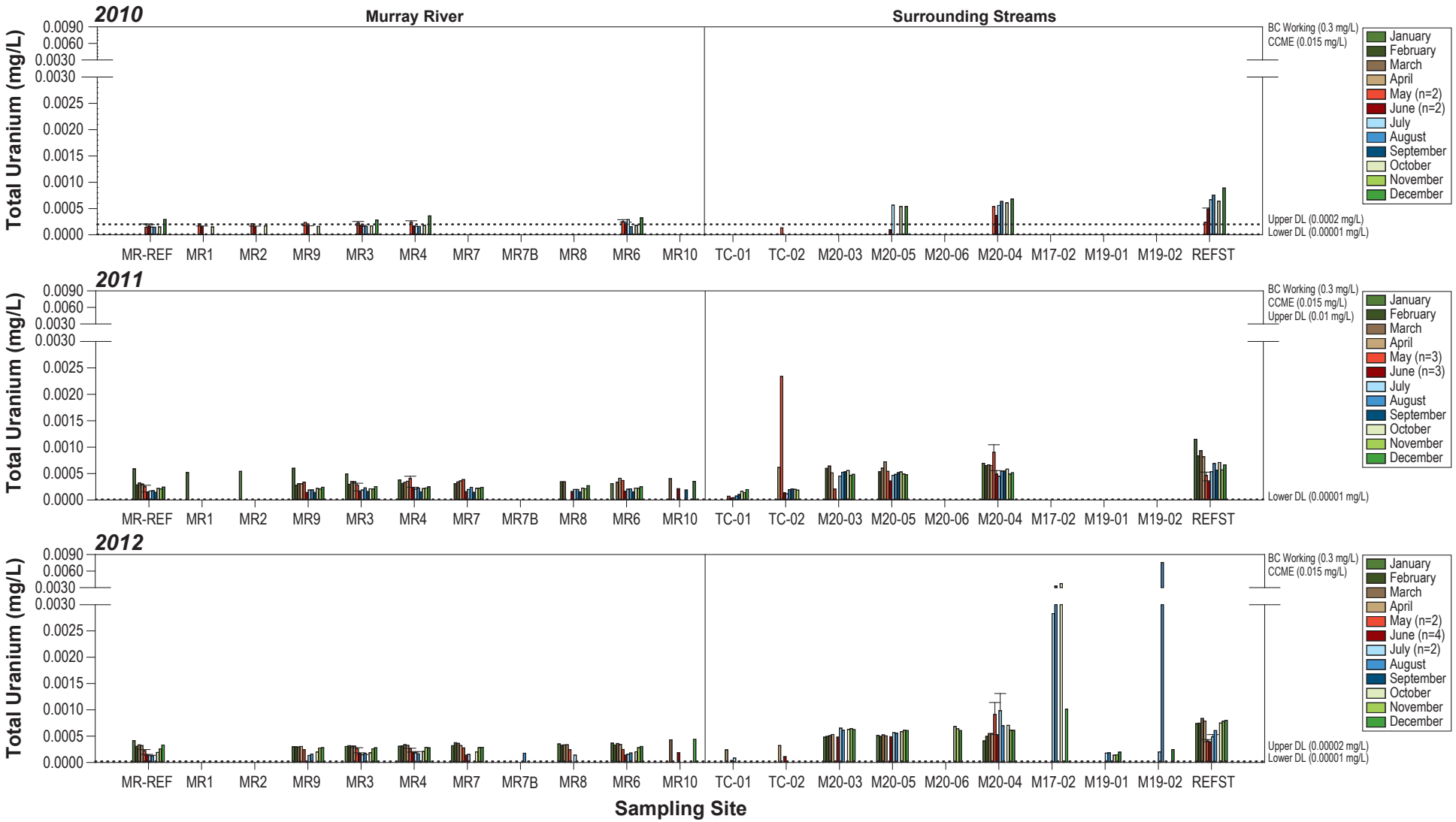
hd Mining

MURRAY RIVER COAL PROJECT

Total Titanium Concentrations in Streams, 2010 to 2012

Figure 4.1-44

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower in 2011 and 2012).
BC Working guideline (0.3 mg/L) and CCME guideline (0.015 mg/L) is greater than graph scales.

Figure 4.1-45

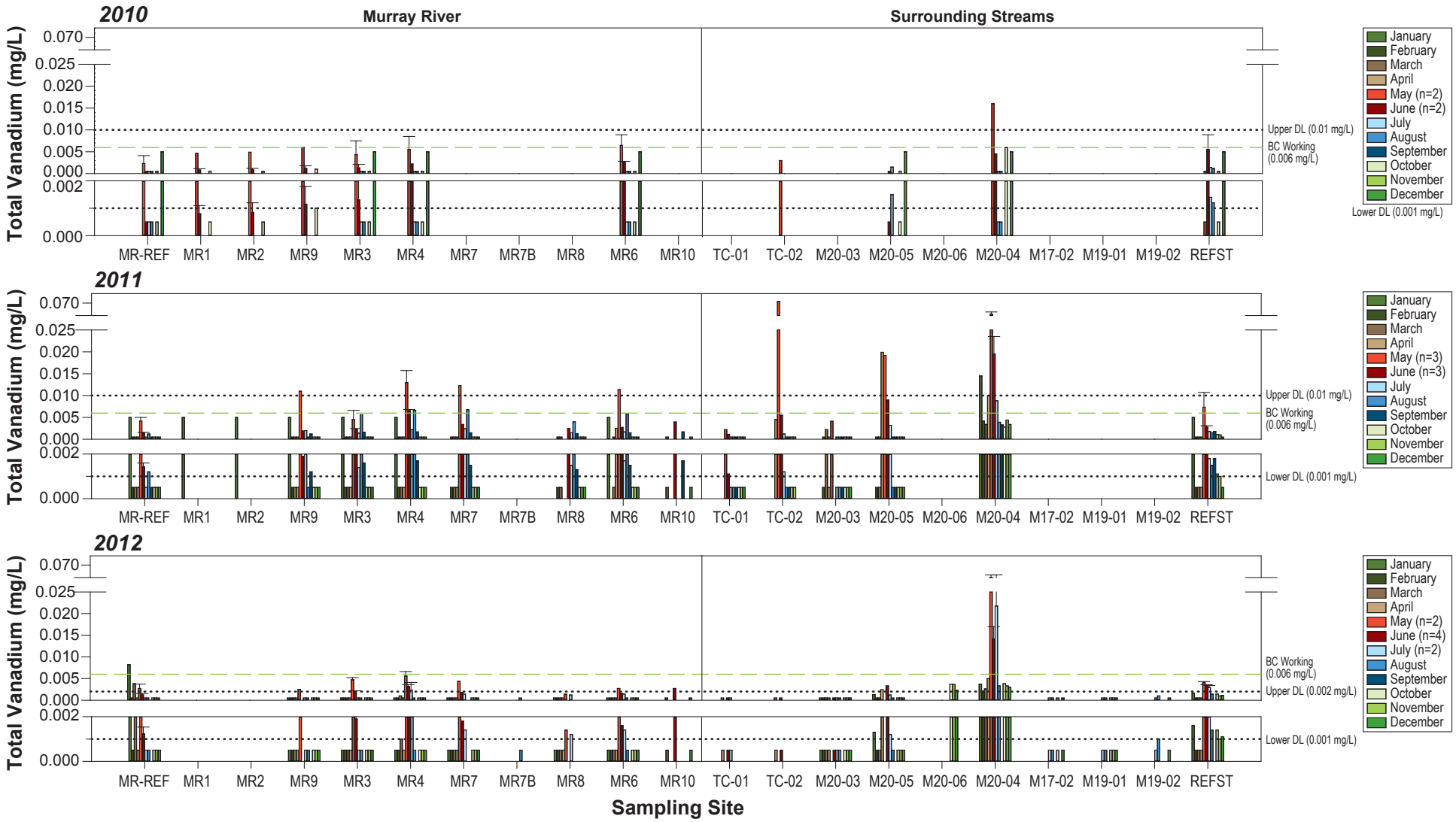
hd Mining

MURRAY RIVER COAL PROJECT

Total Uranium Concentrations in Streams, 2010 to 2012

Figure 4.1-45

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Green dashed lines represent BC Working guideline (0.006 mg/L).

Figure 4.1-46

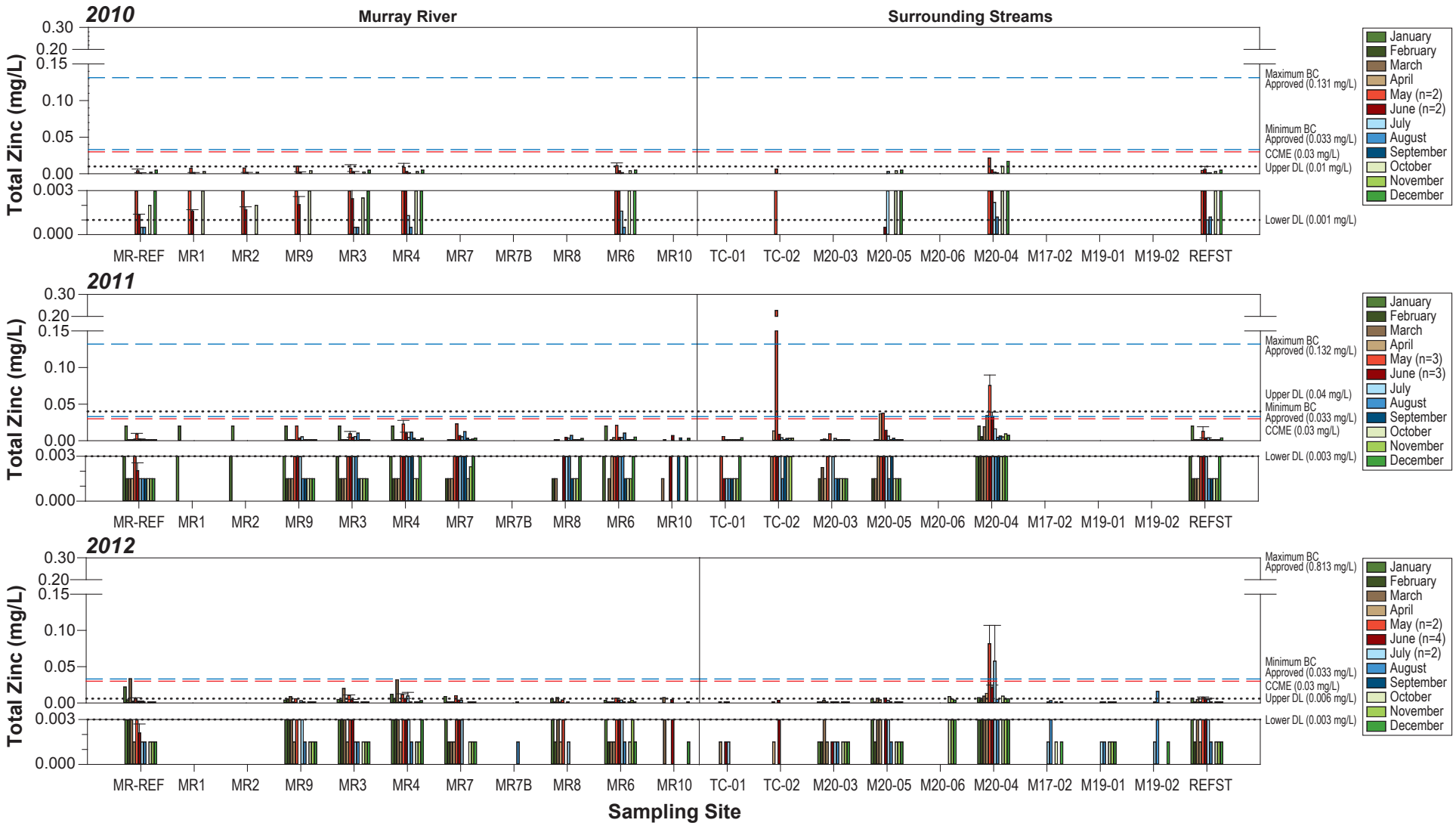
hd Mining

MURRAY RIVER COAL PROJECT

Total Vanadium Concentrations in Streams, 2010 to 2012

Figure 4.1-46

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, except for months with weekly sampling where values are a mean of samples collected that month (number of samples in brackets in legend).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guidelines (hardness dependent; zinc equation (mg/L) = 33 + 0.75(hardness-90)/1000 with minimum = 0.033 mg/L).
Red dashed lines represent CCME guideline (0.03 mg/L).

Figure 4.1-47

hd Mining

MURRAY RIVER COAL PROJECT

Total Zinc Concentrations in Streams, 2010 to 2012

Figure 4.1-47

Rescan Engineers & Scientists

4.1.6 Polycyclic Aromatic Hydrocarbons

PAHs were below their detection limits at most streams sites (Appendix 1-1). Detectable concentrations were only measured for a few parameters at MR-REF in the August 15, 2010 sample (fluoranthene, fluorene, phenanthrene and pyrene) and MR4 on August 16, 2010 (naphthalene).

4.1.7 Water Quality Guidelines

Stream water quality data were compared to CCME guidelines and approved and working BC MOE guidelines for the protection of aquatic life (BC MOE 2006; Nagpal et al. 2006; CCME 2007). Parameters above CCME and BC guidelines in at least one sample were presented in Tables 4.1-1 and 4.1-2.

Overall, concentrations were higher than 14 CCME guidelines and 10 BC MOE guidelines. Commonly elevated parameters above CCME guidelines included total aluminum, cadmium, hexavalent chromium, copper, and iron, with over half of the stream sites higher than the guideline in at least one sample. Total cyanide concentrations were commonly above the CCME free cyanide guideline, but it is unlikely that free cyanide concentrations were above guidelines, since WAD cyanide was typically below the detection limit. Most parameters were below BC guidelines at the majority of stream sites, except total iron.

Camp Creek sites M20-05 and M20-04, and Twenty Creek site TC-02 had replicates above the greatest number of guidelines and by the greatest factor (10 to 14 CCME guidelines; 6 to 9 BC guidelines). For example, total aluminum concentrations were higher than the CCME guideline at TC-02 and M20-04 by an average factor of 44 and 37, respectively. Total arsenic, trivalent chromium, lead, mercury, silver, and zinc concentrations were occasionally higher than the CCME guidelines. Similarly, total arsenic, copper, selenium, silver, zinc, and dissolved aluminum and iron were occasionally above the approved BC MOE guidelines. Total selenium was marginally higher than the CCME guideline in most Camp Creek samples.

The detection limits for some parameters in some samples were above guidelines; thus, it could not be confirmed whether the samples were above guidelines. Of parameters observed above guidelines during sampling, fluoride, cyanide, cadmium, chromium, mercury, selenium, silver, and zinc all had instances where samples were below a detection limit which was greater the guideline. These instances were in samples collected in October 2010, December 2010 and January 2011. These samples were left out of the calculations for the exceedance tables.

No PAH concentrations were higher than CCME or BC MOE guidelines, however detection limits for some parameters (benz(a)anthracene, benzo(a)pyrene, fluoranthene, and pyrene) in some samples were above guidelines.

4.1.8 Quality Assurance and Quality Control

Stream travel and field blank data are presented in Appendix 1-2 and relative percent difference results are available in Appendix 1-3.

In the 33 travel blanks, acidity, alkalinity (bicarbonate), ammonia, nitrate, TOC, barium, calcium, copper, magnesium and zinc were above detection limits. Of these, only ammonia, nitrate, barium and copper levels were double the detection limit, which were sporadic.

Table 4.1-1. Percentage of CCME Guideline Exceedances and Average Factor of Exceedances in Stream Replicates, 2010 to 2012

Parameter		Fluoride		Phosphorus	Cyanide (Free)		Aluminum (Al)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)				Copper (Cu)		Iron (Fe)		Lead (Pb)	
													Cr (VI)		Cr (III)							
CCME Guideline[a]		0.12 mg/L[b]			0.005 mg/L		pH-dependent		0.005 mg/L		Hardness-dependent[b]		0.001 mg/L		0.0089 mg/L		Hardness-dependent		0.3 mg/L		Hardness-dependent	
Site	# Samples	%	Factor	Trigger ranges	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor
MR-REF	43	0%	-	Ultraoligotrophic - Hypereutrophic	5%	1.21	58%	4.88	0%	-	29%	2.09	17%	1.87	0%	-	5%	1.17	40%	3.20	0%	-
MR1	6	0%	-	Oligotrophic - Eutrophic	0%	-	83%	6.54	0%	-	40%	2.47	40%	1.85	0%	-	0%	-	50%	3.83	0%	-
MR2	5	0%	-	Oligotrophic - Eutrophic	0%	-	80%	5.03	0%	-	25%	2.67	25%	1.90	0%	-	0%	-	40%	3.31	0%	-
MR9	27	0%	-	Ultraoligotrophic - Hypereutrophic	4%	1.42	63%	8.01	0%	-	23%	2.48	19%	2.16	0%	-	7%	2.11	41%	3.31	0%	-
MR3	53	0%	-	Ultraoligotrophic - Hypereutrophic	6%	1.25	64%	6.74	0%	-	37%	2.40	37%	1.73	0%	-	8%	1.32	53%	3.58	0%	-
MR4	39	0%	-	Ultraoligotrophic - Hypereutrophic	6%	1.73	72%	11.50	0%	-	44%	3.15	54%	2.51	0%	-	23%	2.26	62%	5.45	3%	1.15
MR7	24	0%	-	Ultraoligotrophic - Hypereutrophic	4%	2.00	54%	8.22	0%	-	25%	2.97	21%	2.62	0%	-	8%	1.93	42%	4.59	4%	1.06
MR8	16	0%	-	Ultraoligotrophic - Eutrophic	0%	-	50%	5.19	0%	-	13%	2.28	13%	1.46	0%	-	0%	-	44%	2.30	0%	-
MR6	34	0%	-	Ultraoligotrophic - Hypereutrophic	10%	1.68	50%	10.26	0%	-	32%	2.96	39%	2.28	0%	-	15%	1.67	47%	4.77	0%	-
MR10	8	0%	-	Ultraoligotrophic - Eutrophic	0%	-	50%	7.67	0%	-	38%	1.81	38%	1.47	0%	-	0%	-	50%	3.15	0%	-
TC-01	12	0%	-	Oligotrophic - Eutrophic	42%	1.56	42%	4.67	0%	-	33%	2.95	17%	1.46	0%	-	0%	-	25%	2.14	0%	-
TC-02	12	0%	-	Oligotrophic - Hypereutrophic	50%	3.05	58%	44.04	8%	3.84	42%	20.42	42%	9.57	8%	3.94	42%	6.63	67%	23.82	17%	10.99
M20-03	27	0%	-	Ultraoligotrophic - Eutrophic	15%	1.81	37%	5.18	0%	-	11%	2.21	19%	1.42	0%	-	4%	1.11	19%	2.71	0%	-
M20-05	26	0%	-	Oligotrophic - Hypereutrophic	17%	2.02	85%	9.84	0%	-	24%	5.50	28%	4.24	0%	-	15%	2.70	38%	8.37	4%	1.56
M20-06	3	33%	1.07	Mesoeutrophic - Mesoeutrophic	0%	-	100%	8.68	0%	-	0%	-	67%	1.58	0%	-	0%	-	100%	2.45	0%	-
M20-04	42	22%	1.11	Ultraoligotrophic - Hypereutrophic	18%	1.97	95%	36.81	12%	1.28	59%	9.60	88%	6.11	21%	1.63	48%	4.26	90%	16.34	21%	2.55
M17-02	4	0%	-	Ultraoligotrophic - Mesotrophic	0%	-	50%	1.33	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
M19-01	5	0%	-	Ultraoligotrophic - Oligotrophic	0%	-	20%	1.03	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
M19-02	3	0%	-	Ultraoligotrophic - Oligotrophic	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
REFST-D/S	41	0%	-	Oligotrophic - Hypereutrophic	5%	1.41	39%	5.45	0%	-	36%	2.17	15%	2.09	0%	-	5%	1.32	24%	3.36	0%	-

Parameter		Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
CCME Guideline[a]		0.000026 mg/L		Hardness-dependent		0.001 mg/L		0.0001 mg/L		0.03 mg/L	
Site	# Samples	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor
MR-REF	43	0%	-	0%	-	0%	-	0%	-	5%	1.11
MR1	6	0%	-	0%	-	0%	-	0%	-	20%	-
MR2	5	0%	-	0%	-	0%	-	0%	-	25%	-
MR9	27	0%	-	0%	-	0%	-	0%	-	4%	-
MR3	53	0%	-	0%	-	0%	-	0%	-	2%	-
MR4	39	0%	-	0%	-	0%	-	0%	-	8%	1.07
MR7	24	0%	-	0%	-	0%	-	0%	-	0%	-
MR8	16	0%	-	0%	-	0%	-	0%	-	0%	-
MR6	34	0%	-	0%	-	0%	-	0%	-	3%	-
MR10	8	0%	-	0%	-	0%	-	0%	-	0%	-
TC-01	12	0%	-	0%	-	0%	-	0%	-	0%	-
TC-02	12	17%	2.77	8%	1.04	8%	1.60	17%	4.04	17%	4.48
M20-03	27	0%	-	0%	-	74%	1.86	0%	-	0%	-
M20-05	26	0%	-	0%	-	73%	1.75	8%	1.11	8%	1.24
M20-06	3	0%	-	0%	-	100%	1.58	0%	-	0%	-
M20-04	42	16%	1.88	0%	-	60%	1.60	21%	2.13	28%	2.44
M17-02	4	0%	-	0%	-	25%	1.57	0%	-	0%	-
M19-01	5	0%	-	0%	-	0%	-	0%	-	0%	-
M19-02	3	0%	-	0%	-	33%	5.07	0%	-	0%	-
REFST-D/S	41	0%	-	0%	-	5%	1.22	0%	-	3%	-

Notes:

[a] *Canadian water quality guideline for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment; accessed March 2013.*

[b] *Interim guideline.*

[c] *Calculated based on a conservative temperature of 30°C.*

Only parameters that had replicates above guidelines are presented.

Frequency (%) represents percentage of replicates collected at each site that were higher than available guidelines.

Factor represents the average factor replicates above guidelines exceeded the guideline concentrations.

Some replicates were below detection limits that were higher than the guideline.

These "ambiguous" replicates were excluded from percent and factor calulations.

Table 4.1-2. Percentage of BC Guideline Exceedances and Average Factor of Exceedances in Stream Replicates, 2010 to 2012

Parameter		Sulphate		Arsenic		Copper		Iron		Mercury		Selenium		Silver		Zinc		Aluminum - dissolved		Iron - dissolved	
BC Guideline[a]		100 mg/L		0.005 mg/L		Hardness-dependent		1 mg/L		0.00002 when MeHg = 0.5% THg		0.002 mg/L		Hardness-dependent		Hardness-dependent		pH-dependent		0.35 mg/L	
Site	# Samples	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor
MR-REF	43	0%	-	0%	-	0%	-	14%	1.85	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR1	6	0%	-	0%	-	0%	-	33%	1.55	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR2	5	0%	-	0%	-	0%	-	20%	1.62	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR9	27	0%	-	0%	-	0%	-	7%	3.05	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR3	53	0%	-	0%	-	0%	-	17%	2.14	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR4	39	0%	-	0%	-	3%	1.31	31%	2.68	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR7	24	0%	-	0%	-	0%	-	13%	3.24	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR8	16	0%	-	0%	-	0%	-	6%	1.80	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR6	34	0%	-	0%	-	0%	-	18%	2.79	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
MR10	8	0%	-	0%	-	0%	-	25%	1.18	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
TC-01	12	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	17%	1.83	0%	-
TC-02	12	0%	-	8%	3.84	17%	4.12	33%	13.61	17%	3.60	0%	-	17%	4.04	17%	4.07	17%	3.06	17%	1.62
M20-03	27	0%	-	0%	-	0%	-	4%	1.55	0%	-	30%	1.31	0%	-	0%	-	4%	1.10	0%	-
M20-05	26	0%	-	0%	-	0%	-	15%	5.37	4%	1.05	23%	1.40	4%	1.13	4%	1.14	8%	1.09	0%	-
M20-06	3	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
M20-04	42	0%	-	12%	1.28	19%	1.61	60%	7.09	18%	2.25	13%	1.33	10%	1.72	19%	1.82	24%	1.61	2%	5.86
M17-02	4	75%	2.84	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
M19-01	5	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-	20%	1.79
M19-02	3	33%	8.87	0%	-	0%	-	0%	-	0%	-	33%	2.54	0%	-	0%	-	0%	-	0%	-
REFST-D/S	41	0%	-	0%	-	0%	-	5%	2.83	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-

Notes:

[a] *British Columbia guideline for the protection of freshwater aquatic life; accessed March 2013.*

Only parameters that had replicates above guidelines are presented.

Frequency (%) represents percentage of replicates collected at each site that were higher than available guidelines.

Factor represents the average factor replicates above guidelines exceeded the guideline concentrations.

Some replicates were below detection limits that were higher than the guideline.

These "ambiguous" replicates were excluded from percent and factor calulations.

The 37 field blanks were above detection limits for hardness, acidity, alkalinity (bicarbonate and total), ammonia, nitrate, barium (total and dissolved), calcium (total and dissolved), magnesium (total and dissolved), manganese (total and dissolved) and strontium (total and dissolved). These elevated levels were sporadic except for the dissolved metals; however, there are no associated federal or provincial guidelines for these parameters.

RPD calculations were performed if the replicate concentration for the parameter was at least five times higher than the detection limit (1,278 of 3,456 cases; BC MOE 2006). Of these RPD calculations, only 8 had RPDs between 20% and 50% and none had RPDs that were greater than 50%. These results indicate that the water quality data are reliable.

4.1.9 Excluded Data

One sample in July 2012 at MR-REF (July 4, 2012) had a very high pH (11.92) in comparison to the other July sample (pH 8.18 on July 23, 2012) at the same site, indicating possible contamination of the general parameters bottle. As a result analytical results generated from this bottle (general parameters and anions) were excluded from graphs and exceedance tables (Tables 4.1-1 and 4.1-2).

4.2 WATER TOXICITY

The results of water toxicity experiments conducted with water collected from MR-REF and MR4 in August 2010 are presented in a report generated by Nautilus Environmental (Appendix 2-1). Note site MR4 is labeled with its 2010 name (MR5) in the Nautilus Environmental report.

4.2.1 Water Quality Guidelines

Water chemistry samples were collected concurrently with water for toxicity experiments. All parameters were below approved BC and CCME guidelines.

4.2.2 Toxicology Testing Results

Overall, the toxicology experiments found no impact of MR-REF and MR4 site water on survival and reproduction of the water flea *Ceriodaphnia dubia* or the rainbow trout *Oncorhynchus mykiss*. However, the water flea *Daphnia magna* had considerably reduced survivorship when site water was present at any concentration. The LC_{50} (lethal concentration for 50% of the sample) was less than 6.25% site water for both sites.

The duck weed *Lemna minor* may have been inhibited by water chemistry at MR-REF, although there was no evidence of this at the downstream MR4 site. The water chemistry at both sites stimulated the growth of the microalgae *Pseudokirchneriella subcapitata*. More detailed results are described below.

Ceriodaphnia dubia Survival and Reproduction Test

The zooplankton *Ceriodaphnia dubia* had survival rates of 90 or 100% at all MR4 and MR-REF site water concentrations (Table 4.2-1). The lethal concentration for 50% of the sample population (LC_{50}) for both samples was greater than 100% site water. Site water from MR4 and MRREF had no effect on reproduction; the inhibition concentrations (IC) for 25% and 50% of the sample population (IC_{25} and IC_{50}, respectively) were greater than 100% for both samples.

Table 4.2-1. Toxicity Test Results for the *Ceriodaphnia dubia* Survival and Reproduction Test, 2010

Site Water Concentration (%)	MR-REF		MR4	
	Survival (%)	Reproduction (# young/female)	Survival (%)	Reproduction (# young/female)
Control	100	16.9 ± 2.9	100	16.3 ± 1.5
5	100	17.7 ± 2	100	15.8 ± 3.6
10	100	16.3 ± 5.7	100	15.2 ± 2.8
20	100	16.9 ± 3.1	100	18 ± 3.5
40	100	17.2 ± 4.9	100	16.1 ± 5.1
60	100	17.4 ± 2.2	100	15.2 ± 3.4
80	90	17 ± 6.3	100	20.1 ± 2.5
100	100	19 ± 3.9	100	16.9 ± 4.3
Test Endpoint	***Site Water Concentration (%)***		***Site Water Concentration (%)***	
LC50	>100	-	>100	-
IC25	-	>100	-	>100
IC50	-	>100	-	>100

Notes: Results are mean ± standard deviation.
LC = lethal concentration; IC = inhibition concentration.

Lemna minor Growth Inhibition Test

No adverse effects were observed in the 7-day duckweed *L. minor* tests on frond growth in MR4 water (Table 4.2-2), and the IC_{25} and IC_{50} for frond growth were greater than 97% site water for MR4. Minor adverse effects on frond growth were detected in MR-REF water (Table 4.2-2). The IC_{25} and IC_{50} values were 57.7% and greater than 97% site water, respectively. When measured as dry weight, there were no adverse effects of MR-REF or MR4 site water relative to the negative control and the IC_{25} and IC_{50} values for both samples were greater than 97% site water.

Table 4.2-2. Toxicity Test Results for the *Lemna minor* Growth Inhibition Test, 2010

Site Water Concentration (%)	MR-REF		MR4	
	Frond Growth (No. of Fronds)	Dry Weight (mg)	Frond Growth (No. of Fronds)	Dry Weight (mg)
Control	81.8 ± 5.7	6.3 ± 0.5	80.2 ± 7.7	6.5 ± 0.5
1.5	70 ± 1.4	5.7 ± 0.4	80.5 ± 10.5	6.3 ± 1.1
3	70.8 ± 3.3	5.4 ± 0.2	70.5 ± 3.3	5.3 ± 0.2
6.1	73 ± 11.4	5.8 ± 1	83.2 ± 9.8	6.4 ± 0.3
12.1	73.5 ± 10.3	5.9 ± 0.6	86.8 ± 3.4	6.9 ± 0.4
24.2	71.5 ± 7	5.9 ± 0.4	82.2 ± 19	7 ± 1.2
48.5	61.8 ± 9.1	5.1 ± 0.7	84.2 ± 5.2	6.9 ± 1
97	60 ± 4.2	5.2 ± 0.4	65.2 ± 10.2	6 ± 1.1
Test endpoint	***Site Water Concentration (%)***		***Site Water Concentration (%)***	
IC25 (95% CL)	57.7 (19.5 - 97)	>97	>97	>97
IC50	>97	>97	>97	>97

Notes: Results are mean ± standard deviation.
LC = lethal concentration; IC = inhibition concentration; CL = confidence limits.

Pseudokirchneriella subcapitata Growth Inhibition Test

Growth of the microalga *P. subcapitata* was stimulated by both MR-REF and MR4 site water at all test concentrations (1.5 to 95.2%), relative to the control (Table 4.2-3). Thus, there was no measurable toxic effect of site water on *P. subcapitata* and the IC_{25} and IC_{50} values were greater than 95.2% site water. The stimulation of algal growth (cell density increases) ranged from 16 to 896% in MR-REF site water and 11 to 482% in MR4 site water.

Table 4.2-3. Toxicity Test Results for the *Pseudokirchneriella subcapitata* Growth Inhibition Test, 2010

Site Water Concentration (%)	MR-REF		MR4	
	Cell Density (x 10^4 cells/mL)	Stimulation (%)	Cell Density (x 10^4 cells/mL)	Stimulation (%)
Control	41.5 ± 5.1	0	43.6 ± 4.4	0
1.48	48.2 ± 4.9	16.3	48.5 ± 5.2	11.2
2.95	49.5 ± 2.4	19.3	57.8 ± 6.6	32.4
5.9	60.5 ± 12.4	45.8	70.5 ± 10.3	61.6
11.9	100.2 ± 10.2	141.6	104.8 ± 13.2	140.1
23.8	221.8 ± 17.6	434.3	146 ± 37.1	234.7
47.6	262.2 ± 22.1	531.9	241.5 ± 27.8	453.6
95.2	413.5 ± 49.2	896.4	254 ± 20.7	482.2
Test Endpoint	***Site Water Concentration (%)***		***Site Water Concentration (%)***	
IC25	>95.2	-	>95.2	-
IC50	>95.2	-	>95.2	-

Notes: Results are mean ± standard deviation.
LC = lethal concentration; IC = inhibition concentration.

Oncorhynchus mykiss LC_{50} Test

Rainbow trout (*Oncorhynchus mykiss)* survival was 100% at all MR-REF and MR4 site water concentrations (Table 4.2-4). The 96 hour LC_{50} for the samples was greater than 100%.

Table 4.2-4. Toxicity Test Results for the *Oncorhynchus mykiss* Survival Test, 2010

Site Water Concentration (%)	MR-REF	MR4
	Survival (%)	Survival (%)
Control	100	100
6.25	100	100
12.5	100	100
25	100	100
50	100	100
100	100	100
Test Endpoint	***Site Water Concentration (%)***	
LC50	>100	>100

Notes:
Results are mean ± standard deviation.
LC = lethal concentration.

LC_{50} *Daphnia magna* Test

Effects on the zooplankton *D. magna* survival were observed in all MR-REF and MR5 site water concentrations (6.25-100%) relative to the control after 48 hours of exposure (Table 4.2-5). Therefore, the 48 hour LC_{50} was less than 6.25% for both samples.

Table 4.2-5. Toxicity Test Results for the *Daphnia magna* Survival Test, 2010

Site Water Concentration (%)	MR-REF	MR4
	Survival (%)	Survival (%)
Control	100	100
6.25	10	20
12.5	0	0
25	0	0
50	0	0
100	0	0
Test Endpoint (% v/v)	***Site Water Concentration (%)***	
LC50	>6.25	>6.25

Notes:
Results are mean ± standard deviation.
LC = lethal concentration.

4.3 SEDIMENT QUALITY

Sediment quality parameters of interest and those with CCME or BC MOE guidelines were graphed and presented in Figures 4.3-1 to 4.3-12. Stream sediment quality data are presented in Appendices 3-1 and 3-2.

4.3.1 Sediment Particle Size Composition

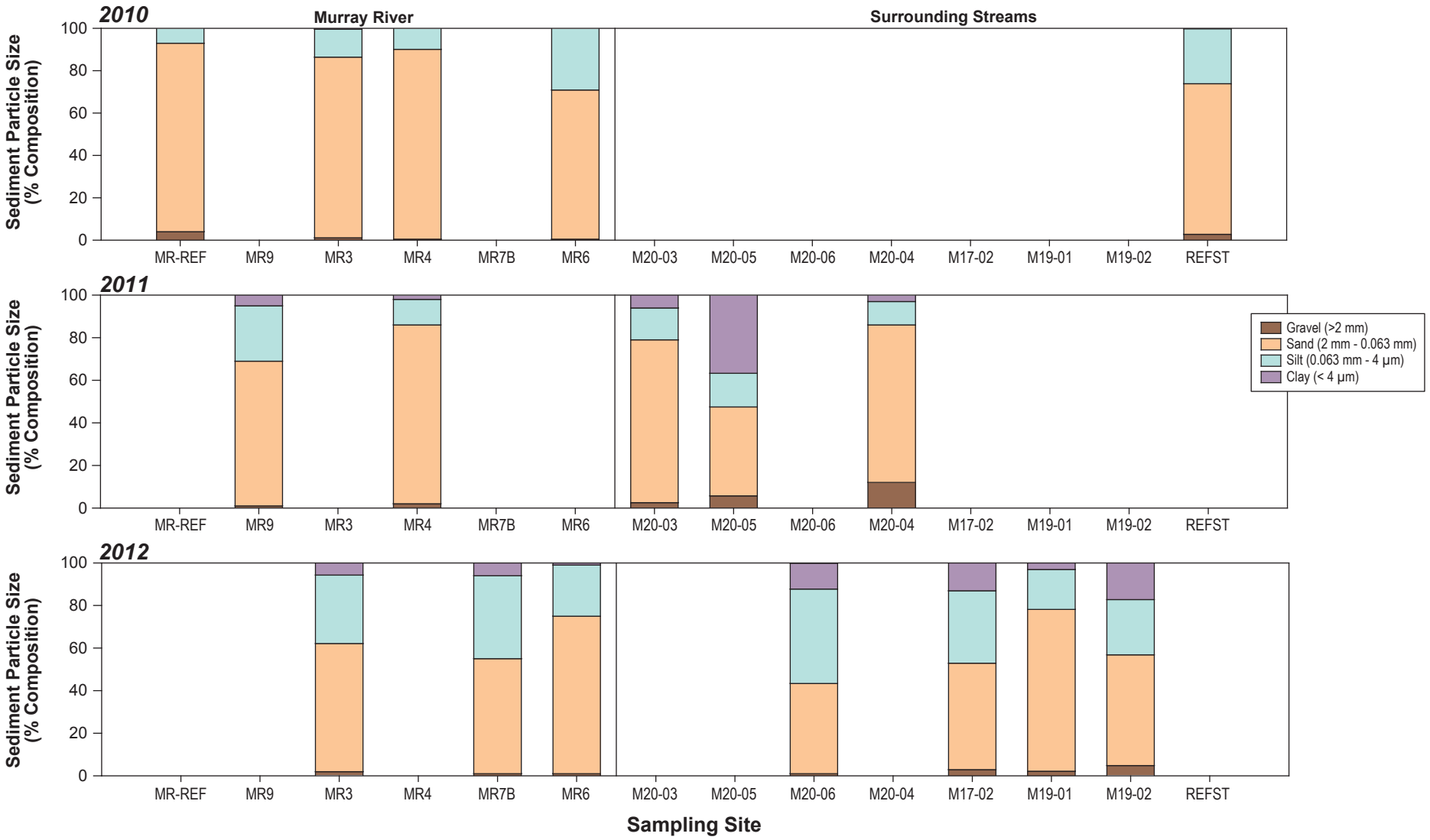
Most stream sediments were composed of over 50% sand (2 – 0.063 mm), with silt (0.063 mm – 4 µm) comprising a significant component (range: 6-45%; Figure 4.3-1). Clay (< 4 µm) comprised 37% at Camp Creek site M20-05, but was less important at other sites (range: 0.1-17%). Gravel (> 2 mm) was rare in Project area stream sediments and comprised at most 10% of sediments (M20-04). Very little clay was measured in the 2010 sediment samples, averaging less than 1% at all sites, while more clay was measured in 2011 and 2012 samples. Due to the greater surface area to volume ratio and surface active properties of silt and clay, metals adsorb to silt and clay more effectively than sands and gravels; thus, Project area stream sediments have considerable capacity to bind and retain metals.

4.3.2 Sediment Nutrients

TOC and total nitrogen content had a similar pattern and were greatest in Club Creek (REFST; Figure 4.3-2). TOC concentrations were variable between years at some sites (MR3 and MR4). Available phosphate concentrations were below or near the detection limit (2 mg/kg) except at M20-04 where it was 8.8 mg/kg (Figure 4.3-2).

4.3.3 Sediment Metals

Overall, metal concentrations tended to be greater in Camp Creek sediments compared to Murray River sediments (Figures 4.3-3 to 4.3-6). This was similar to the patterns observed for water quality. Camp Creek site M20-05 had the greatest sediment iron, lead, manganese, and mercury concentrations in addition to relatively high arsenic, cadmium, selenium, and zinc concentrations. Camp Creek site M20-06 had the greatest sediment copper concentrations.



Notes: 2010 values represent mean values of three replicate samples.
2011 values represent single samples at MR9, MR4, and M20-04, mean of a single sample split into two and analyzed separately at M20-03, and mean of five replicate samples (including one split) at M20-05.
2012 values represent single samples at MR7B, MR-6, M20-06, M17-02, and M19-02, mean of a single sample split into four and analyzed separately at M19-01, and mean of five replicates samples at MR3.

Figure 4.3-1

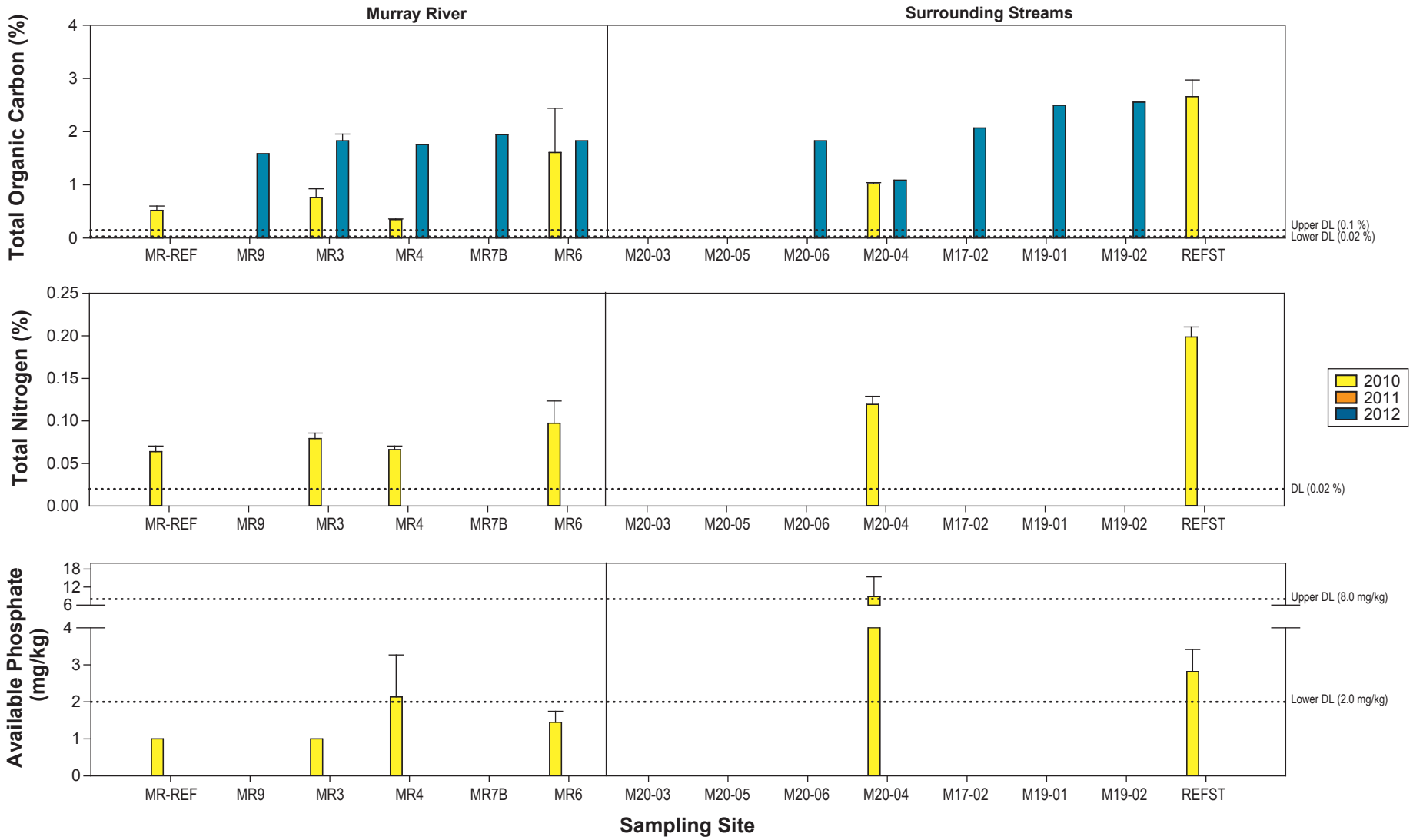
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Particle Size in Streams, 2010 to 2012

Figure 4.3-1

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted line represents realized detection limits (DL).
Parameters not analyzed in 2011.

Figure 4.3-2

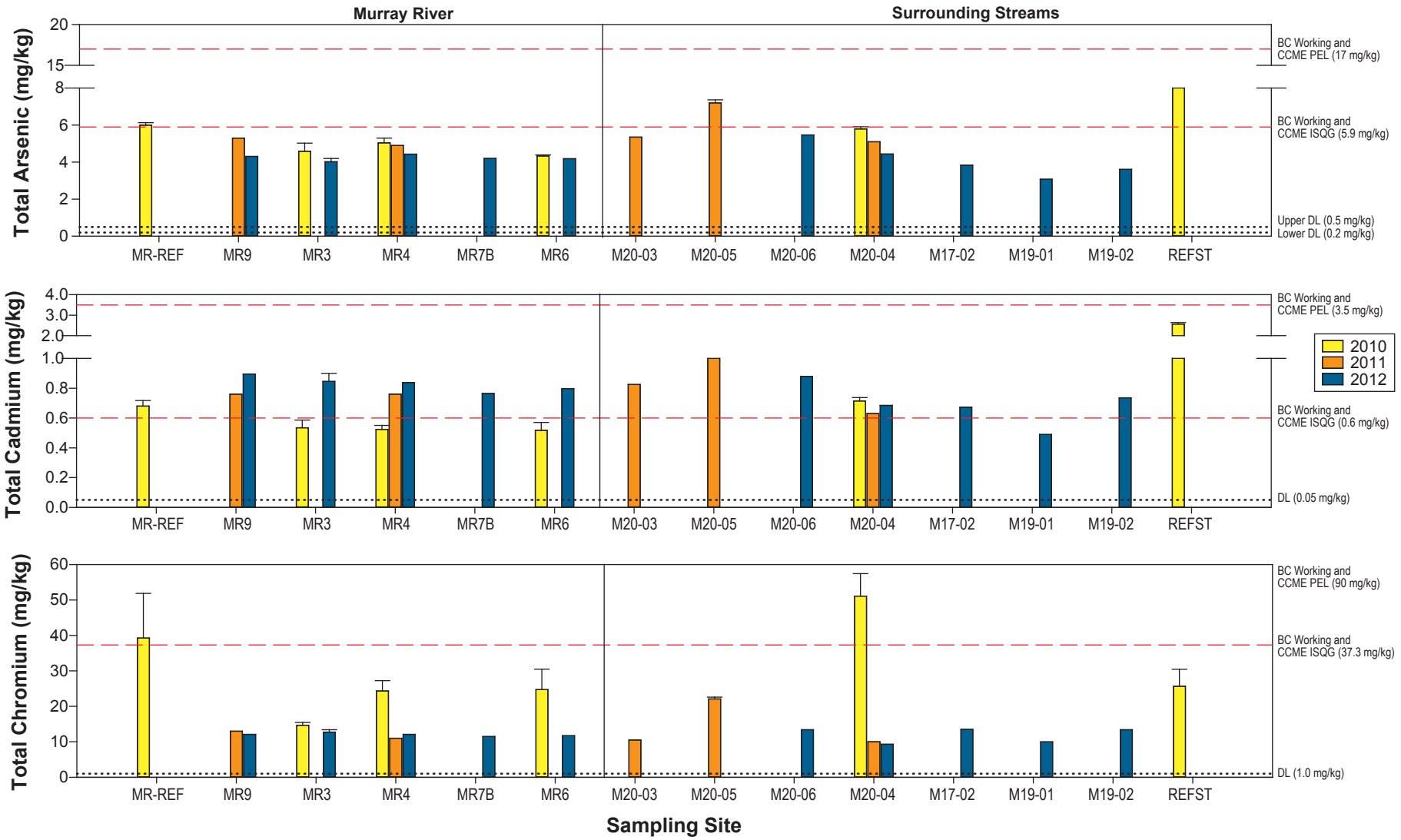
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Total Organic Carbon, Total Nitrogen, and Available Phosphate Concentrations in Streams, 2010 to 2012

Figure 4.3-2

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.3-3

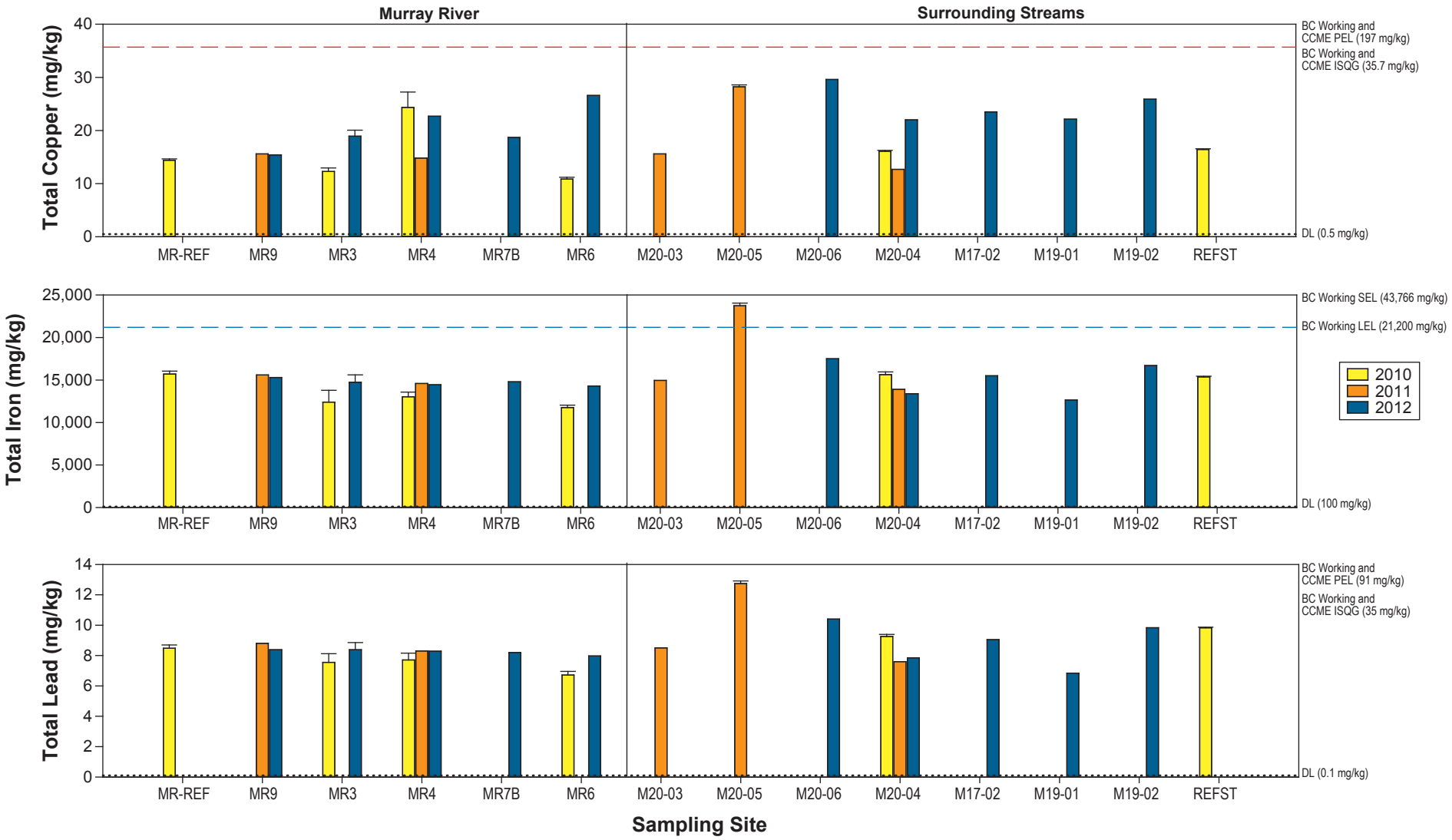
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Arsenic, Cadmium, and Chromium Concentrations in Streams, 2010 to 2012

Figure 4.3-3

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
Blue dashed lines represent BC Working Guidelines for the lowest effect level (LEL) and severe effect level (SEL) based on a screening level concentration.

Figure 4.3-4

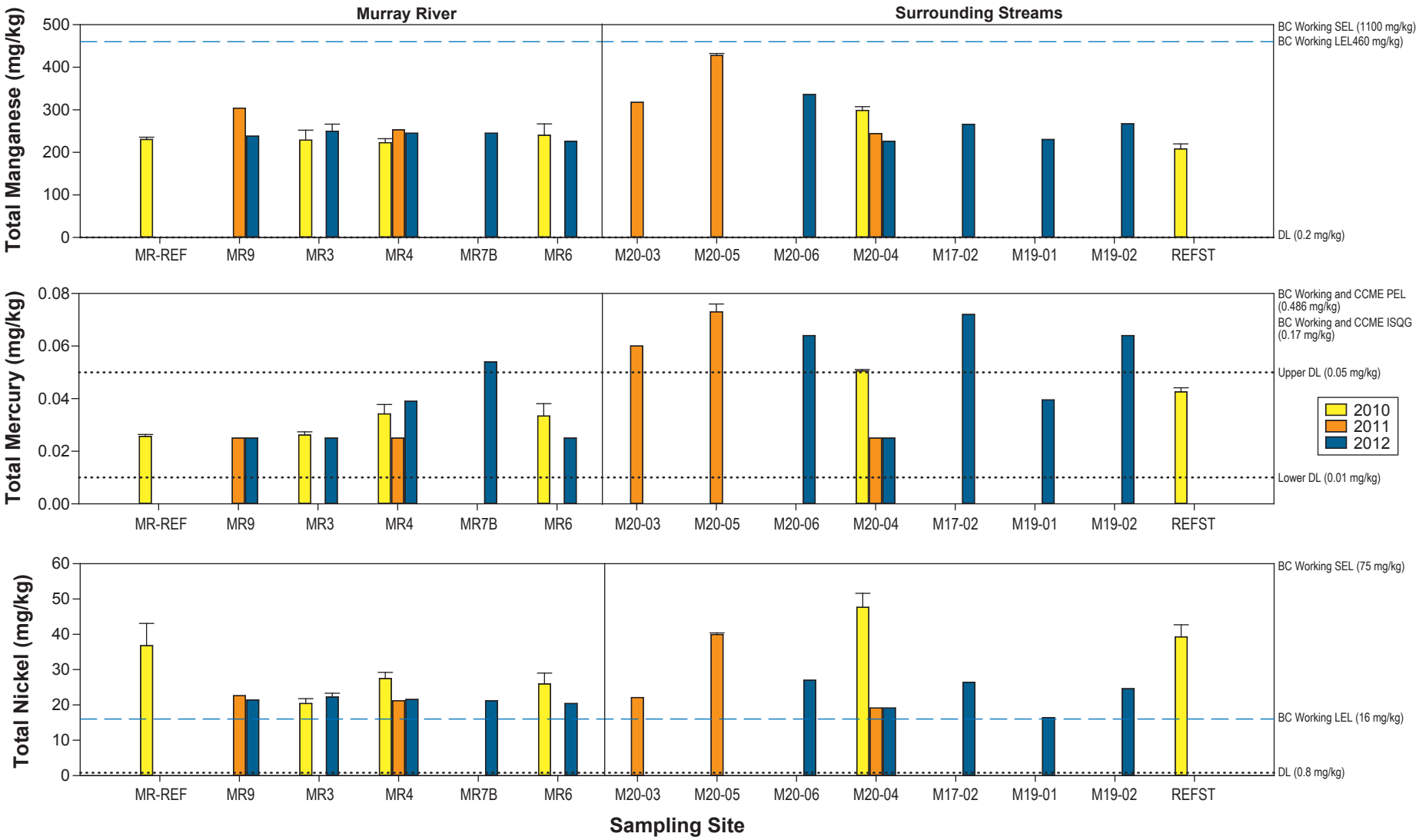
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Copper, Iron, and Lead Concentrations in Streams, 2010 to 2012

Figure 4.3-4

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
Blue dashed lines represent BC Working Guidelines for the lowest effect level (LEL) and severe effect level (SEL) based on a screening level concentration.

Figure 4.3-5

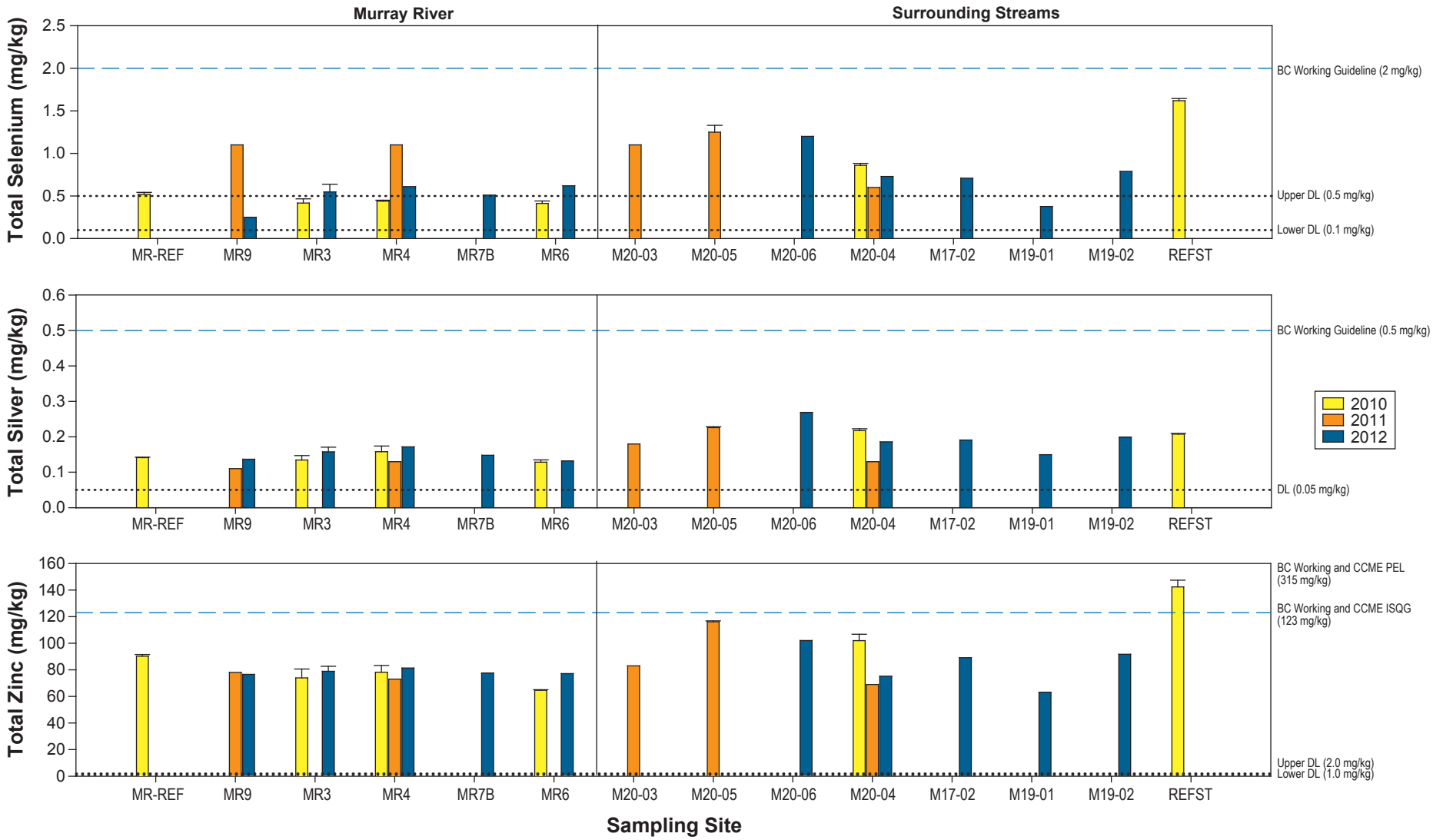
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Manganese, Mercury, and Nickel Concentrations in Streams, 2010 to 2012

Figure 4.3-5

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
Blue dashed lines represent BC Working Guidelines.

Figure 4.3-6

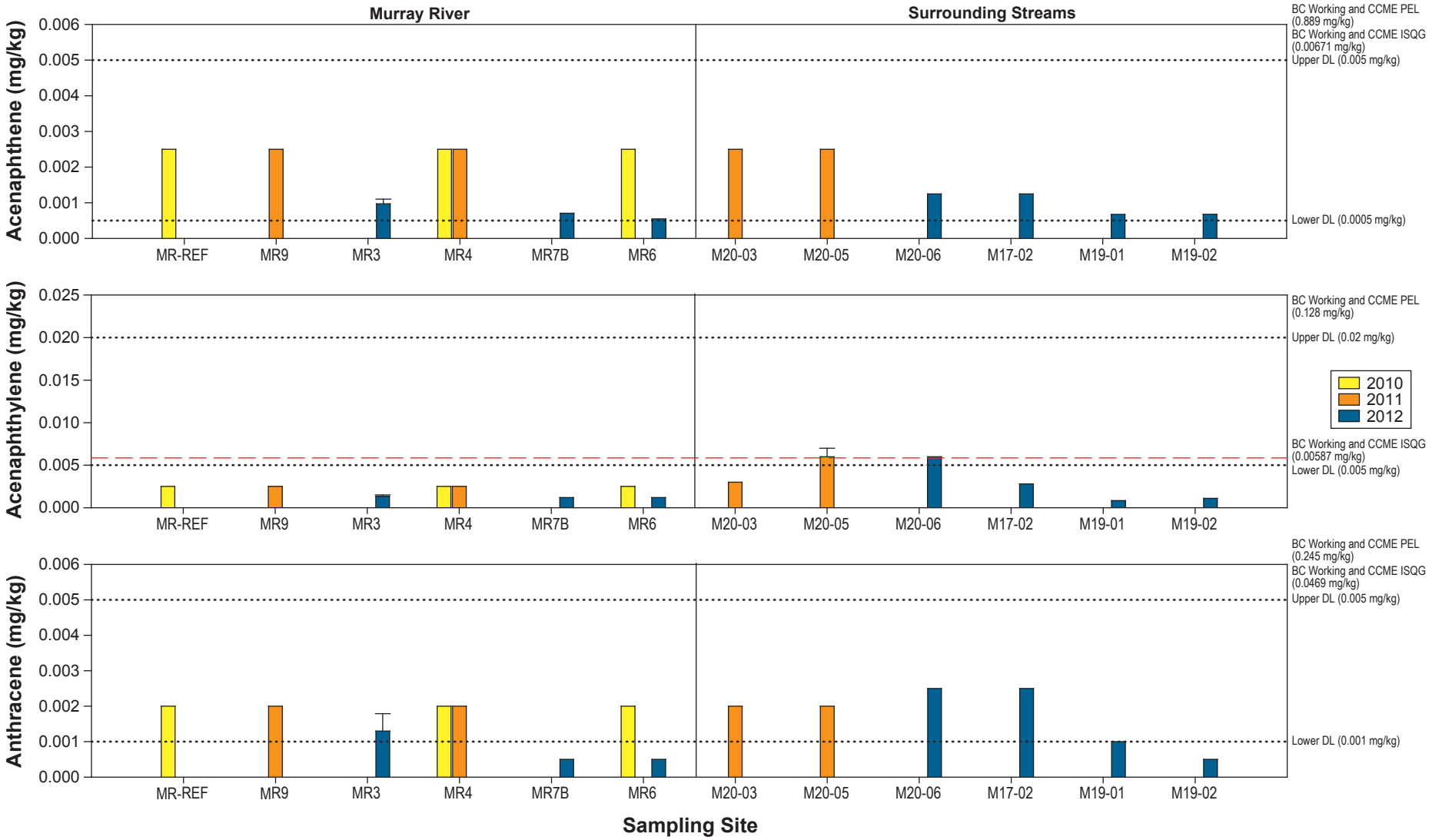
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Selenium, Silver, and Zinc Concentrations in Streams, 2010 to 2012

Figure 4.3-6

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.3-7

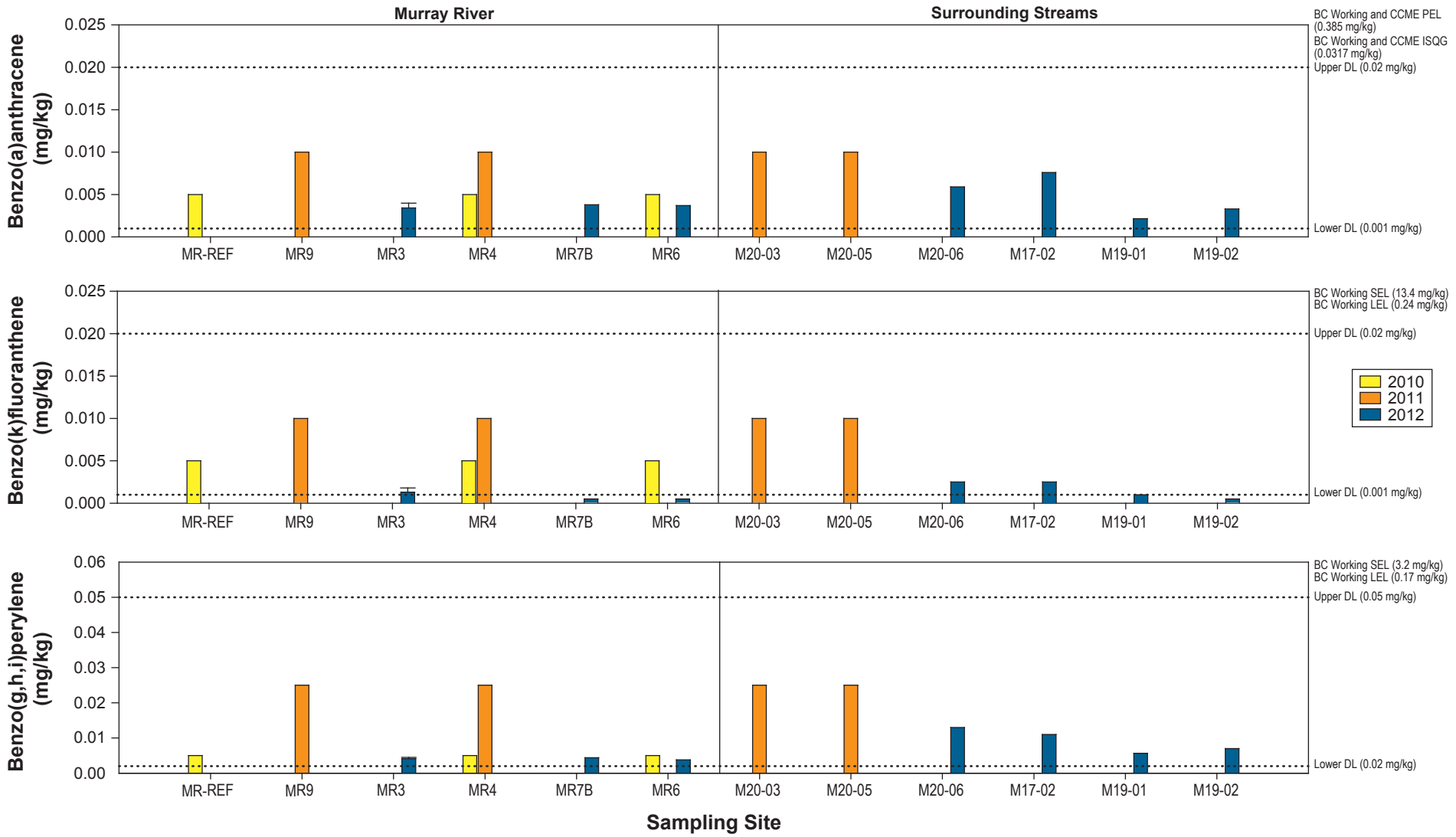
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (Acenapthene, Acenaphthylene, and Anthracene) Concentrations in Streams, 2010 to 2012

Figure 4.3-7

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines are greater than the scale and are not shown.
BC Working Guidelines for the lowest effect level (LEL) and severe effect level (SEL) based on a screeing level concentration are greater than the scales and are not shown.

Figure 4.3-8

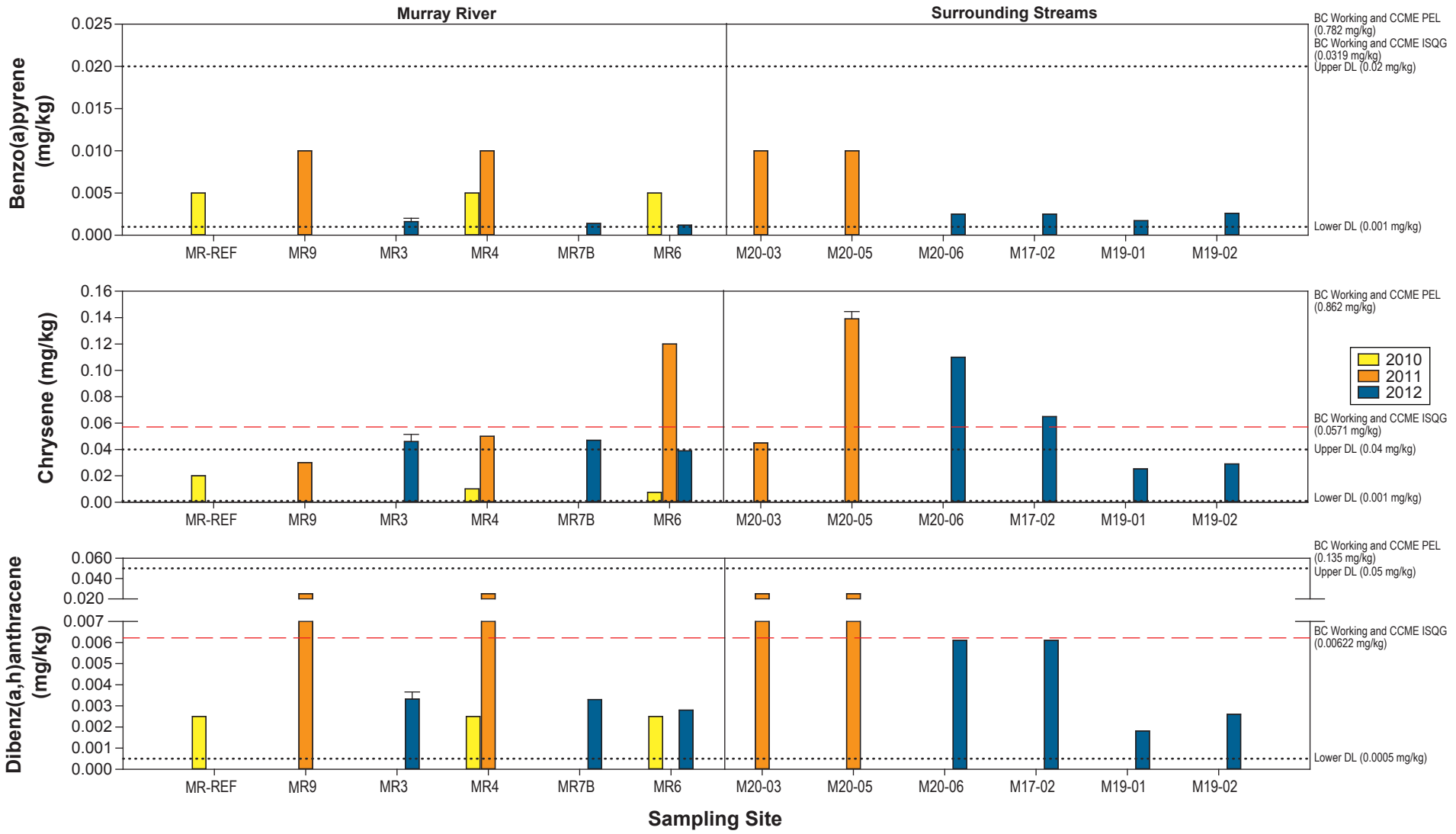
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (Benzo(a)anthracene, Benzo(k)fluoranthene, and Benzo(g,h,i)perylene) Concentrations in Streams, 2010 to 2012

Figure 4.3-8

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.3-9

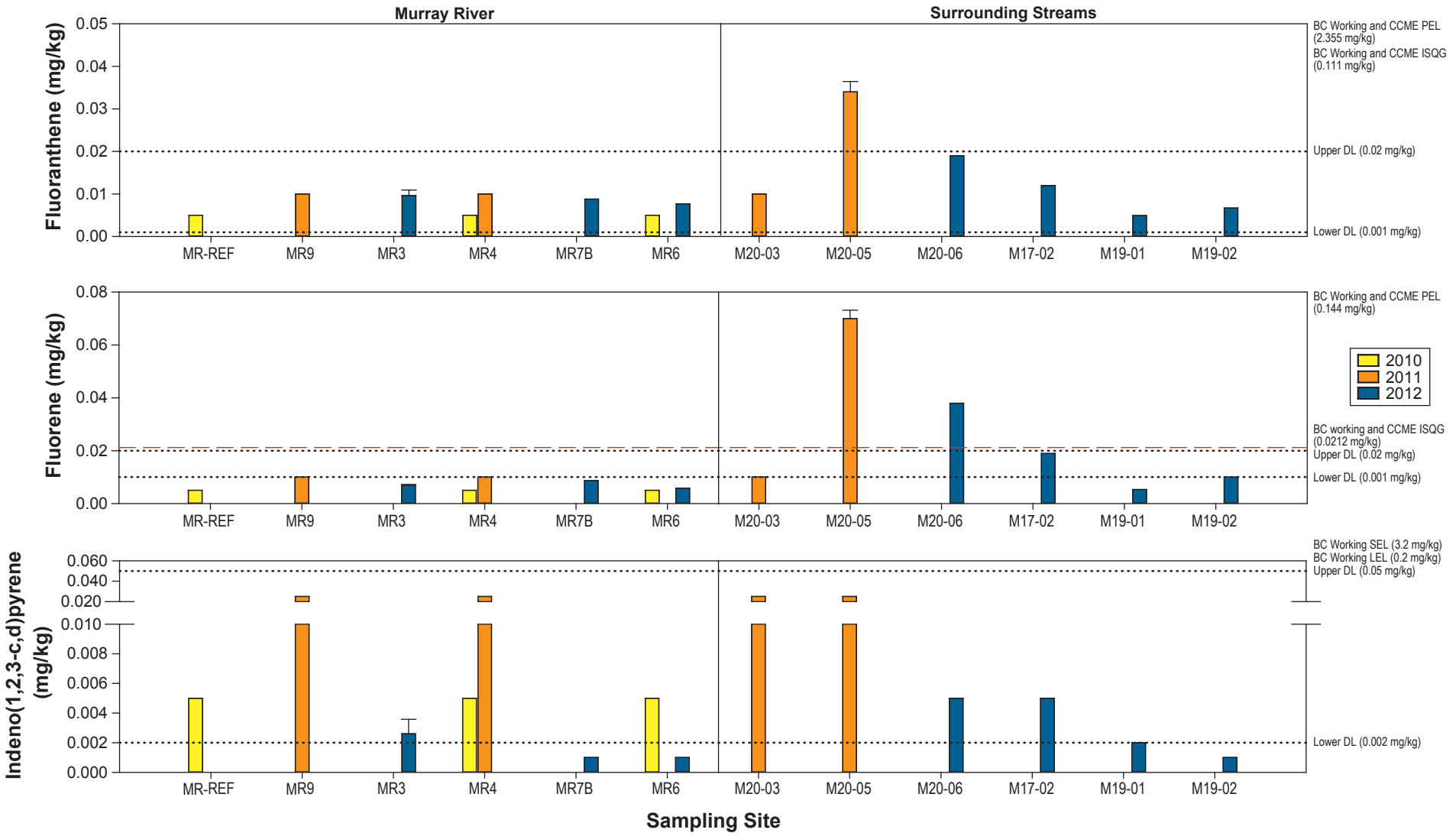
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (Benzo(a)pyrene, Chrysene, and Dibenz(a,h)anthracene) Concentrations in Streams, 2010 to 2012

Figure 4.3-9

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
BC Working Guidelines for the lowest effect level (LEL) and severe effect level (SEL) based on a screeing level concentration are greater than the scale and are not shown.

Figure 4.3-10

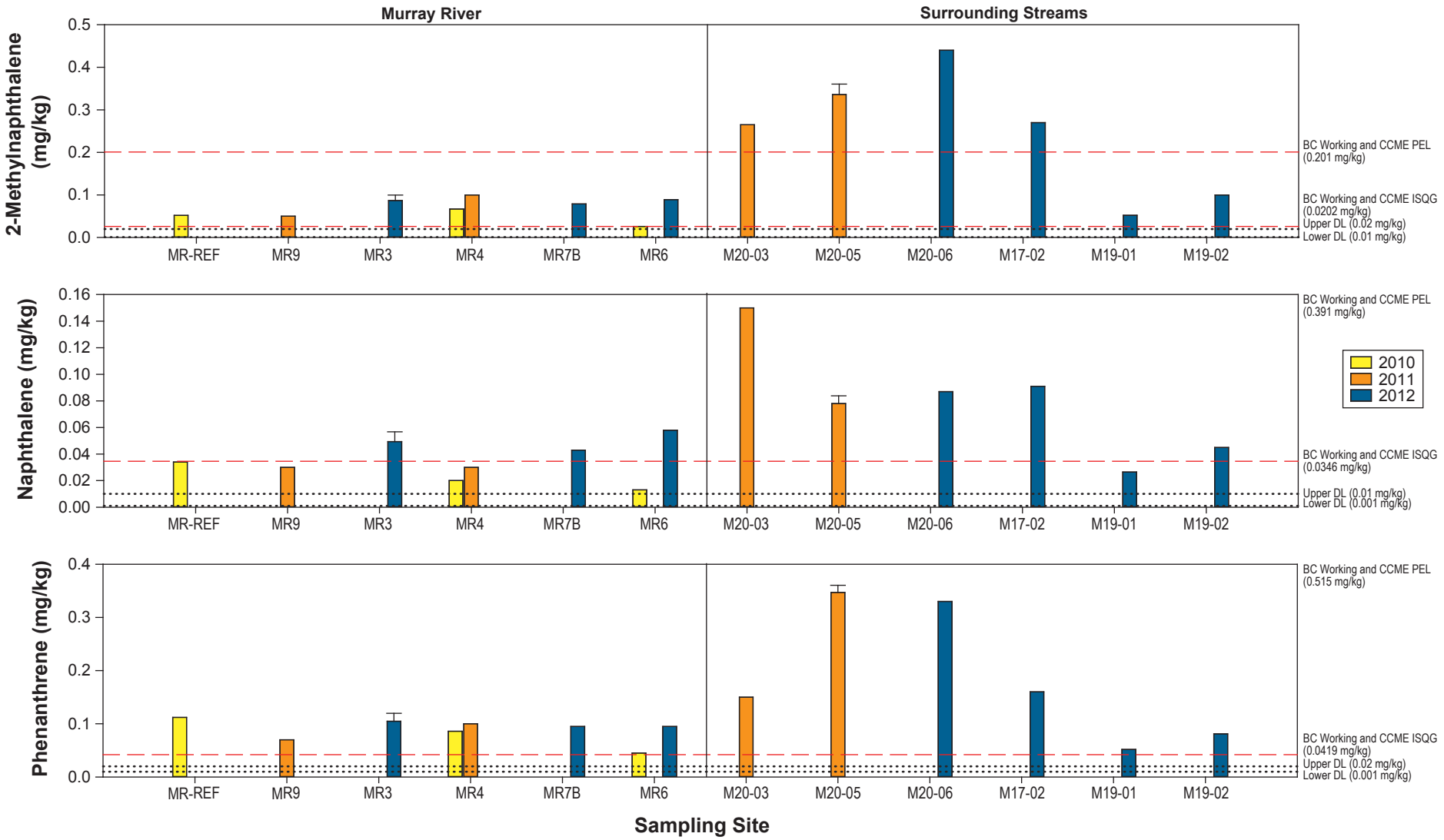
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (Fluoranthene, Fluorene, and Indeno(1,2,3-c,d)pyrene) Concentrations in Streams, 2010 to 2012

Figure 4.3-10

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.3-11

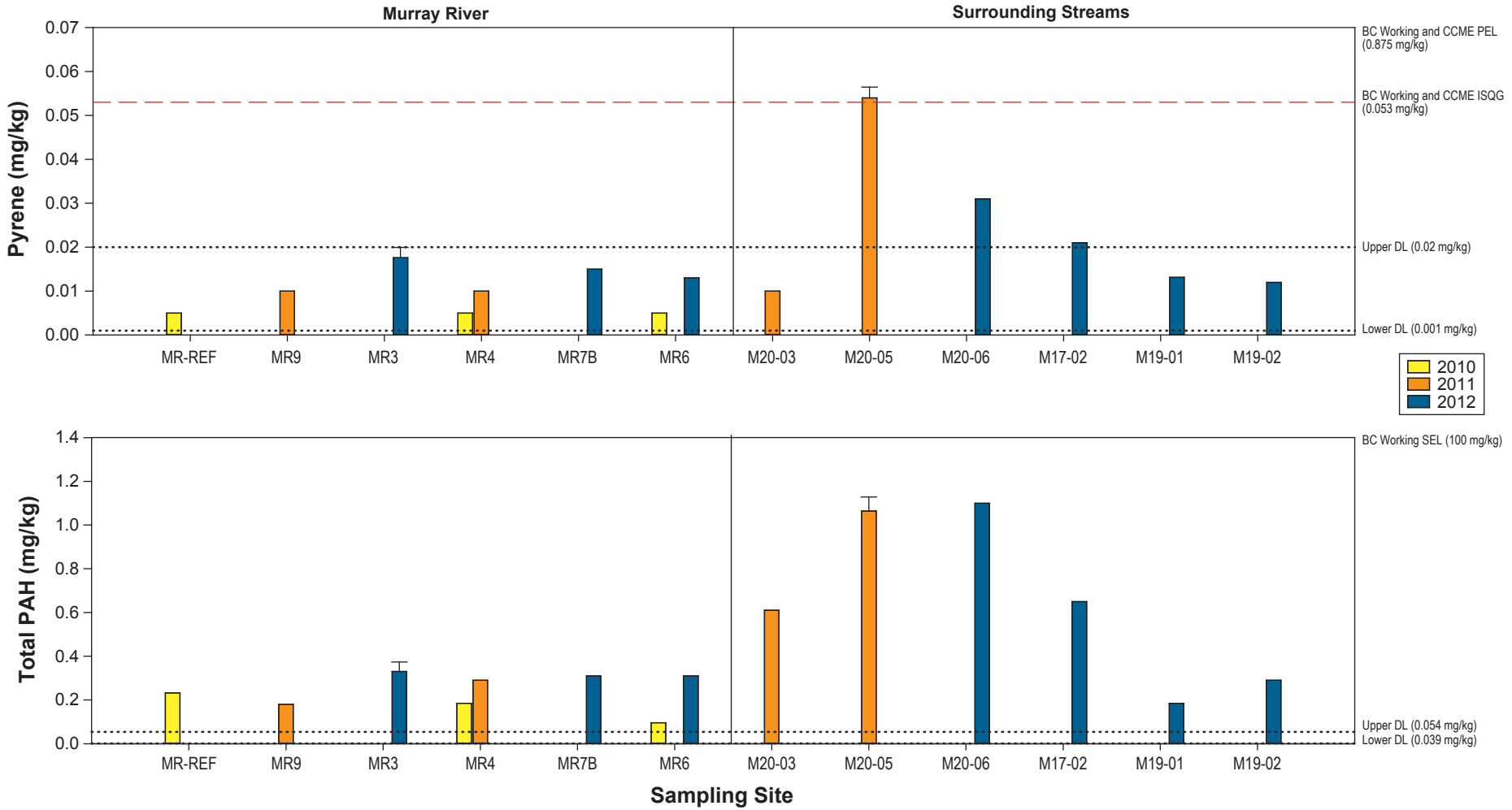
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (2-Methylnaphthalene, Naphthalene, and Phenanthrene) Concentrations, 2010 to 2012

Figure 4.3-11

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
BC Working Guidelines for the severe effect level (SEL) based on a screeing level concentration exceed the scale and are not shown.

Figure 4.3-12

hd Mining

MURRAY RIVER COAL PROJECT

Sediment Hydrocarbon (Pyrene and Total PAH) Concentrations in Streams, 2010 to 2012

Figure 4.3-12

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The greatest sediment arsenic, cadmium, selenium, and zinc concentrations were measured at the upstream reference site, Club Creek (REFST). Chromium, nickel, and mercury concentrations at Camp Creek site M20-04 were twice as high in 2010 compared to 2011 and 2012 suggesting inter-annual variation in sediment chemistry or sampling.

4.3.4 Polycyclic Aromatic Hydrocarbons

PAH concentrations were below detection limits in 2010 and 2011, except for benzo(b)fluoranthene, chrysene (2011 only), 2-methylnaphthalene, naphthalene and phenanthrene. Improved detection limits in 2012 allowed detectable concentrations of hydrocarbons in sediments.

In general, PAH parameters above detection limits were elevated in M20 and M17 compared to the Murray River. For example, naphthalene levels in the Murray River ranged from 0.013 to 0.074 mg/kg and concentrations in the tributaries M20 and M17 ranged from 0.070 to 0.17 mg/kg.

4.3.5 Sediment Quality Guidelines

CCME guidelines (CCME 2002) are defined for seven sediment quality parameters: arsenic, cadmium, chromium, copper, lead, mercury, and zinc. BC MOE has adopted the CCME sediment quality guidelines in addition to provincial guidelines for iron, manganese, nickel, selenium, and silver (Nagpal et al. 2006). Both CCME and BC MOE guidelines consist of threshold levels: the interim sediment quality guidelines (ISQG) and lower effects level (LEL), and the probable effects level (PEL) and severe effects level (SEL). Stream sediment quality data were compared to CCME and BC MOE guidelines for the protection of aquatic life. Parameters above CCME and BC MOE guidelines in at least one sample were presented in Table 4.3-1.

4.3.5.1 Metals

Sediment nickel concentrations were elevated in LSA streams and nearly all stream sediment samples were above the BC LEL nickel guideline, with samples from M20-05 above the LEL by a mean factor of 2.49 (Table 4.3-1). Similarly, all stream sites except M19-01 were higher than the CCME and BC ISQG cadmium guideline by a maximum factor of 4.3 (REFST). Arsenic, chromium, iron, and zinc concentrations were marginally above the CCME or BC ISQG or LEL sediment quality guidelines in at least one sample at one site. The reference sites MR-REF and REFST, and at the Camp Creek sites M20-05 and M20-04 were above the most metal guidelines, four. No sediment samples were elevated above CCME PEL or BC SEL guidelines.

4.3.5.2 Polycyclic Aromatic Hydrocarbons

Sediment concentrations of 2-methylnapththalene were higher than the CCME and BC ISQG in nearly all samples, except those collected at Camp Creek site M20-04 and Club Creek site REFST where no PAHs were above CCME or BC guidelines (Table 4.3-1). In addition, 2-methylnapththalene levels were above the CCME and BC PEL at the Camp Creek sites M20-05 and M20-06, and at MR17 Creek by a maximum factor of 2.2 (M20-06). Naphthalene and phenanthrene were higher than the CCME and BC ISQG in most samples by maximum factors of 2.6 (MR17-02) and 8.4 (MR20-05), respectively. Chrysene, fluorine, and pyrene occasionally were above the BC and CCME ISQG at a number of sites.

Detection limits were above guideline levels for acenaphthylene and dibenz(a,h)anthracene. Detection limits were also above guidelines for some MC20-03 and MC20-05 PAH samples. These “ambiguous” samples were excluded from the exceedance table calculations.

4.4 PERIPHYTON

Stream periphyton biomass samples were collected in summer 2010, 2011, and 2012. Periphyton data are presented in Appendices 4-3 to 4-4.

4.4.1 Biomass, Density, and Community Composition

Overall, stream periphyton biomass was low; less than 1 µg chl *a*/cm^2, except at MR4, MR7 and M20-03 (2.16, 4.95, and 3.69 µg chl *a*/cm^2, respectively) in 2011 (Figure 4.4-1). The correspondingly low densities at these sites could reflect communities with large-celled taxa. Periphyton densities in Murray River tributaries were typically higher than in the Murray River (Figure 4.4-1). Average densities were highest and at Camp Creek site M20-03 and M19 Creek site M19-02, (206,000 and 180,000 cells/cm^2, respectively), while other Murray River tributary sites averaged less than 90,000 cells/cm^2. In the Murray River, periphyton densities were always less than 50,000 cells/cm^2.

Overall, periphyton communities were typically dominated by Bacillariophyceae (diatoms, 3 to 97% of the community; Figure 4.4-2). Cyanophyta were important in 2010, and Chlorophyta (green algae) were important in the Murray River tributaries in 2012. In 2011, unidentified organisms and the protozoan *Euglena* (MR7 only) were prevalent in the Murray River. In 2012, cyanobacteria comprised half the periphyton community at MR6. Diatoms of the genus *Achnanthes* were common in all years (0 to 58% of communities), while the diatoms *Gomphonema* and *Diatoma* were common in 2011, and the diatom *Cocconeis* was common in 2012. The cyanobacteria *Homoethrix variens* and *Chamaesiphon* (Cyanophyta) were common in 2010. At M19-02 high densities of the green algae *Draparnaldiopsis* were observed in one replicate, making up over 80% of the replicate's periphyton community. *Draparnaldiopsis* is a filamentous algae that contained numerous small cells per specimen, resulting in a high cell density and low biomass.

4.4.2 Richness and Diversity

Streams sampled in multiple years tended to have inter-annual variability in both richness and diversity (Figure 4.4-3). Richness varied between years and tended to be greater in 2010 than in 2011 or 2012. Streams sampled in 2010 had richness averaging between 20 and 31 genera per sample, while streams sampled in 2011 and 2012 had an average of between 2 and 13 genera per sample. Simpson's diversity index was high, typically ranging from 0.65 to 0.80 with few exceptions.

4.4.3 Quality Assurance and Quality Control

The re-count of the 2011 periphyton taxonomy samples revealed considerable differences (percent similarity of 7.7% and 40%) between the two taxonomists, which mainly resulted from the low specimen abundance (only 3 to 13 individuals counted) and the amount of detritus (Appendix 4-5). The 2012 periphyton taxonomy samples percent similarities of 79% to 94% between taxonomists, and the differences were determined to have resulted from differences in subsamples analyzed (Appendix 4-5). The original data was used in both 2011 and 2012, as advised by the taxonomists.

4.5 BENTHIC INVERTEBRATES

Stream benthic invertebrates (benthos) were collected with a 250 µm Hess sampler in 2010 and with a 400 µm kick-net (CABIN) in 2011 and 2012 during August. Due to the differences in collection techniques, the discussion below considers 2010 data separately from the 2011 and 2012 data. Stream benthos taxonomic data are available in Appendices 5-1 and 5-2.

Table 4.3-1. Percentage of CCME and BC Guideline Exceedances and Average Factor of Exceedances in Stream Sediment Replicates, 2010 to 2012

Parameter		Arsenic		Cadmium		Chromium		Iron		Nickel		Zinc		Chrysene		Fluorene		2-Methylnapthalene				Napthalene		Phenanthrene		Pyrene	
Jurisdiction		CCME[a] = BC[b]		CCME = BC		CCME = BC		BC		BC		CCME = BC		CCME = BC		CCME = BC		CCME = BC		CCME = BC		CCME = BC		CCME = BC		CCME = BC	
		ISQG[c]		ISQG		ISQG		LEL[d]		LEL		ISQG		ISQG		ISQG		ISQG		PEL		ISQG		ISQG		ISQG	
Guideline		5.9 mg/kg		0.6 mg/kg		37.3 mg/kg		21,200 mg/kg		16 mg/kg		123 mg/kg		0.0571 mg/kg		0.0212 mg/kg		0.0202 mg/kg		0.201 mg/kg		0.0346 mg/kg		0.0419 mg/kg		0.053 mg/kg	
Site	# Samples	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor			%	Factor	%	Factor	%	Factor
MRREF	3	67%	1.04	100%	1.13	33%	1.66	0%	-	100%	2.30	0%	-	0%	-	0%	-	100%	2.57	0%	-	0%	-	100%	2.67	0%	-
MR9	2	0%	-	100%	1.38	0%	-	0%	-	100%	1.38	0%	-	0%	-	0%	-	100%	2.48	0%	-	0%	-	100%	1.67	0%	-
MR3	8	0%	-	75%	1.34	0%	-	0%	-	100%	1.35	0%	-	20%	1.07	0%	-	100%	4.31	0%	-	80%	1.55	100%	2.50	0%	-
MR4	6	0%	-	50%	1.35	0%	-	0%	-	100%	1.53	0%	-	0%	-	0%	-	100%	4.13	0%	-	0%	-	100%	2.22	0%	-
MR7B	1	0%	-	100%	1.28	0%	-	0%	-	100%	1.33	0%	-	0%	-	0%	-	100%	3.91	0%	-	100%	1.24	100%	2.27	0%	-
MR6	4	0%	-	50%	1.17	0%	-	0%	-	100%	1.53	0%	-	0%	-	0%	-	100%	2.85	0%	-	50%	1.68	100%	1.67	0%	-
M20-03	2	0%	-	100%	1.38	0%	-	0%	-	100%	1.38	0%	-	-	-	0%	-	0%	-	0%	-	-	-	-	-	0%	-
M20-05	6	100%	1.22	100%	1.99	0%	-	100%	1.12	100%	2.49	0%	-	100%	2.45	100%	3.30	80%	17.08	80%	1.72	100%	2.31	100%	8.35	50%	1.13
M20-06	1	0%	-	100%	1.47	0%	-	0%	-	100%	1.69	0%	-	100%	1.93	100%	1.79	100%	21.78	100%	2.19	100%	2.51	100%	7.88	0%	-
M20-04	5	20%	1.01	100%	1.15	60%	1.37	0%	-	100%	2.26	0%	-		-	-	-	-	-	-	-	-	-	-	-	-	-
MR17-02	1	0%	-	100%	1.12	0%	-	0%	-	100%	1.65	0%	-	100%	1.14	0%	-	100%	13.37	100%	1.34	100%	2.63	100%	3.82	0%	-
M19-01	4	0%	-	0%	-	0%	-	0%	-	50%	1.12	0%	-	0%	-	0%	-	100%	2.59	0%	-	0%	-	100%	1.24	0%	-
MR19-02	1	0%	-	100%	1.23	0%	-	0%	-	100%	1.54	0%	-	0%	-	0%	-	100%	4.95	0%	-	100%	1.30	100%	1.93	0%	-
REFST-D/S	3	100%	1.37	100%	4.28	0%	-	0%	-	100%	2.45	100%	1.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

[a] *Canadian sediment quality guideline for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, accessed March 2013.*

[b] *British Columbia working sediment guideline for the protection of freshwater aquatic life, accessed March 2013.*

[c] *CCME interim sediment guideline.*

[d] *BC lowest effect level based on the screening level concentration.*

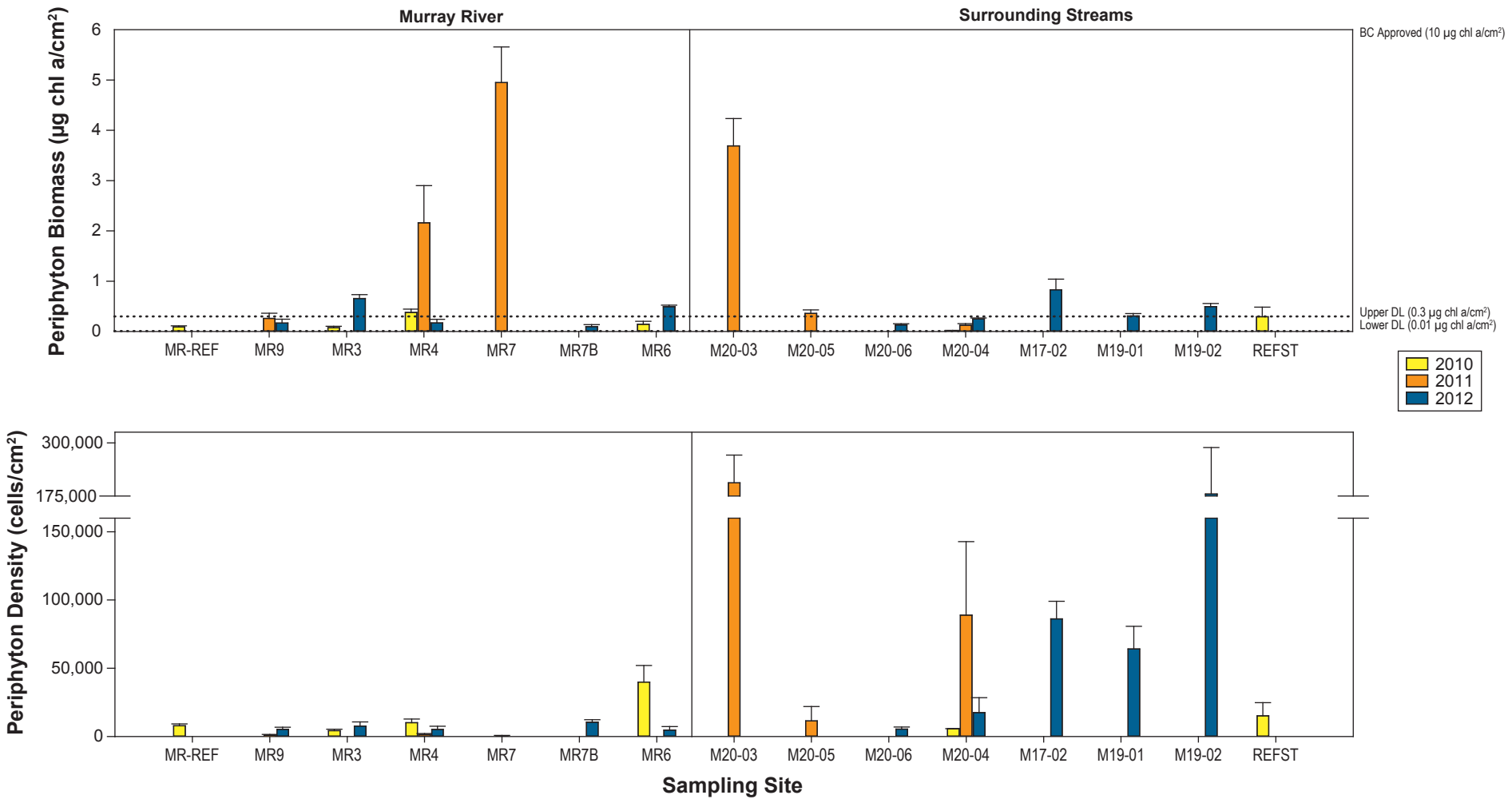
Only parameters that had replicates above guidelines are presented.

Frequency (%) represents percentage of replicates collected at each site that were higher than available guidelines.

Factor represents the average factor replicates above guidelines exceeded the guideline concentrations.

Some replicates were below detection limits that were higher than the guideline.

These "ambiguous" replicates were excluded from percent and factor calulations.



Notes: Values represent mean values of three or more replicate samples.
Error bars represent standard error of the mean.

Figure 4.4-1

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MURRAY RIVER COAL PROJECT

Periphyton Biomass and Density in Streams, 2010 to 2012

Figure 4.4-1

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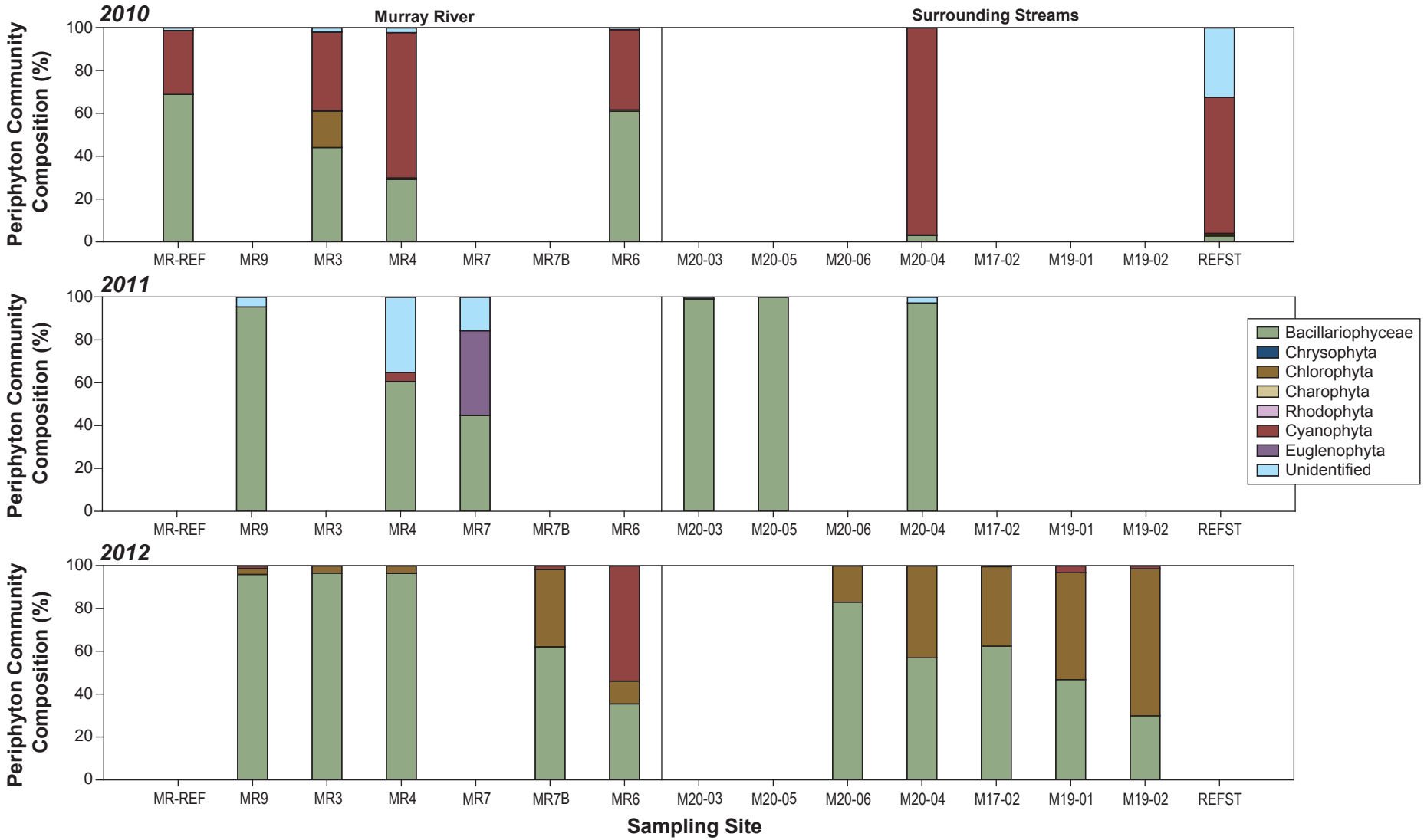


Note: Values represent mean values of three replicate samples.

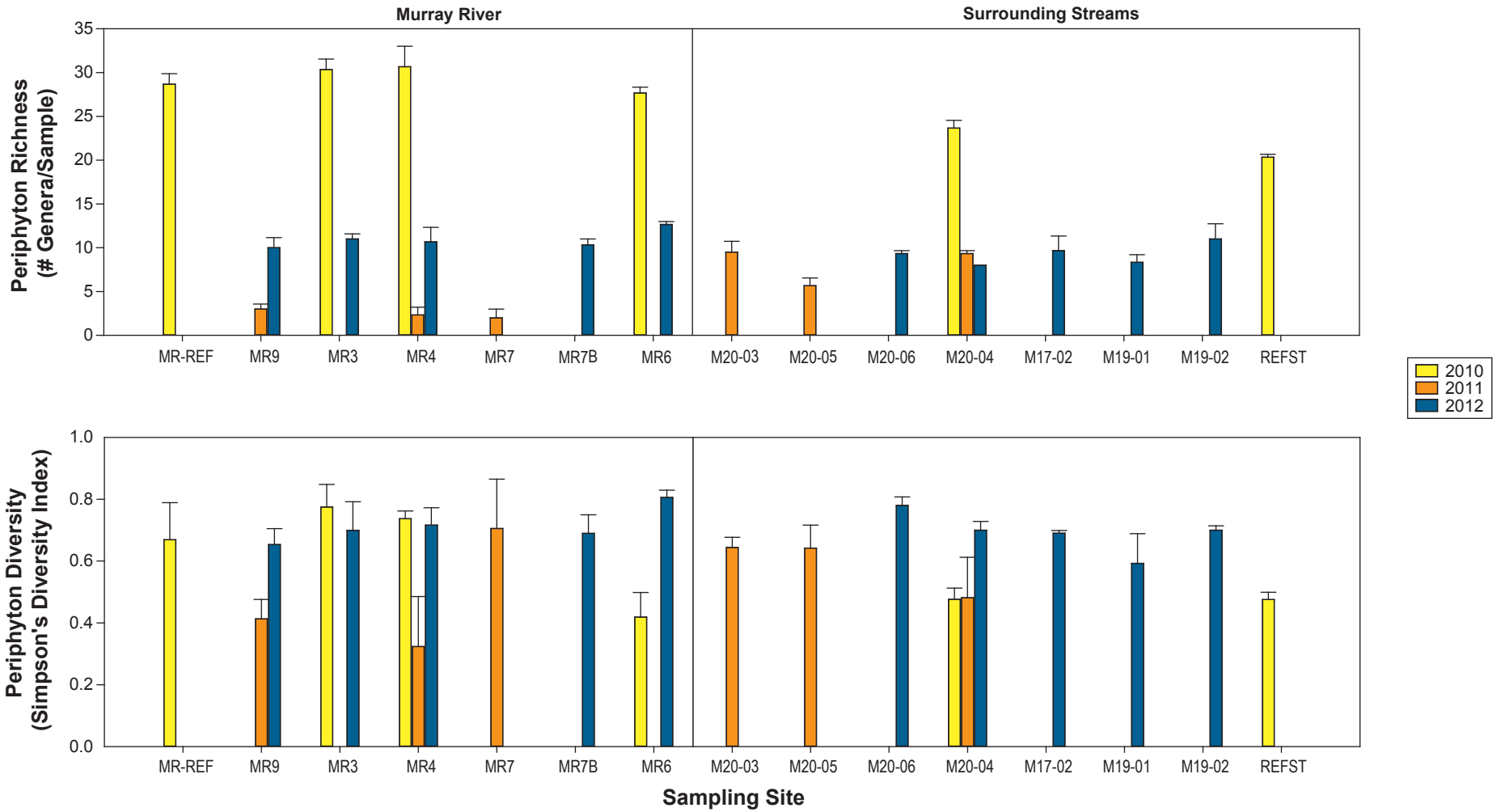
Figure 4.4-2

MURRAY RIVER COAL PROJECT

Periphyton Community Composition in Streams, 2010 to 2012

Figure 4.4-2

Rescan Engineers & Scientists



Notes: Values represent mean values of three replicate samples (except in 2011 at M20-03 where all replicates and in 2012 at M19-02 where one replicate had both dominant and sub-dominant communities sampled).
Error bars represent standard error of the mean.

Figure 4.4-3

hd Mining

MURRAY RIVER COAL PROJECT

Periphyton Richness and Diversity in Streams, 2010 to 2012

Figure 4.4-3

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4.5.1 Density and Community Composition

4.5.1.1 Hess Samples

Benthos densities in 2010 were highest at the reference tributary REFST, which had a mean density of 12,000 organisms/m^2 (Figure 4.5-1). Benthos densities within the Murray River were variable, ranging from 1,700 organisms/m^2 at MR-REF to 9,657 organisms/m^2 at MR4.

Project area stream benthic communities were dominated by Ephemeroptera (mayflies), Plecoptera (stoneflies) and Diptera (true flies; Figure 4.5-2). Ephemeroptera, Plecoptera and Diptera (EPT) are pollution-sensitive taxa that are good indicators of environmental conditions. Ephemeroptera and Plecoptera comprised 53% to 69% of benthic communities except at MR4, which was dominated by Diptera larvae (primarily Chironomidae) that made up 66% of the community.

4.5.1.2 Kick-net Samples

Benthic invertebrates densities in 2011 and 2012 were generally low in the Murray River and high in its tributaries (Figure 4.5-1). Murray River benthos densities were lower than 3.5 organisms/sec (except at MR6), while its tributaries had more than double those densities. M20-03 densities were particularly high, with a mean of 87.9 organisms/sec and densities in M20-04 were high in both 2011 (31.8 organisms/sec) and 2012 (19.8 organisms/sec).

Ephemeroptera, Plecoptera, and Trichoptera were common in kick-net samples and combined made up 15 to 93% of benthic communities (Figure 4.5-2). Diptera (primarily Chironomidae) were also prevalent in the Project area, and comprised 5 to 63% of communities. 2011 stream benthos communities were primarily comprised of mayflies (range: 29-68% of communities) and stoneflies (range: 18-54% of communities), except MR7 which had an abundance of water mites (Arachnida; 59% of the community). Mayflies and stoneflies were also common in 2012, however, Diptera were more prevalent compared to 2011. Diptera were particularly common at M17-02 and M19-02 where they comprised of 63% and 56% of the community, respectively.

4.5.2 Richness and Diversity

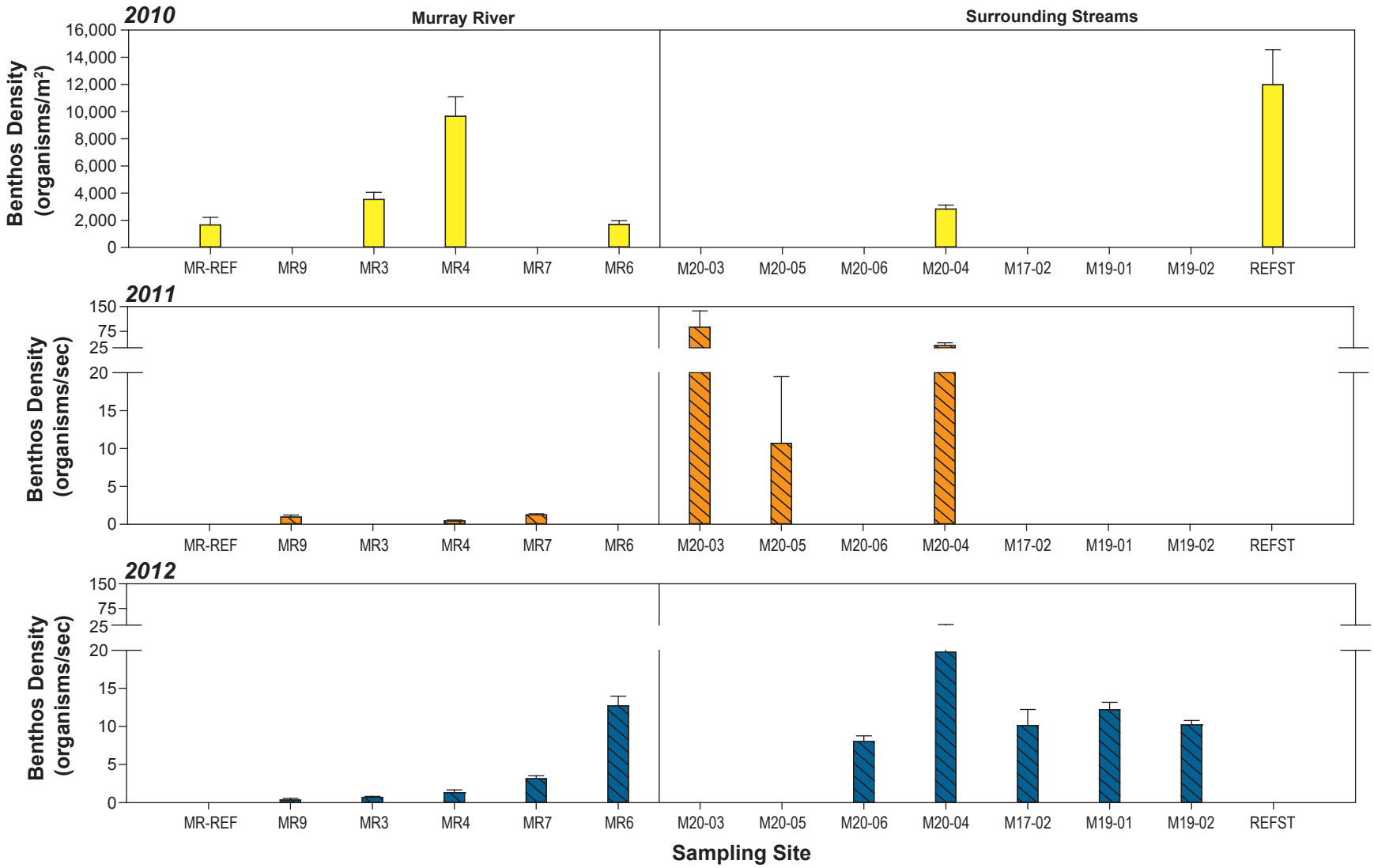
4.5.2.1 Hess Samples

Mean benthos (20 families/sample) and EPT (11 families/sample) richness in Hess samples was similar among LSA streams (Figure 4.5-3). Diversity was high and Simpson's diversity index ranged from 0.67 to 0.87, except at MR4 where it was lower (mean: 0.54; Figure 4.5-3).

Mean benthos richness ranged from 8 families/sample in MR9 (2012) to 27 families/sample in M17-02 (2012). EPTs were found in every stream, and EPT richness was highest in M19-01 in 2012, with a mean of 15 EPT families/sample. Benthos family diversity as indicated by Simpson's Diversity Index was generally high in the Project area, ranging from 0.54 at MR4 to 0.88 at M19-01.

4.5.2.2 Kick-net Samples

Despite benthos being collected with different methods and mesh sizes, benthos family richness in 2011 and 2012 kick-net samples were remarkably similar to those observed in 2010 Hess samples (Figure 4.5-3). Benthos richness was similar among Project area stream sites and means ranged from 13 to 27 families/sample, except at the Murray River sites MR7 in 2011 (mean: 13 families/sample) and MR9 (mean: 8 families/sample) in 2012. A similar pattern was observed for EPT richness (Figure 4.5-3). Simpson's Diversity index was high at all Project area stream sites (range: 0.62-0.91; Figure 4.5-3).



Notes: Values represent mean values of three or more replicate samples and error bars represent standard error of the mean.
Units are different for 2010 compared to 2011 and 2012 due to the different methods used (Hess (solid) vs CABIN (cross-hatched)).

Figure 4.5-1

hd Mining

MURRAY RIVER COAL PROJECT

Benthos Density in Streams, 2010 to 2012

Figure 4.5-1

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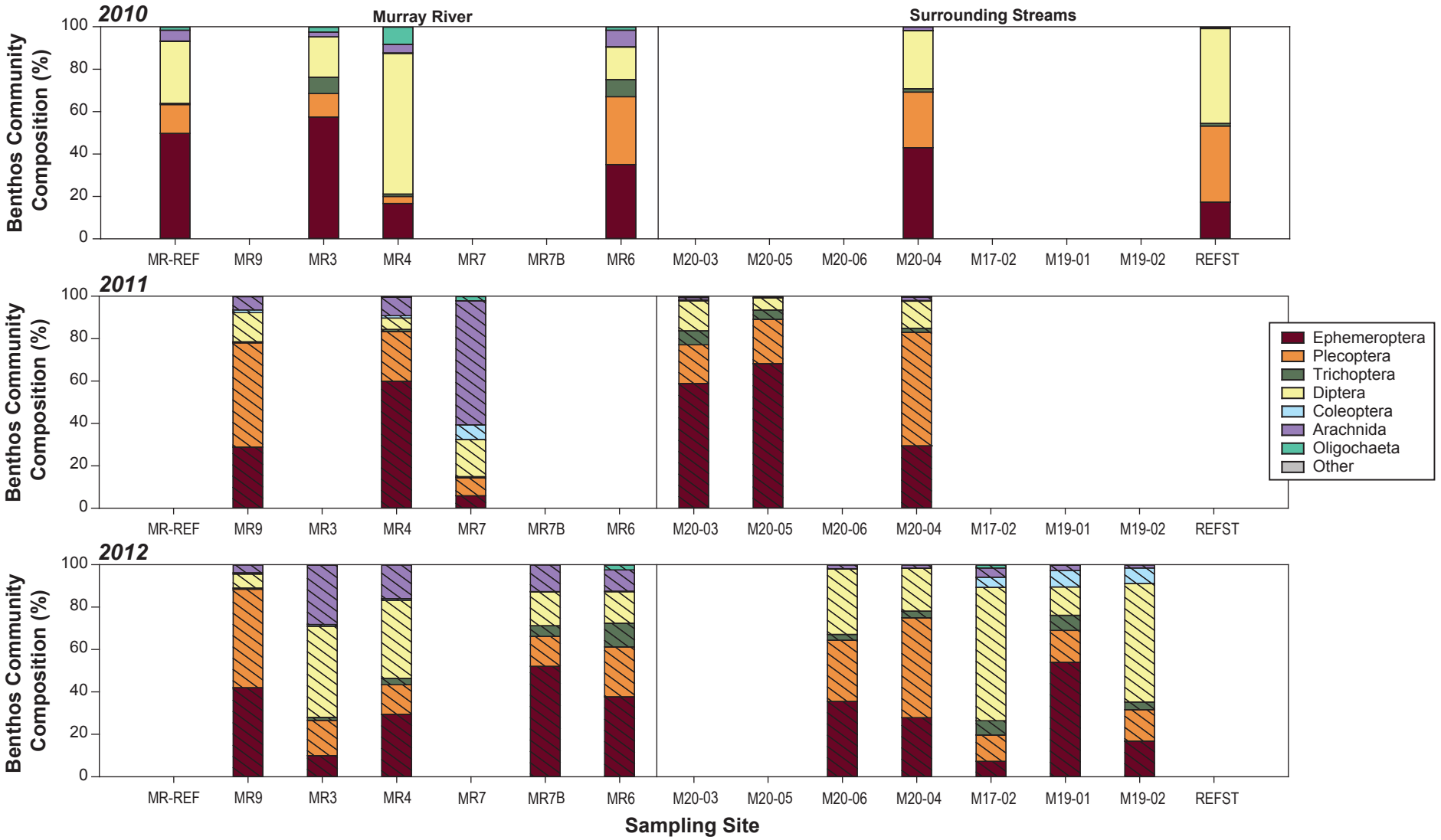

Notes: Values represent mean values of three replicate samples.
Different methods were used for 2010 sampling and 2011 and 2012 sampling (Hess (solid) vs CABIN (cross-hatched)).
The Other group represents Hydrozoa, Collembola, Megaloptera, Clitella, and Bivalvia.

Figure 4.5-2

hd Mining

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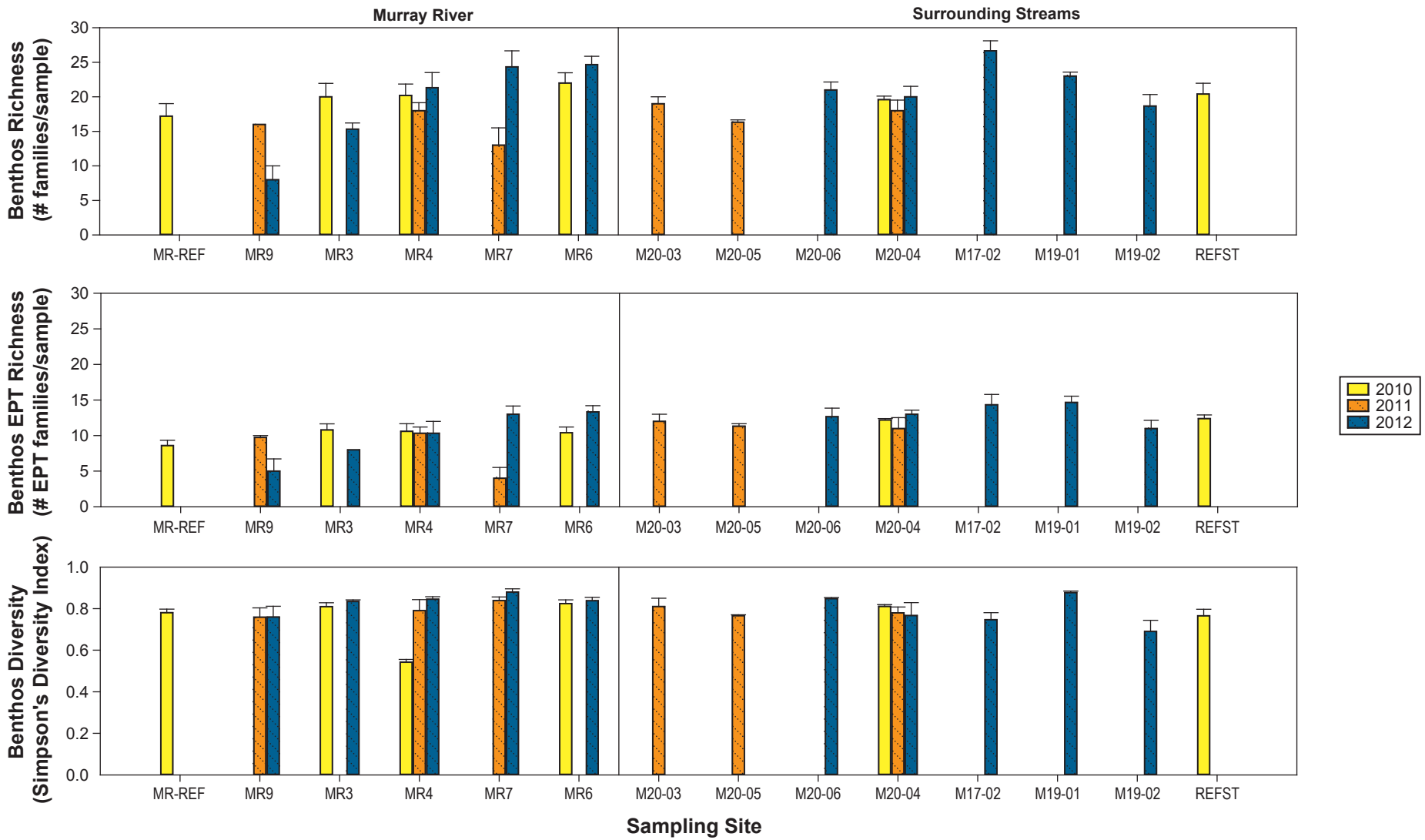
Benthos Community Composition in Streams, 2010 to 2012

Figure 4.5-2

Rescan Engineers & Scientists



Notes: Values represent mean values of three replicate samples and error bars represent standard error of the mean.
Different methods were used for 2010 sampling and 2011 and 2012 sampling (Hess (solid) vs CABIN (cross-hatched)).

Figure 4.5-3

hd Mining

MURRAY RIVER COAL PROJECT

Benthos Richness and Diversity in Streams, 2010 to 2012

Figure 4.5-3

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4.5.3 Quality Assurance and Quality Control

A re-count of 10% of the 2010 benthic invertebrate taxonomy samples by a second taxonomist indicated that the original identifications were reliable as the percent similarity between taxonomists was within Cordillera's QA/QC guidelines (>90% similarity; Appendix 5-3).

The re-count of 10% of the 2011 and 2012 benthic invertebrate taxonomy samples by a second taxonomist had a percent similarity above EcoAnalyst's QA/QC guidelines (>85% similarity), except for one sample that upon a third re-sort was above 85% similarity (Appendix 5-4).

4.6 TISSUE METALS

Stream periphyton tissue metal data are presented in Appendix 6-1 and benthic invertebrate tissue metal data are presented in Appendix 6-2. Relative percent difference results of replicates are available in Appendices 6-3 and 6-4. Many sites are only represented by one sample, so results should be interpreted with caution. Parameters identified as contaminants of potential concern (COPC) that bioaccumulate were graphed (arsenic, cadmium, mercury and selenium) and compared with sediment metal concentrations.

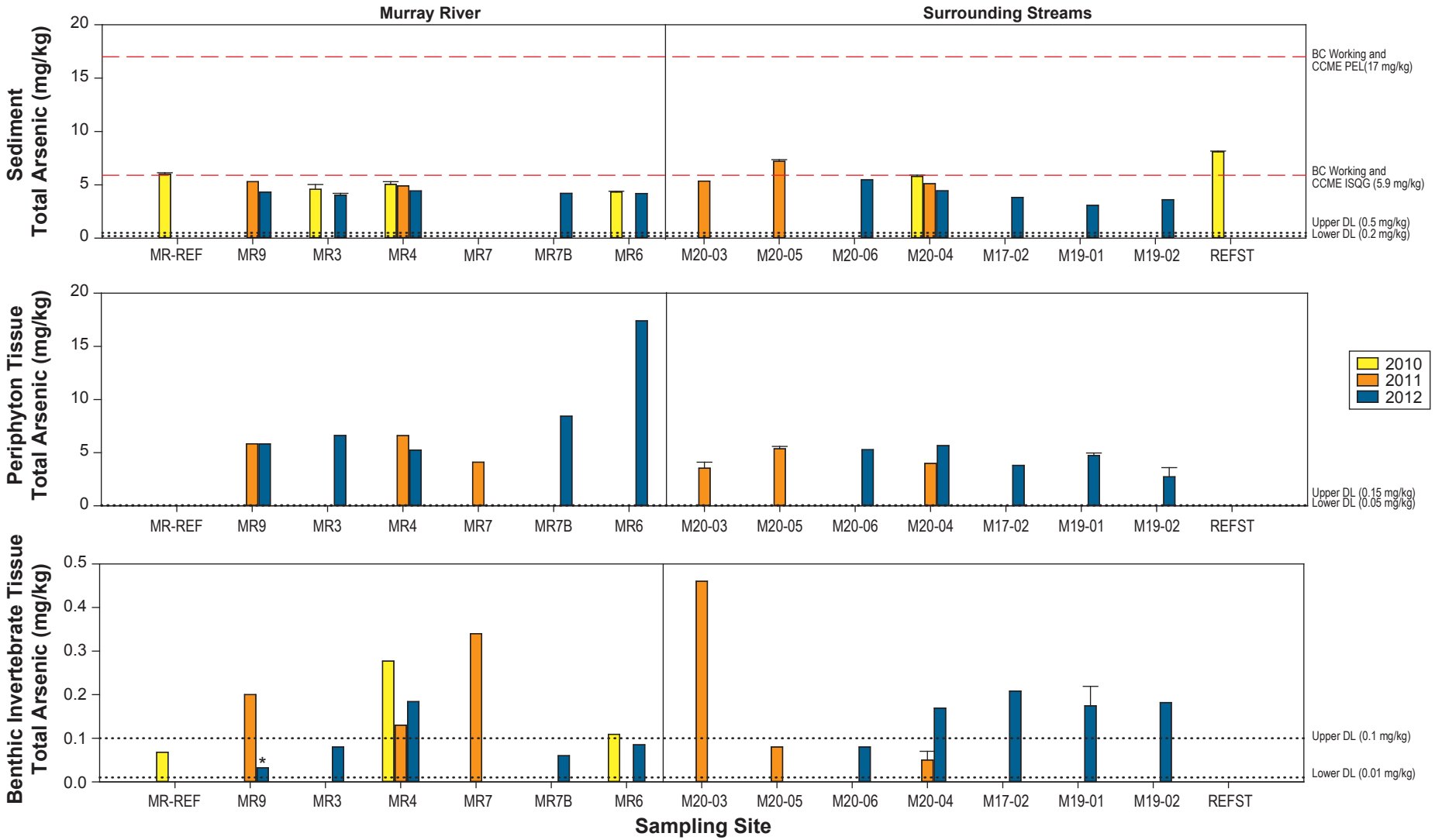
Periphyton tissues had elevated levels of mercury and selenium in tributaries of the Murray River. Arsenic and selenium concentrations were high in stream benthic invertebrate tissues from Murray River tributaries compared to Murray River sites.

Stream periphyton had tissue arsenic concentrations that were similar among sites and similar to sediment arsenic concentrations, except at MR6 where tissue concentrations were double those in other LSA streams (17.4 mg/kg), and 4-fold those measured in MR6 sediments (Figure 4.6-1). In benthic invertebrate tissues, arsenic concentrations were similar in the Murray River tributaries (range: 0.07 to 0.46 mg/kg) compared to sites in the Murray River (range: 0.03 to 0.34 mg/kg), with sites MR7 and M20-03 being particularly high in 2011. Compared to sediment arsenic concentrations, benthic invertebrate tissue concentrations were an order of magnitude lower.

Periphyton tissue cadmium levels were similar among LSA streams, except at MR7B the concentration was double those measured at other sites (Figure 4.6-2). Periphyton tissue cadmium concentrations were similar to sediment cadmium concentrations, except at MR7B where the periphyton tissue concentration was triple the sediment concentration. Benthic invertebrate tissues had cadmium concentrations that were also similar among sites and similar to sediment cadmium concentrations, except for higher concentrations measured at MR4 (2012 only) and M19-01.

Mercury concentrations in periphyton tissue were slightly elevated in M20 and M19-02 compared to the Murray River, which generally matched sediment mercury levels (Figure 4.6-3). Periphyton mercury levels ranged from 0.030 to 0.057 mg/kg in the Murray River, while M20 concentrations were between 0.054 and 0.070 mg/kg and M19-02 had a mean concentration of 0.073 mg/kg. Benthic invertebrate mercury concentrations were generally less than 0.01 mg/kg, except for MR9, MR4 and M19-01 which were almost double. In 2011, Total mercury concentrations were above realized detection limits at MR9, MR4, MR7 and M20-06 (indicated by a *) and therefore not considered in the interpretation.

Selenium concentrations in periphyton tissues were elevated in MR6, M20 and M17-02 and did not correspond to sediment concentrations (Figure 4.6-4). Periphyton selenium levels in MR6 were high (2.02 mg/kg) and other sites in the Murray River were less than 1.20 mg/kg. M20 and M17-02 periphyton tissue metal concentrations were also elevated, and ranged from 0.75 to 4.28 mg/kg. Selenium concentrations in benthic invertebrates collected from Murray River were all less than 0.7 mg/kg, while concentrations in surrounding tributaries ranged from 0.28 to 1.33 mg/kg.



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Periphyton tissue concentrations were from dry weight samples and benthic invertebrate concentrations were from wet weight samples.
The scale of the benthic invertebrate arsenic concentration graph differs from the sediment and periphyton tissue arsenic concentration graphs.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
** Indicates a sample where all replicates were below realized detection limits.*

Figure 4.6-1

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Arsenic Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012

Figure 4.6-1

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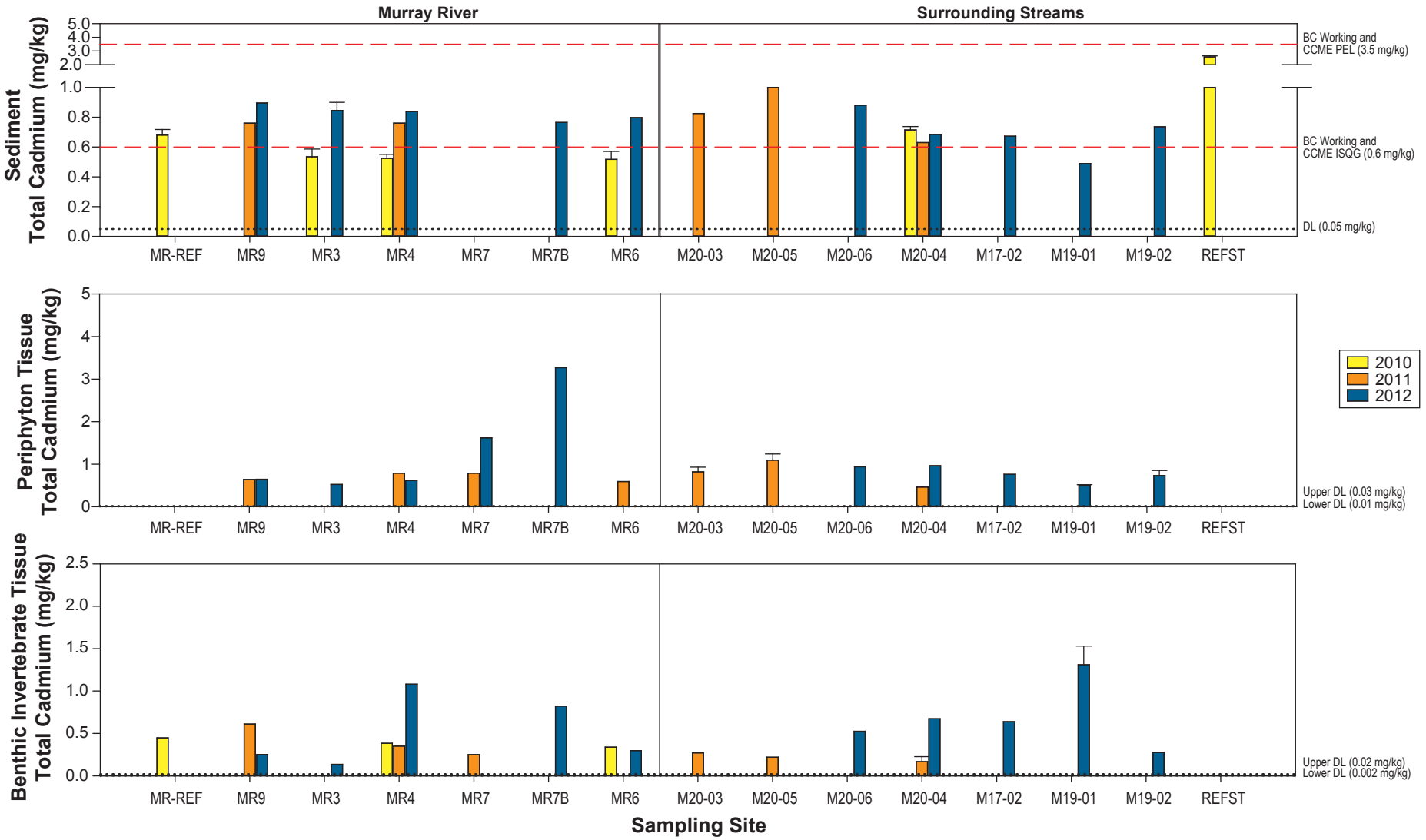

Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Periphyton tissue concentrations were from dry weight samples and benthic invertebrate concentrations were from wet weight samples.
The scale of the benthic invertebrate cadmium concentration graph differs from the sediment and periphyton tissue cadmium concentration graphs.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.6-2

hd Mining

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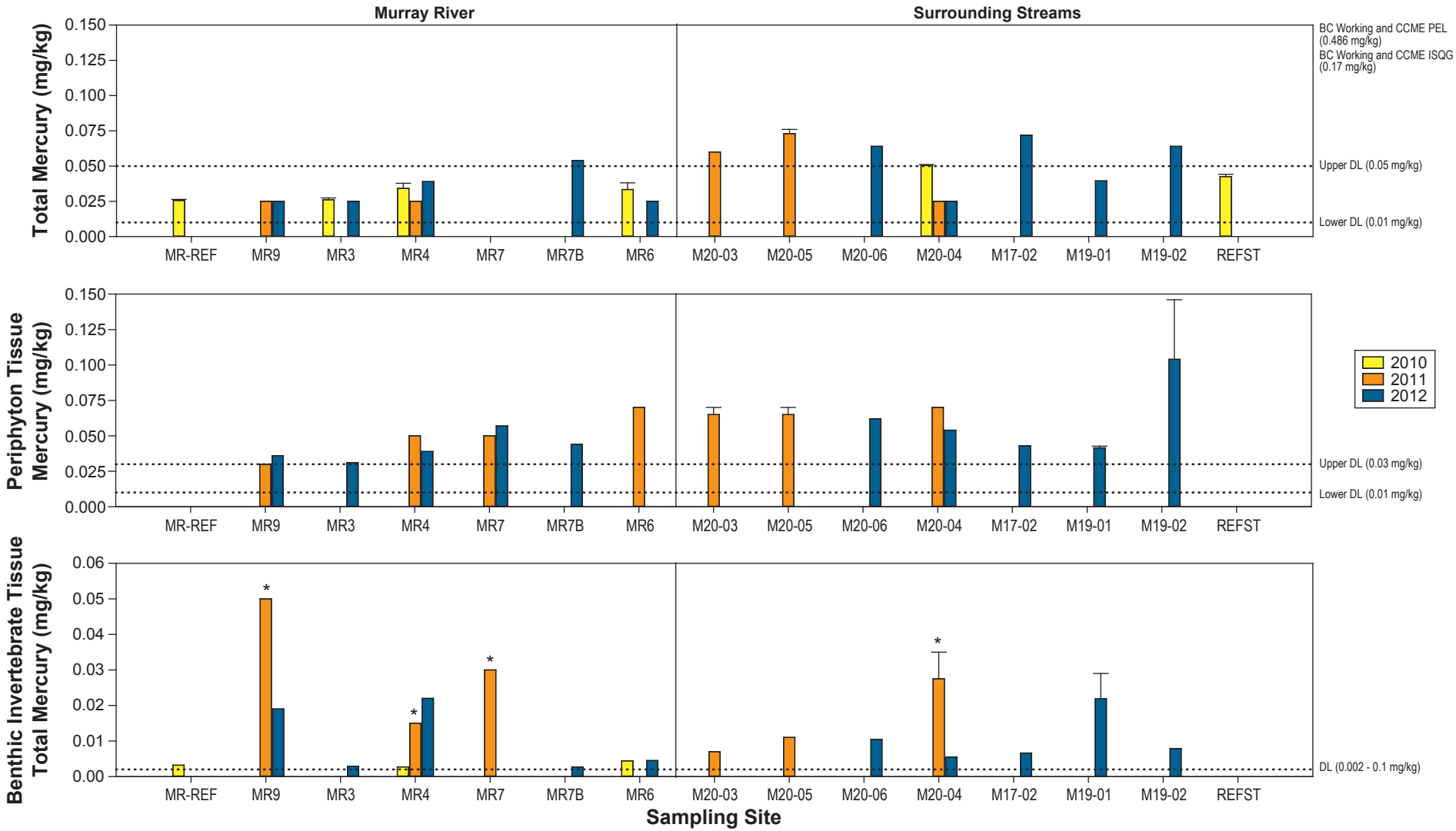
Cadmium Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012

Figure 4.6-2

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Periphyton tissue concentrations were from dry weight samples and benthic invertebrate concentrations were from wet weight samples.
The scale of the benthic invertebrate mercury concentration graph differs from the sediment and periphyton tissue mercury concentration graphs.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
** Indicates a sample where all replicates were below realized detection limits.*

Figure 4.6-3

hd Mining

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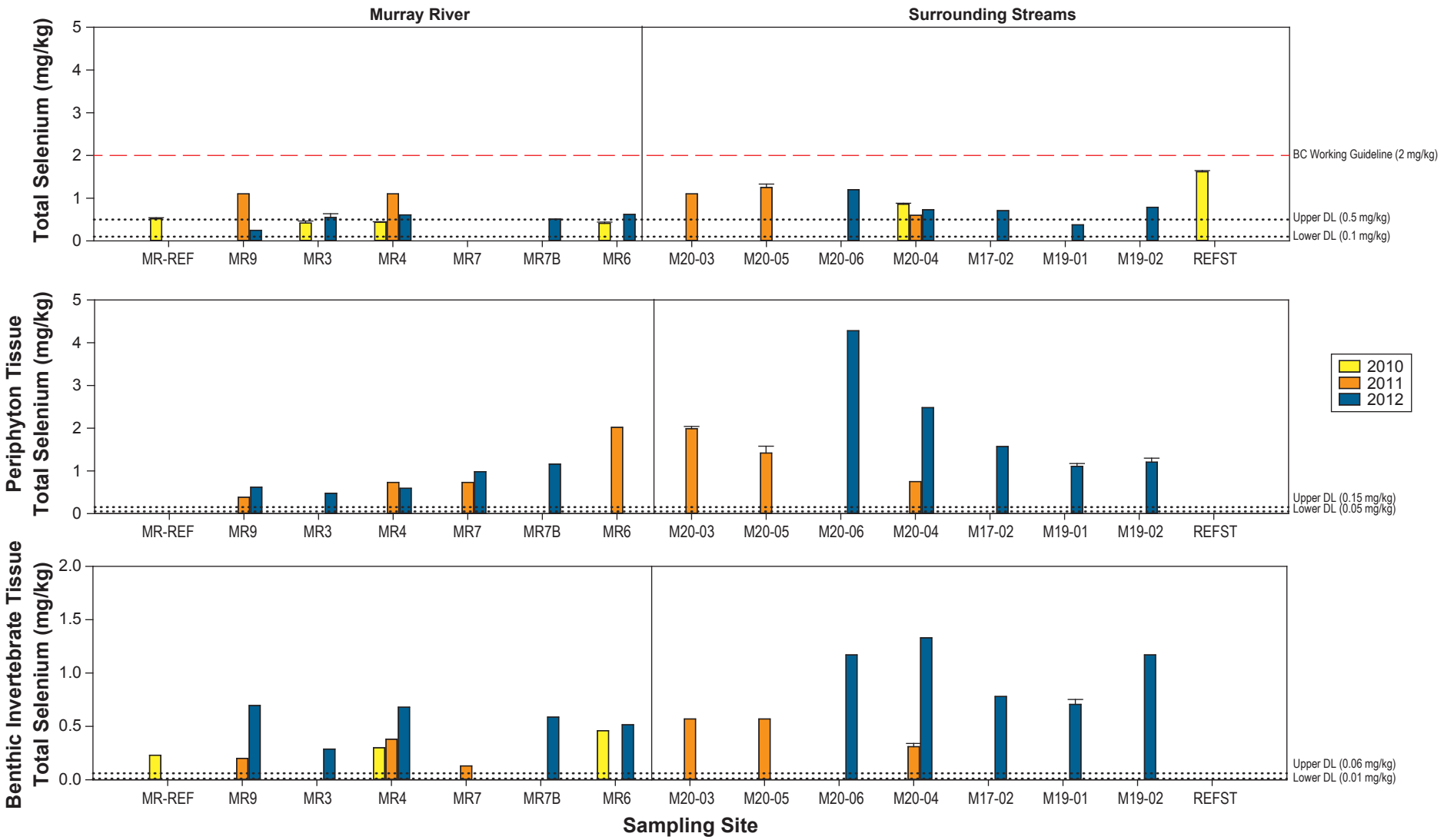
Mercury Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012

Figure 4.6-3

Rescan Engineers & Scientists



Notes: Values represent single samples or mean values of duplicate samples and error bars represent standard error of mean samples.
Periphyton tissue concentrations were from dry weight samples and benthic invertebrate concentrations were from wet weight samples.
The scale of the benthic invertebrate selenium concentration graph differs from the sediment and periphyton tissue selenium concentration graphs.
Black dotted lines represent realized detection limit (DL).
Red dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 4.6-4

hd Mining

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Selenium Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams, 2010 to 2012

Figure 4.6-4

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5. Wetland Sampling Results

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5. Wetland Sampling Results

5.1 WATER QUALITY

Water quality parameters of interest and those with CCME or BC MOE water quality guidelines for the protection of freshwater aquatic life (CCME 2007; BC MOE 2006) were graphed and presented in Figures 5.1-1 to 5.1-24. Wetland water quality data are presented in Appendix 7-1.

5.1.1 General Parameters and Anions

Wetlands in the Murray River Project area contained alkaline (pH range: 7.74 to 8.41), hard water (greater than 120 mg $CaCO_3$/L), with low sensitivity to acid inputs (total alkalinity range: 143 to 301 mg $CaCO_3$/L; Figures 5.1-1 and 5.1-2). Site LW11 contained very hard water that was 827 mg $CaCO_3$/L and had elevated TDS levels (1,360 mg/L) compared to other wetlands where TDS ranged from 225 to 278 mg/L (Figure 5.1-2).

Chloride concentrations were similar among sites, though concentrations doubled at W9.0 during autumn 2012 (Figure 5.1-3). Chloride concentrations at REF and RW3 were always below the detection limit. Site LW11 had elevated concentrations of sulphate (798 mg/L) and fluoride (0.292 mg/L) compared to concentrations at other sites which were below 10 mg/L and 0.10 mg/L, respectively (Figures 5.1-3 and 5.1-4).

5.1.2 Suspended Material

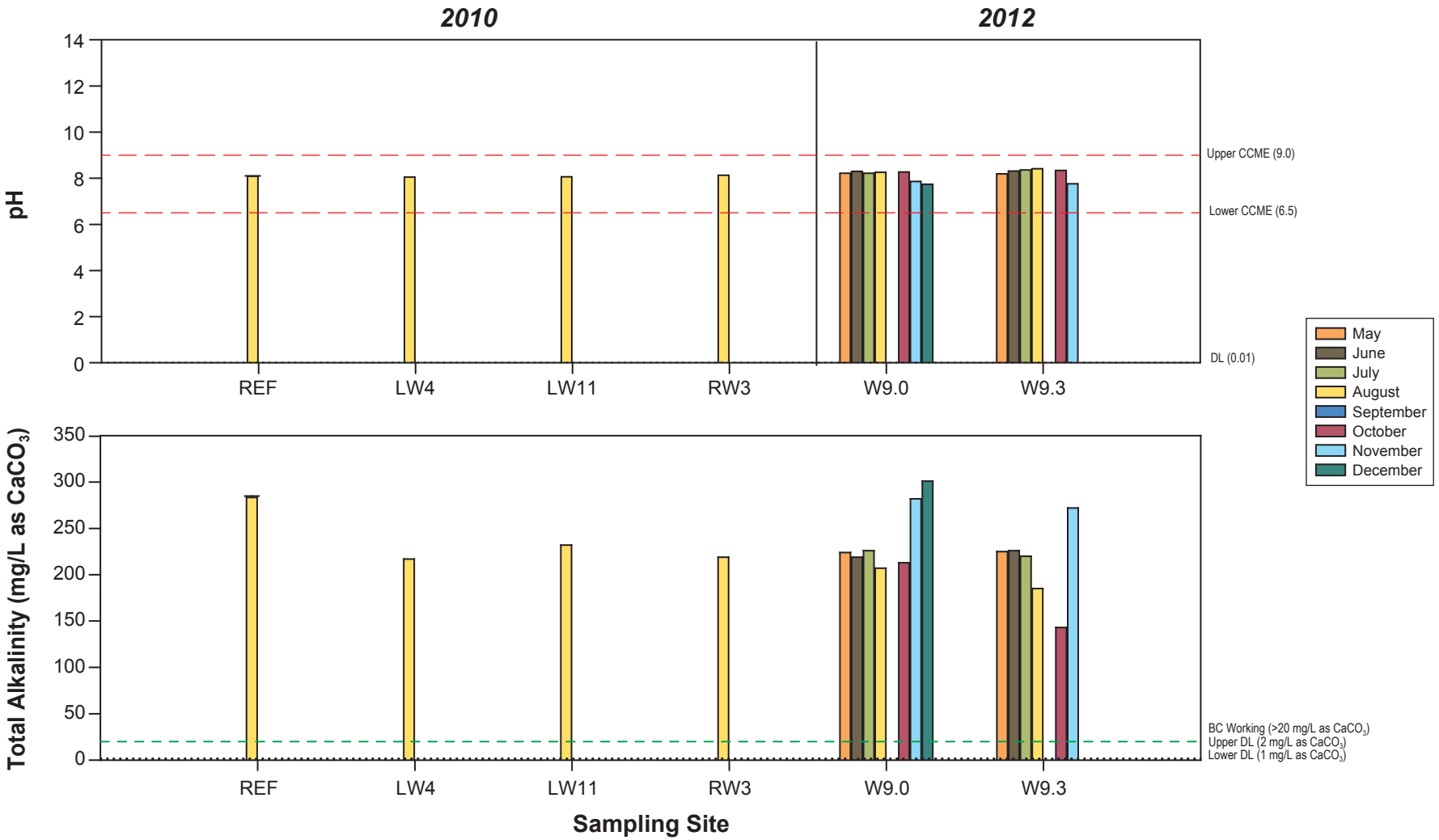
Overall, turbidity and TSS had a similar pattern, though TSS at LW4 was very high (95 mg/L) compared other wetlands which reached a maximum of 21 mg/L at W9.3 (Figures 5.1-4 and 5.1-5). Turbidity at W9.0 and W9.3 was low (< 1.5 NTU) and TSS concentrations were all below the detection limit (3 mg/L), except in the winter (November and December) when turbidity and TSS at W9.3 reached 13 NTU and 21 mg/L, respectively. Turbidity is typically greatest during freshet, or after storm events, making these data points anomalous. Turbidity is sensitive to sampling disturbance, and these samples could reflect that.

5.1.3 Nutrients and Total Organic Carbon

Nutrient concentrations were generally low in LSA wetlands, except at W9.0 and W9.3 in the winter. Total nitrogen concentrations were generally at or near the detection limit (0.05 to 0.5 mg N/L) in LSA wetlands, except at LW4 in August and W9.0 in November (Figure 5.1-5). Ammonia concentrations were also low, though higher concentrations were measured at RW3 and W9.0 and W9.3 in the winter (Figure 5.1-6). For example, ammonia concentrations in W9.3 were below or near the detection limit (0.005 mg N/L) for most of 2012, until concentrations increased to 0.79 mg N/L in November.

All nitrite concentrations were below the detection limit (0.001 mg N/L), except W9.0 in December (Figure 5.1-6). Similarly, nitrate concentrations were always below the detection limit (0.005 mg N/L), except at W9.0 in December and W9.3 in May and June (Figure 5.1-7).

Total phosphorus concentrations at W9.0 and W9.3 were generally low (<0.01 mg/L) in May and June and were ultra-oligotrophic or oligotrophic based on CCME trigger ranges (Figure 5.1-7). Total phosphorus levels increased in the summer and the wetlands were hyper-eutrophic by the winter, with a concentration of 0.11 mg/L at W9.0 (December) and 0.16 mg/L at W9.3 (November). Orthophosphate concentrations were below or near the detection limit (0.001 mg/L), except at W9.0 in December when the concentration was 0.008 mg/L (Figure 5.1-8).



Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For pH, red dashed lines represent the CCME guidelines (upper and lower).
For total alkalinity, green dashed lines represent the BC Working guideline, where water with alkalinities >20 mg/L of $CaCO_3$ have a low sensitivity to acid inputs.

Figure 5.1-1

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pH and Total Akalinity Levels in Wetlands, 2010 to 2012

Figure 5.1-1

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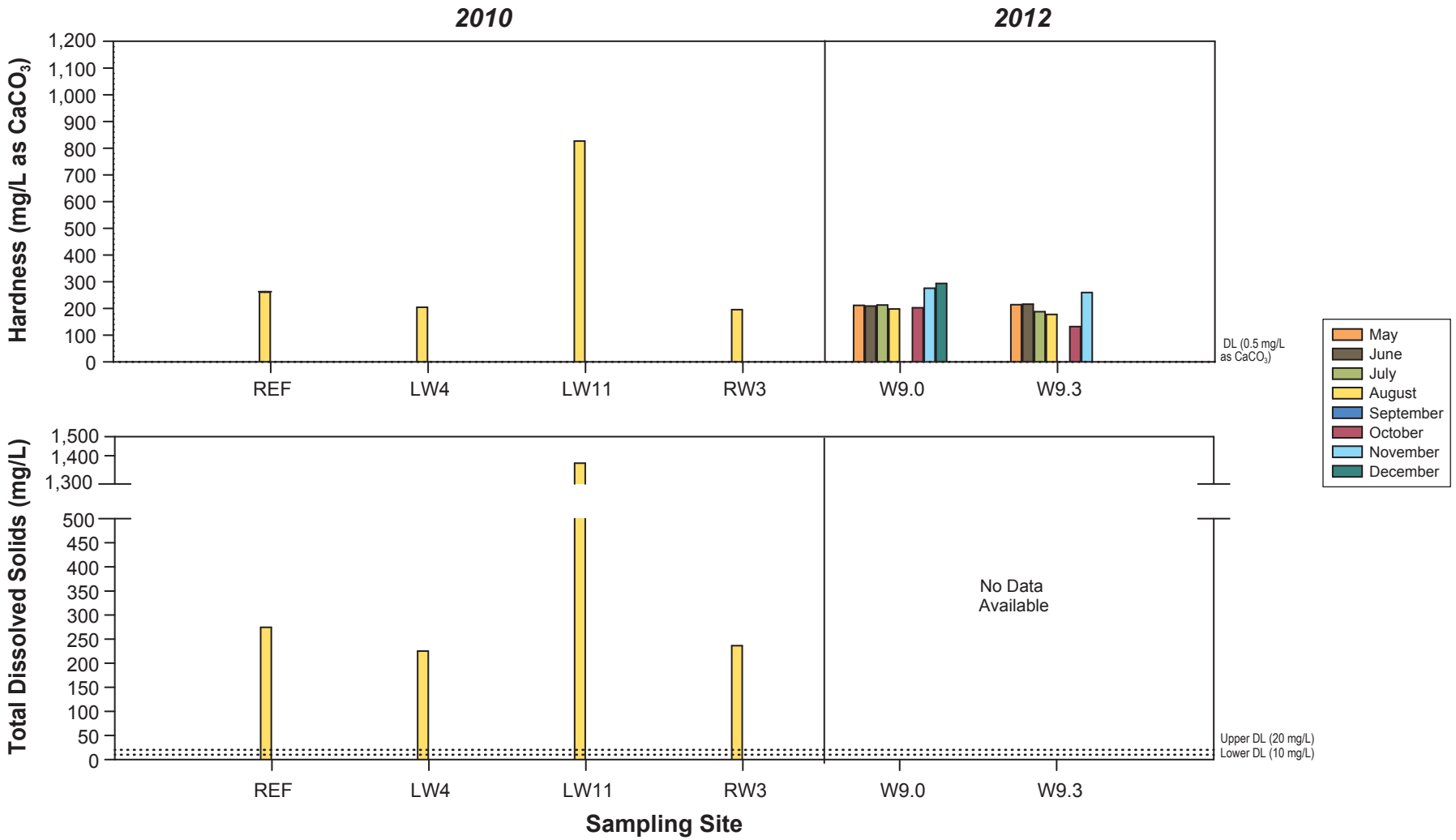

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).

Figure 5.1-2

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Total Hardness Levels and Total Dissolved Solids in Wetlands, 2010 to 2012

Figure 5.1-2

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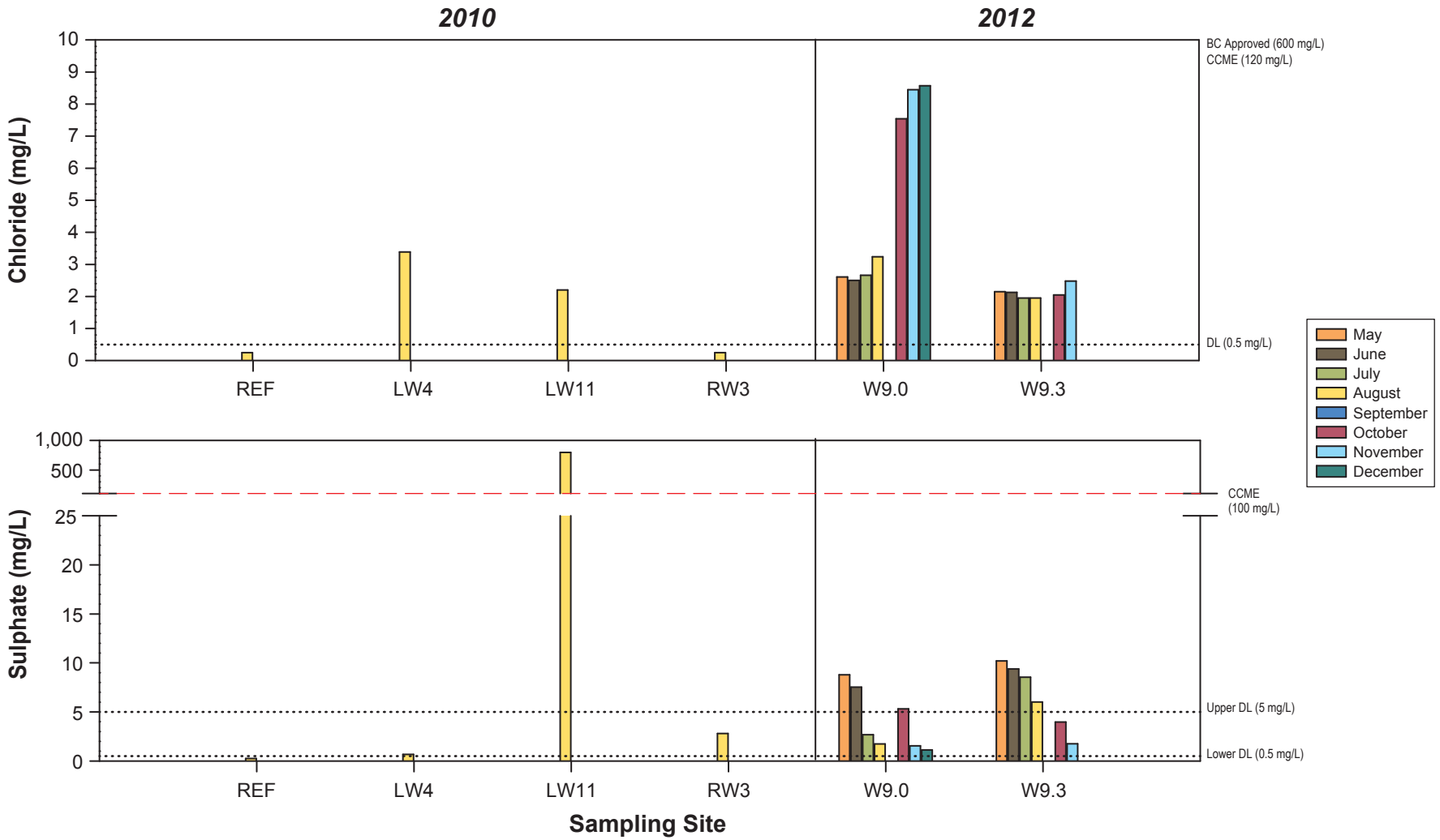

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For chloride, BC Approved guideline (600 mg/L) and CCME guideline (120 mg/L) are greater than graph scales.
For sulphate, red dashed lines represent CCME guideline (100 mg/L).

Figure 5.1-3

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Chloride and Sulphate Concentrations in Wetlands, 2010 to 2012

Figure 5.1-3

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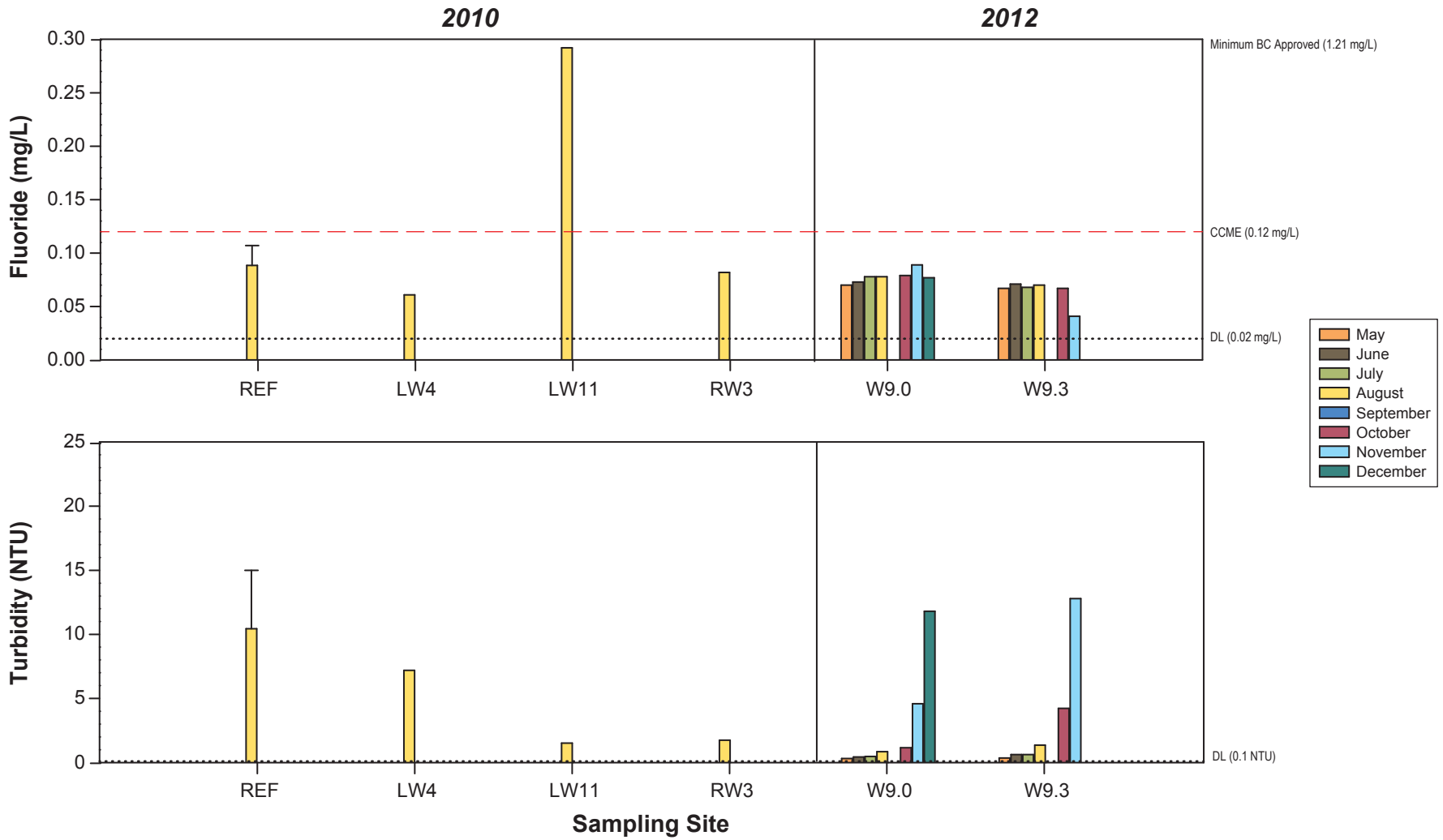

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
*For fluoride, red dashed lines represent the CCME guideline (0.12 mg/L; minimum BC Approved guideline (hardness dependent; fluoride equation (mg/L) = -51.73 + 92.57*log10(hardness)*0.001) is greater than graph scales.*

Figure 5.1-4

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Fluoride and Turbidity Concentrations in Wetlands, 2010 to 2012

Figure 5.1-4

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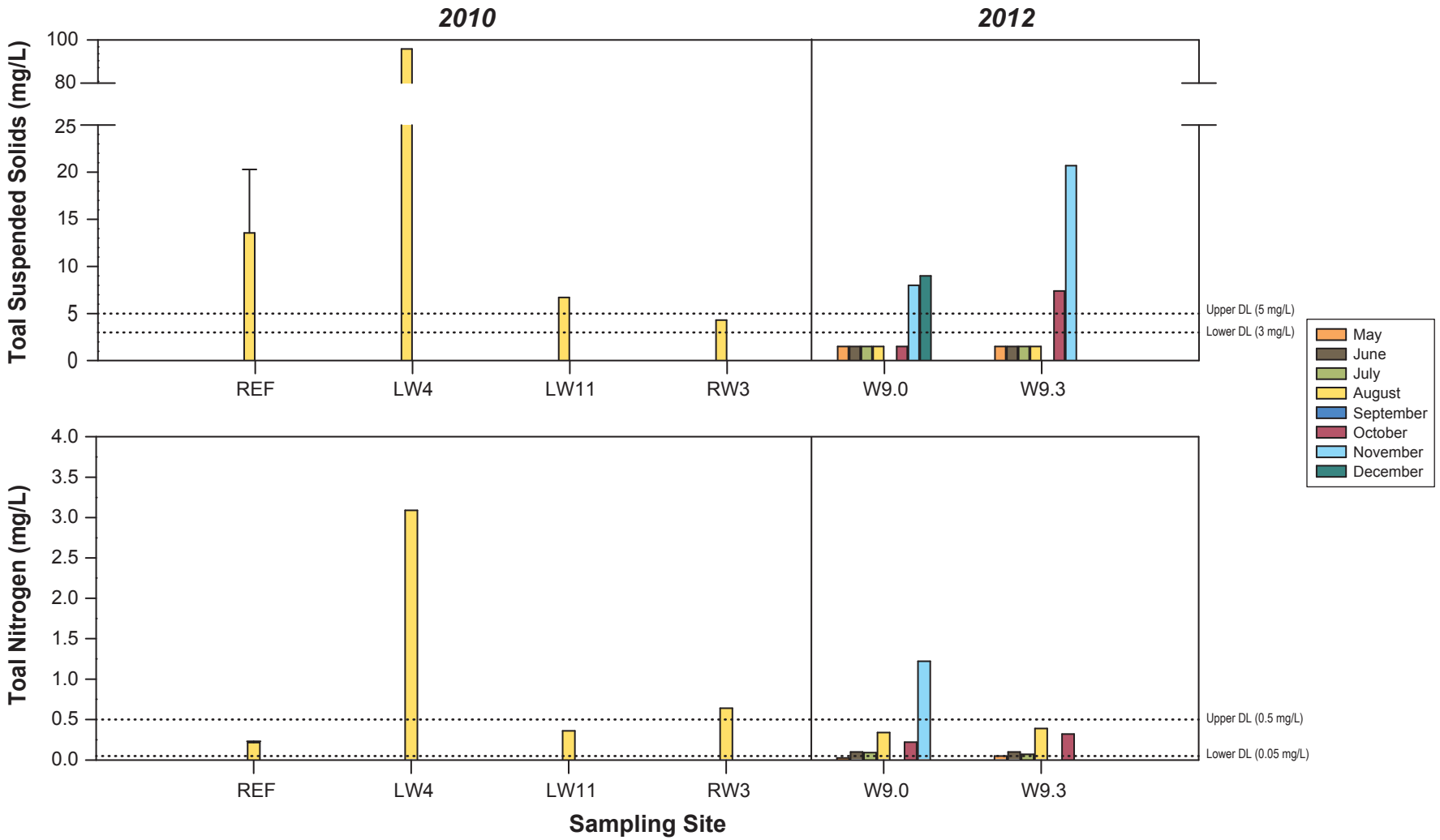

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For total nitrogen, BC Approved guideline (32.8 mg/L) and CCME guideline (13 mg/L) is greater than graph scales.

Figure 5.1-5

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Total Suspended Solids and Total Nitrogen Concentrations in Wetlands, 2010 to 2012

Figure 5.1-5

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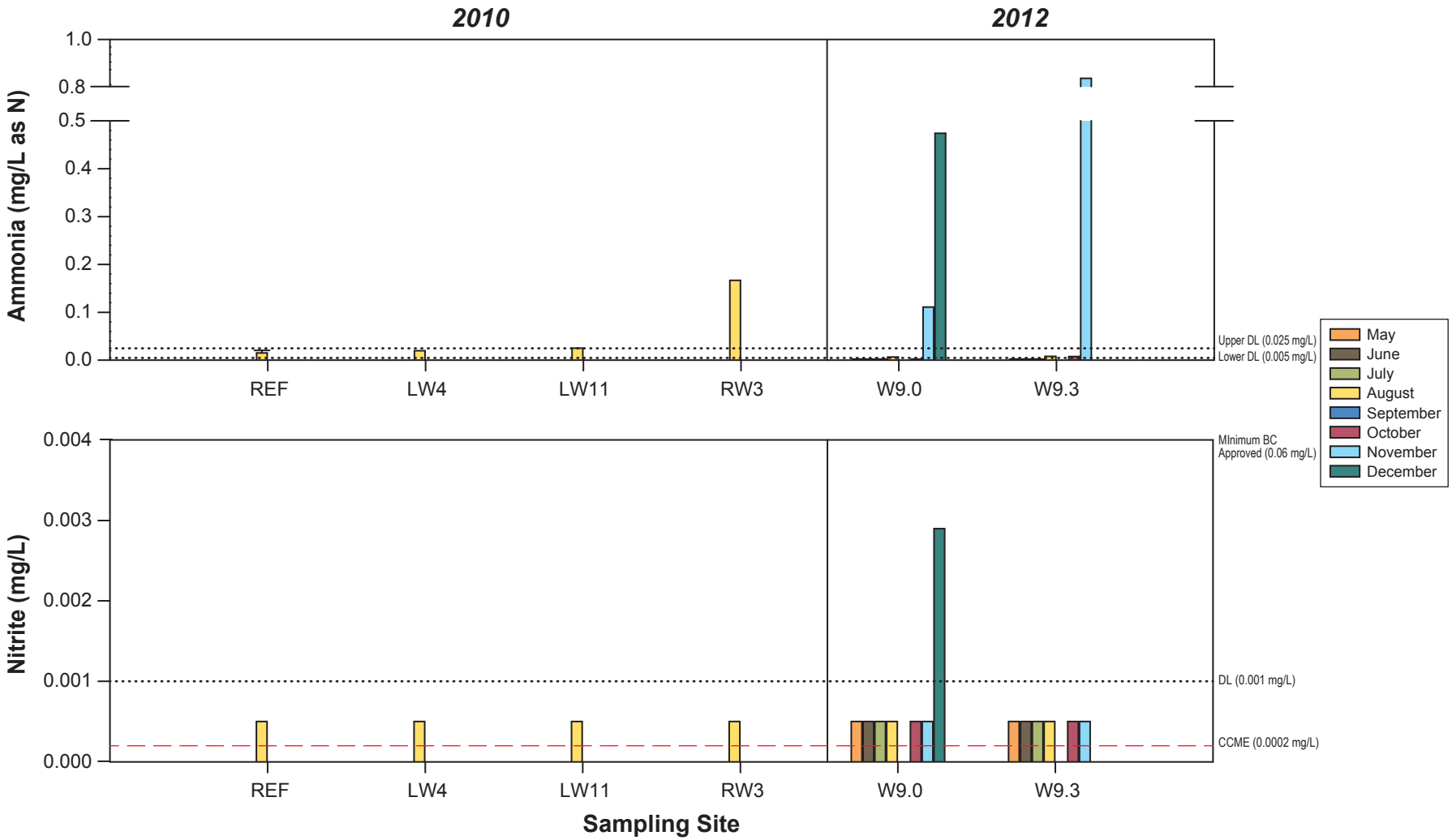

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For ammonia, CCME guidelines are temperature and pH dependent, and temperature data is unavailable.
For nitrite, red dashed lines represent CCME guideline (0.0002 mg/L), and the BC Approved guideline (chloride dependent; minimum = 0.06 mg/L when Cl < 2mg/L) is greater than graph scales.

Figure 5.1-6

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Ammonia and Nitrite Concentrations in Wetlands, 2010 to 2012

Figure 5.1-6

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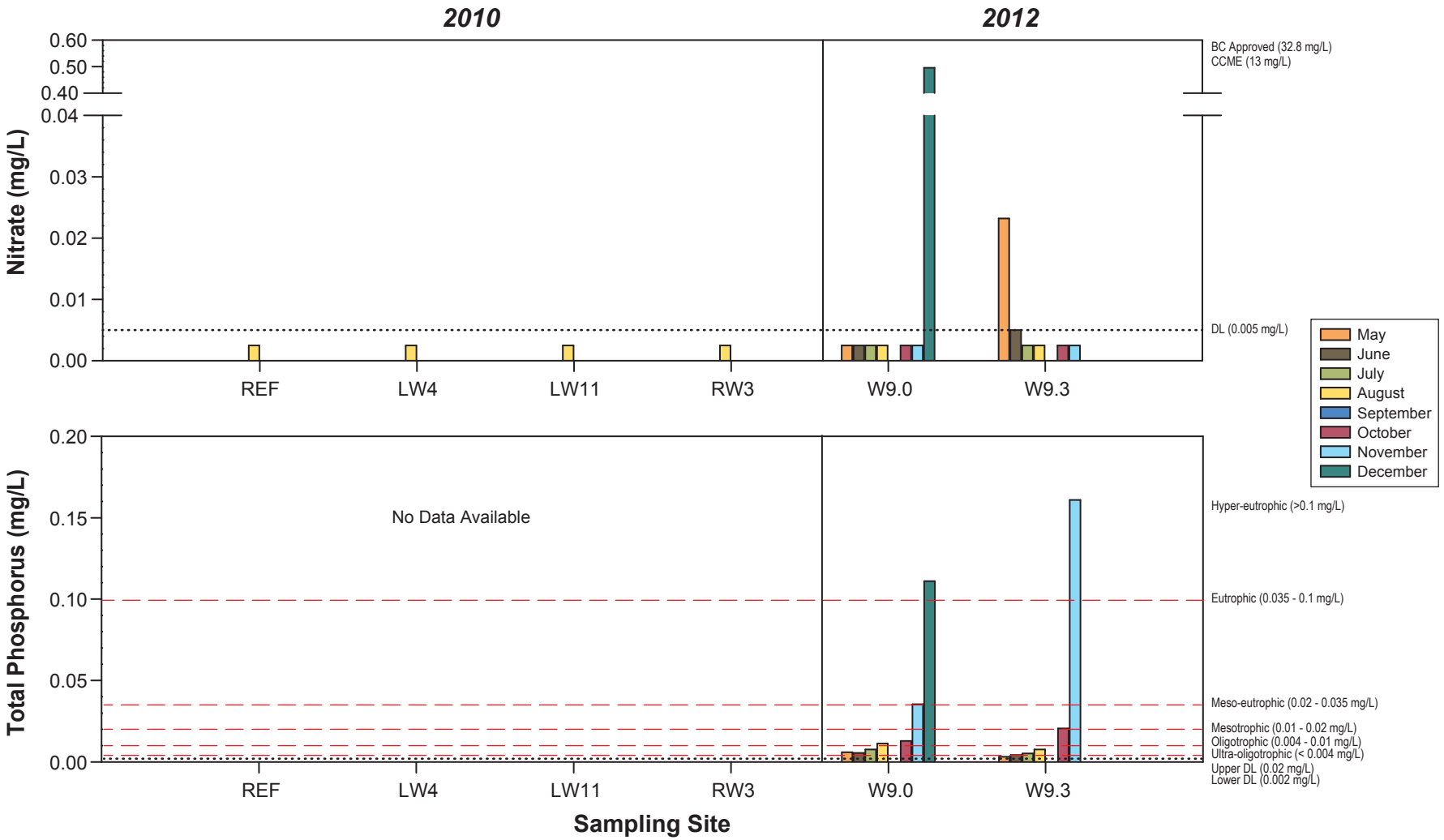

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
BC Approved guideline (32.8 mg/L) and CCME guideline (13 mg/L) are greater than graph scales.

Figure 5.1-7

hd Mining | MURRAY RIVER COAL PROJECT

Nitrate and Total Phosphorus Concentrations in Wetlands, 2010 to 2012

Figure 5.1-7

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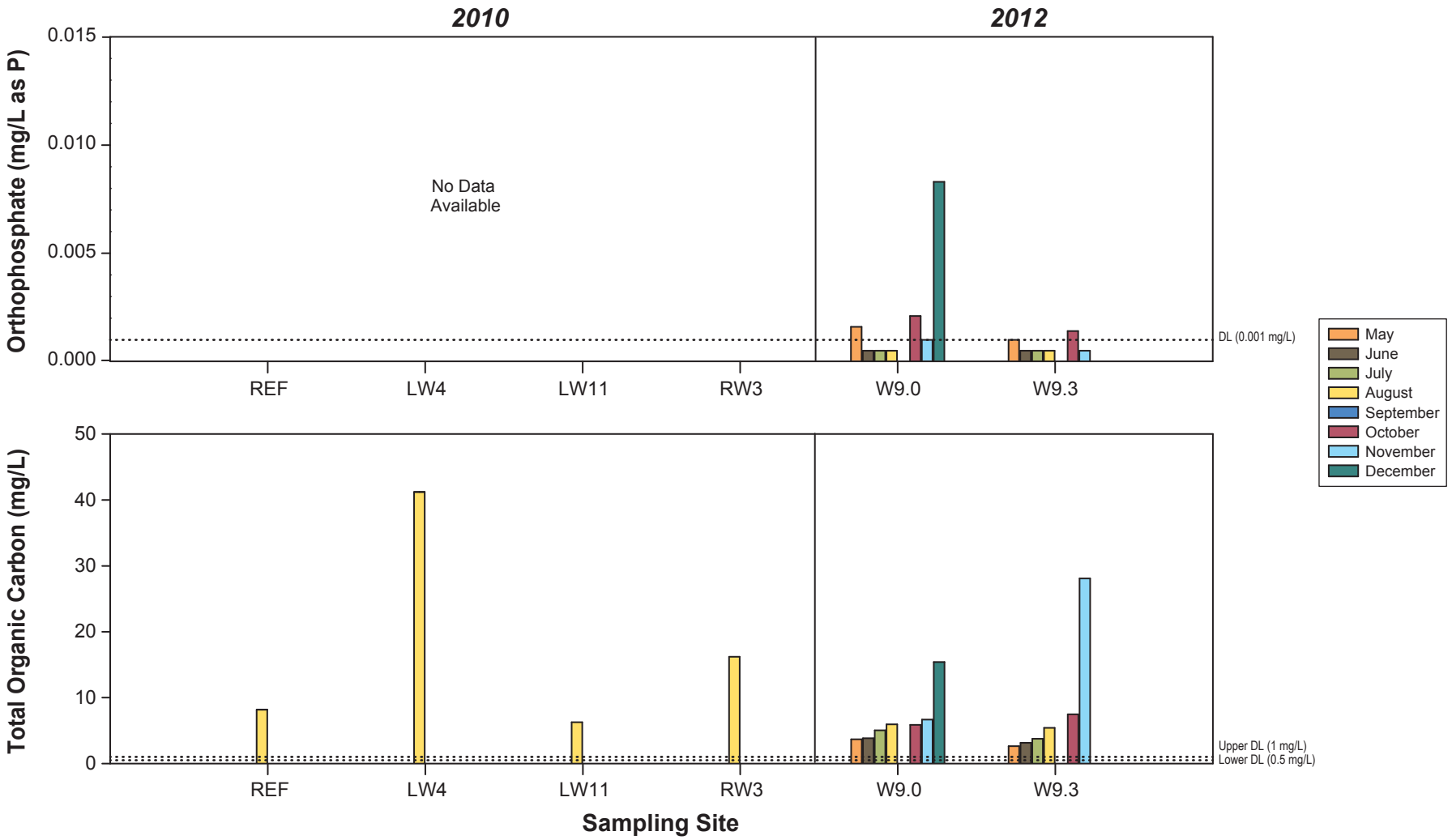

Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).

Figure 5.1-8

MURRAY RIVER COAL PROJECT

Dissolved Orthophosphate and Total Organic Carbon Concentrations in Wetlands, 2010 to 2012

Figure 5.1-8

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TOC concentrations followed the same pattern as for TSS (Figures 5.1-5 and 5.1-8). TOC levels were highest at LW4 (41.2 mg/L) followed by W9.3 (28.1 mg/L). Otherwise, TOC levels were lower and ranged from 2.63 mg/L at W9.3 in May to 16.2 mg/L at RW3 in August.

5.1.4 Cyanides

Total cyanide concentrations in 2010 followed a similar pattern as TOC and ranged from 0.0052 mg/L at REF to 0.0181 mg/L at LW4 (Figure 5.1-9). All samples from W9.0 and W9.3 collected in 2012 were below detection limits for total cyanide. In May 2012, ALS changed their total cyanide method, resulting in lower detection limits and fewer false positive results that can occur due to the presence of dissolved organic carbon. This suggests that the 2010 total cyanide concentrations may be false positives. Weak acid dissociable cyanide concentrations were near or below the detection limit of 0.001 mg/L at all sites (Figure 5.1-9).

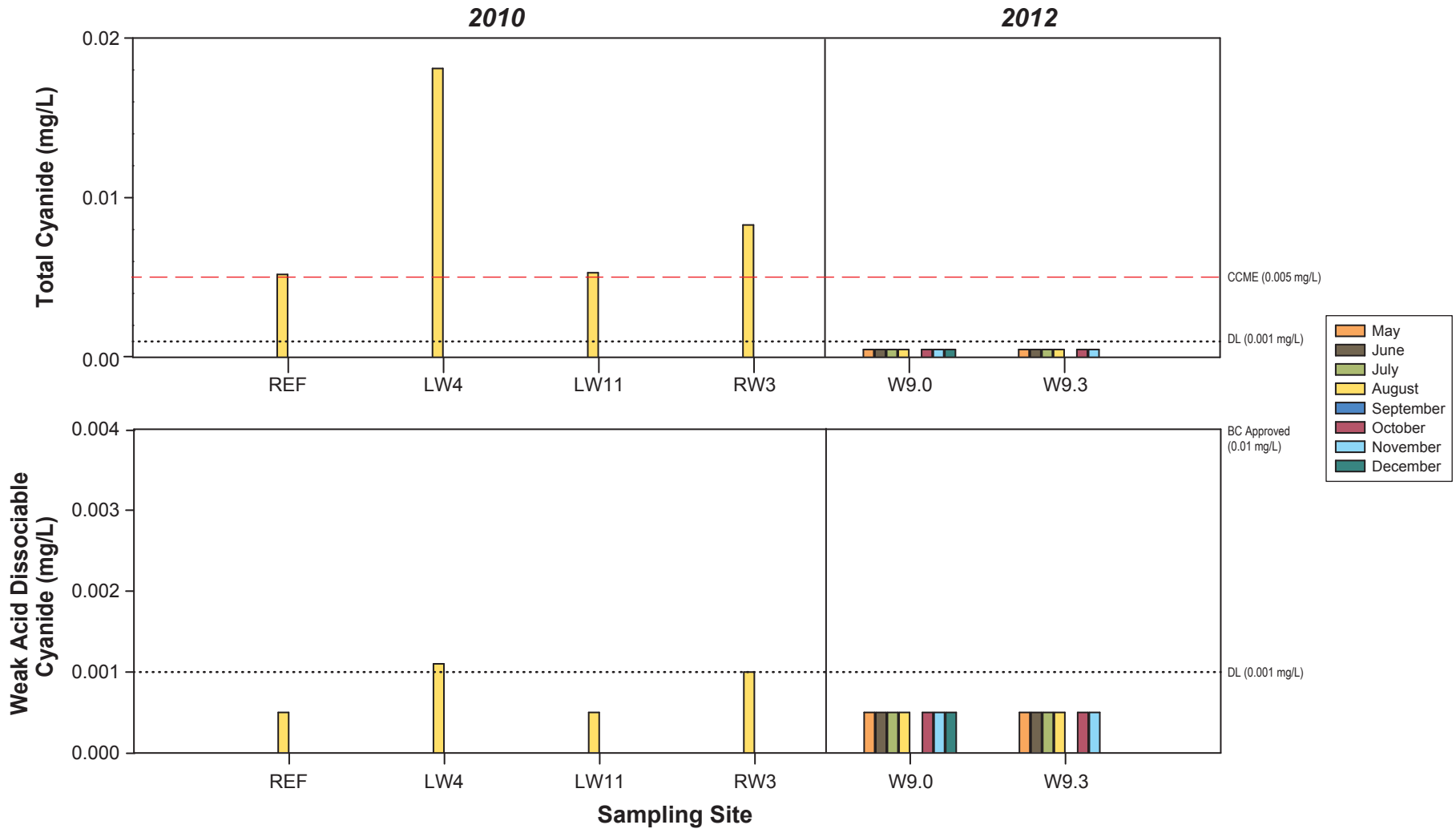
5.1.5 Metals

Metal concentrations were generally similar among wetlands in the Project area (Figures 5.1-10 to 5.1-24). However, some samples had elevated TSS levels which corresponded to elevated metal concentrations (Figures 5.1-5, and 5.1-10 to 5.1-24). For example, the August samples collected at REF and LW4 had elevated TSS which was reflected in the elevated concentrations of total aluminum, total arsenic, total cadmium, total chromium, total cobalt, total iron, total lead, and total nickel compared to other wetlands. Similarly, concentrations of total and dissolved iron, total lead, total manganese, and total silver were elevated at W9.0, and to a lesser extent, at W9.3 in November and December 2012 when those samples had elevated TSS compared to the spring and summer months at the sites. The high TDS site, LW11, had elevated concentrations of total boron, dissolved calcium, total lithium, total molybdenum, total nickel, total potassium, total uranium, and total vanadium. Since the wetlands REF, LW4, LW11, and RW3 were only sampled once (August 2010), it cannot be determined if metals were consistently elevated.

Total barium, total copper, and total selenium concentrations were similar among wetlands. Dissolved aluminum, total antimony, total titanium and total zinc concentrations were at or near their detection limits. All samples were below their detection limits for total beryllium, total mercury, total thallium, and total tin.

5.1.6 Guidelines

Total aluminum and total iron concentrations were naturally elevated in wetlands of the Murray River Project area and sites were often greater than CCME guidelines (Table 5.1-1). Total iron levels were particularly high at LW4, and concentrations were higher than the CCME guideline by a factor of 12.4. Ammonia concentrations were occasionally above the pH- and temperature-dependent guideline CCME guideline at RW3, W9.0, and W9.3 when an extremely conservative estimate of temperature was used (30°C). Total cyanide concentrations were higher than the CCME free cyanide guideline in the wetlands sampled in 2010 (REF, LW4, LW11, and RW3). Fluoride (LW11), cadmium (LW4), chromium (REF), and silver (W9.0) concentrations were sporadically greater than their CCME guidelines. The BC MOE guidelines for sulphate (LW11), total iron (REF, LW4, and W9.0), and dissolved iron (W9.0 and W9.3) were occasionally elevated above guidelines in LSA wetlands (Table 5.1-2).



Notes: Values represent a single sample or mean of duplicates (REF in 2010),
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For Weak Acid Dissociable Cyanide, BC Approved guideline (0.010 mg/L) is greater than graph scales.

Figure 5.1-9

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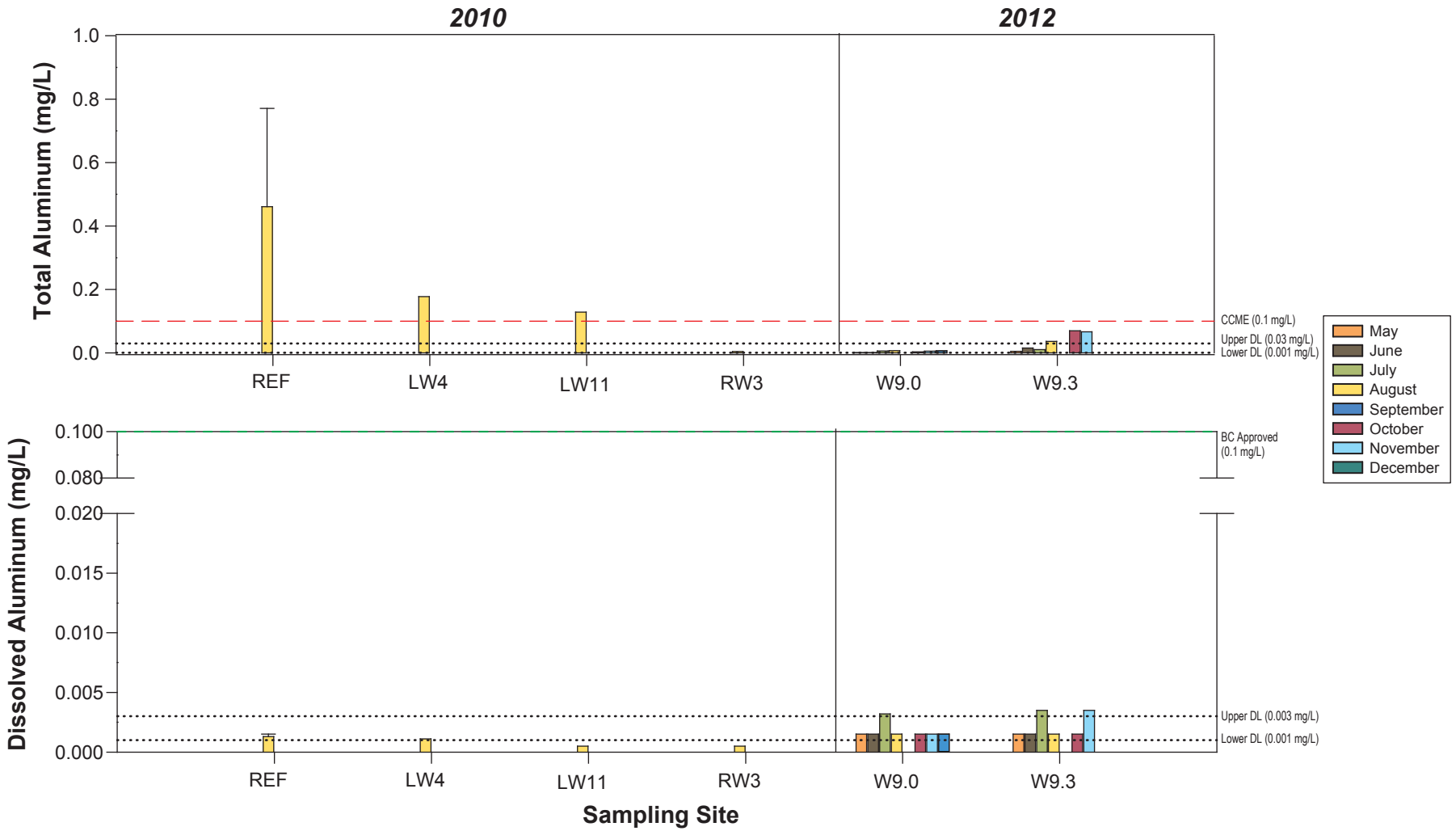
Total Cyanide and Weak Acid Dissociable Cyanide Concentrations in Wetlands, 2010 to 2012

Figure 5.1-9

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For total aluminum, red dashed lines represent CCME guideline (pH dependent; 0.1 mg/L when pH > 6.5).
For dissolved aluminum, blue dashed lines represent BC Approved guideline (pH dependent; 0.1 mg/L when pH > 6.5).

Figure 5.1-10

hd Mining

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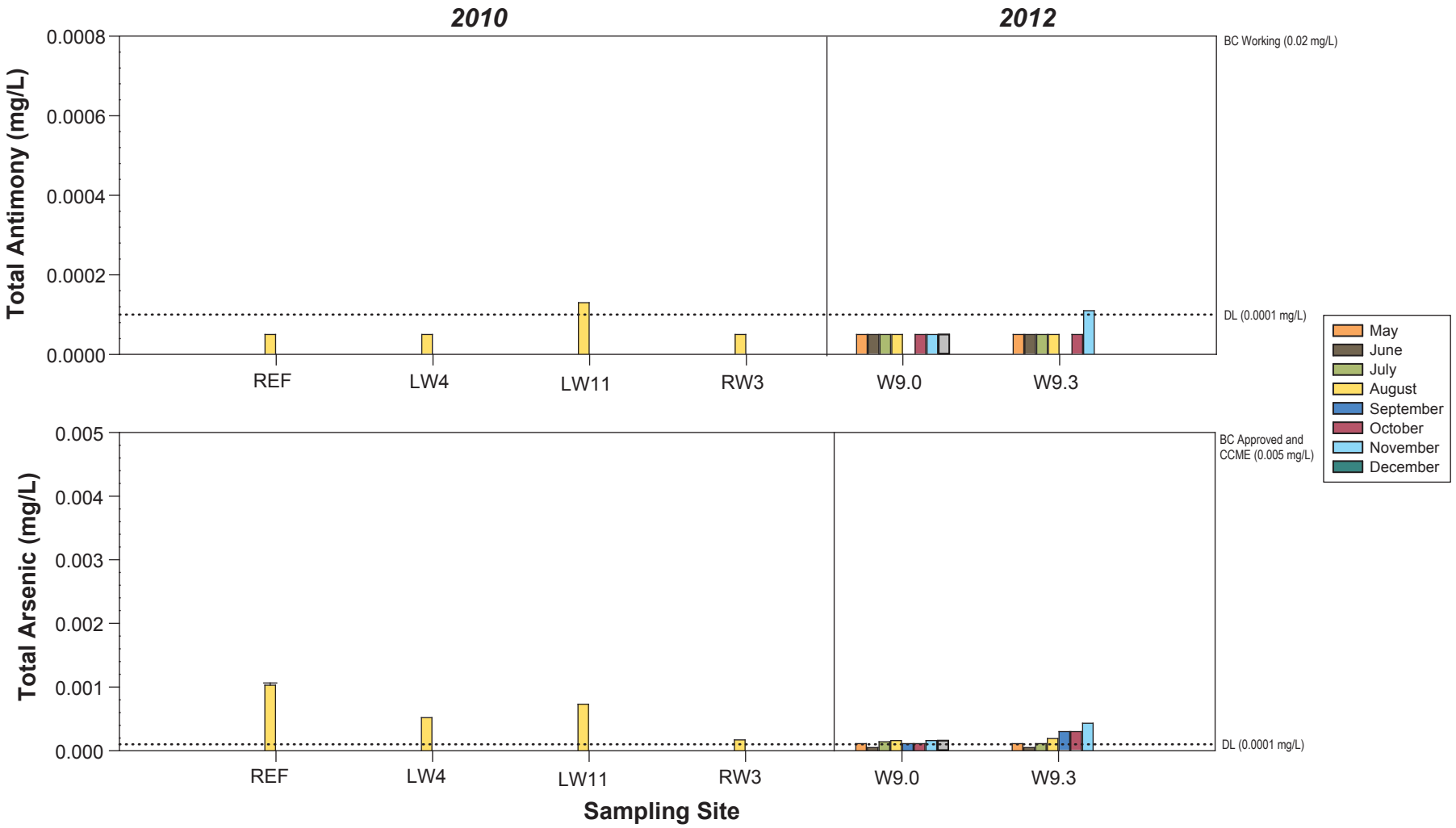
Total and Dissolved Aluminum Concentrations in Wetlands, 2010 to 2012

Figure 5.1-10

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For antimony, BC Working guideline (proposed Ontario guideline; 0.02 mg/L) is greater than graph scales.
For arsenic, BC Approved guideline and CCME guideline (0.005 mg/L) is greater than graph scales.

Figure 5.1-11

hd Mining

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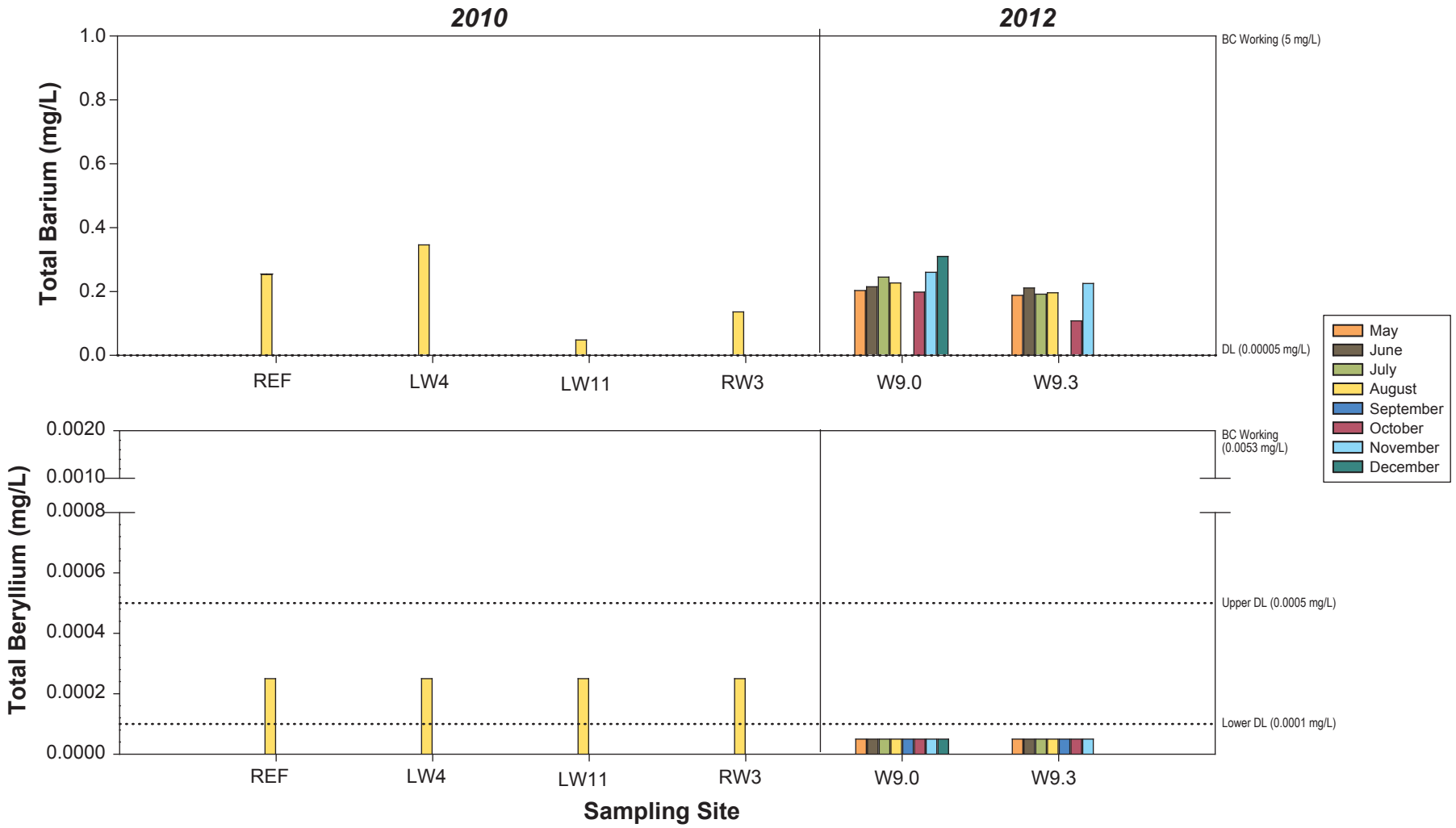
Total Antimony and Arsenic Concentrations in Wetlands, 2010 to 2012

Figure 5.1-11

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For barium, BC Working guideline (under Ministry review; 5 mg/L) is greater than graph scales.
For beryllium, BC Working guideline (under Ministry review; 0.0053 mg/L) is greater than graph scales.

Figure 5.1-12

hd Mining

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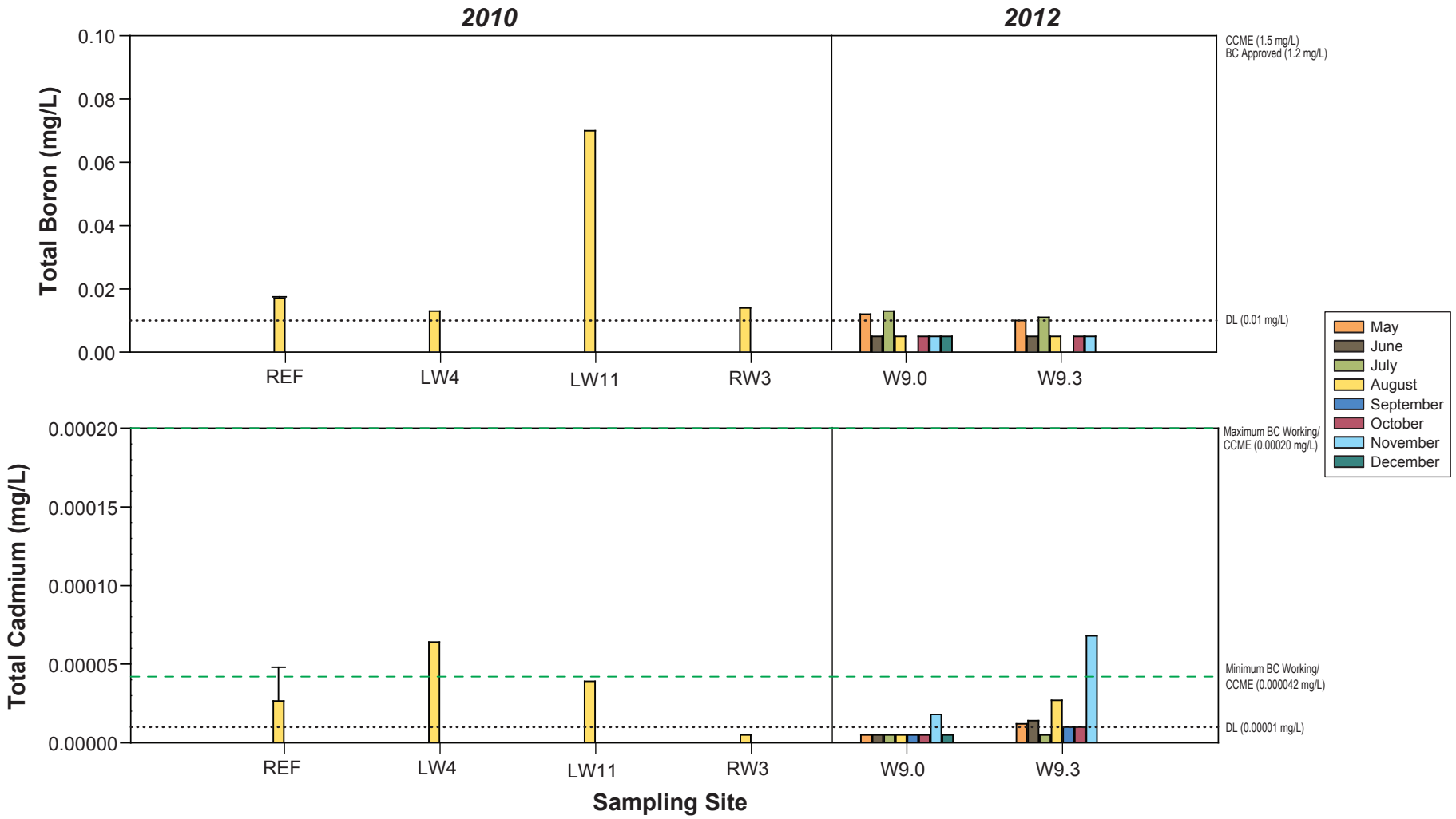
Total Barium and Beryllium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-12

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For boron, BC Approved guideline (1.2 mg/L) and CCME guideline (1.5 mg/L) are greater than graph scales.
For cadmium, green dashed lines represent BC Working/CCME guidelines (hardness dependant; cadmium equation (mg/L) = $10^{0.86[\log10(\text{hardness})]-3.2}$ / 1000).

Figure 5.1-13

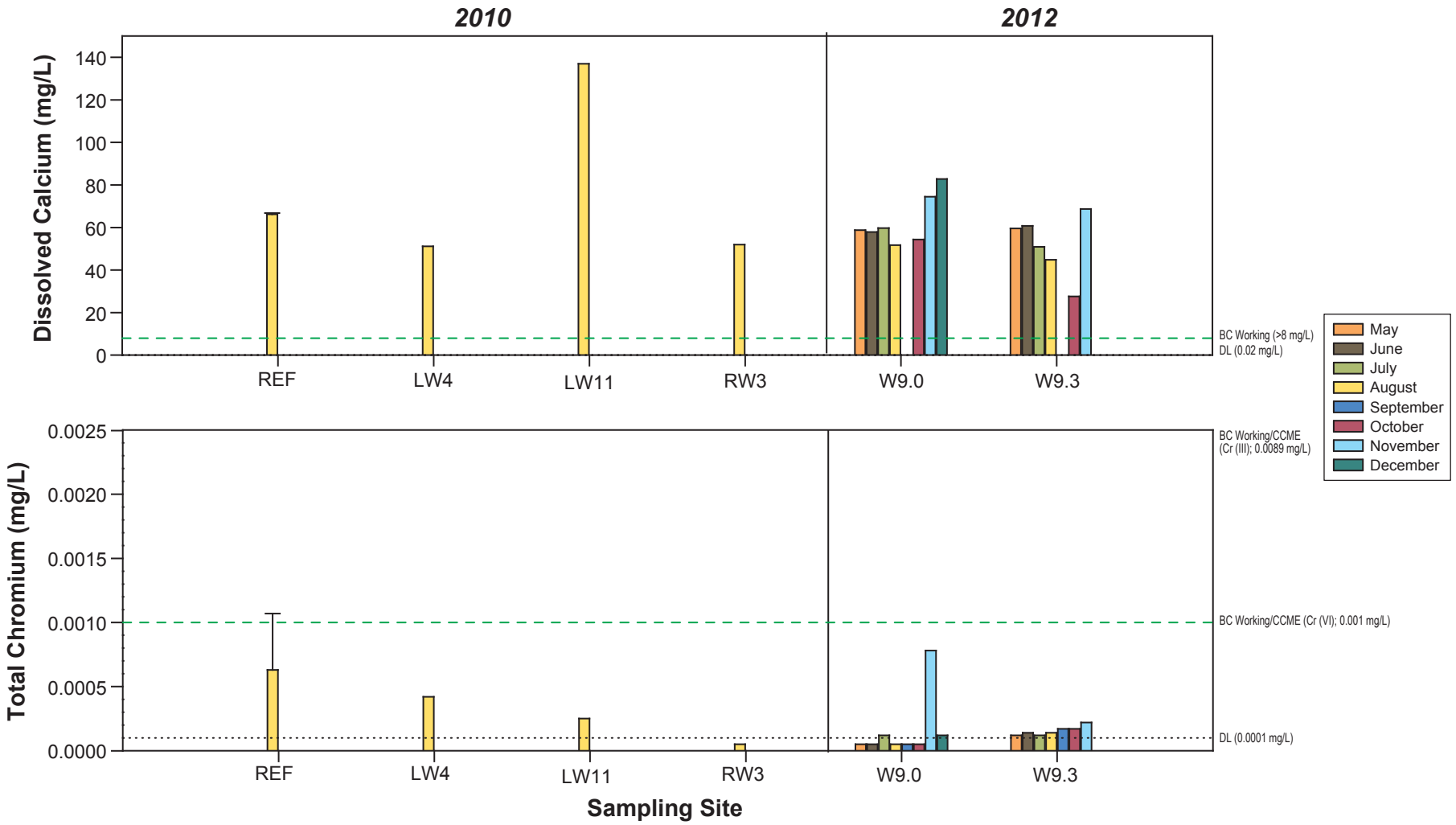
hd Mining

MURRAY RIVER COAL PROJECT

Total Boron and Cadmium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-13

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For dissolved calcium, green dashed lines represent the BC Working guideline, where water with concentrations >8 mg/L dissolved calcium have a low sensitivity to acid inputs.
For total chromium, green dashed lines represent BC Working and CCME guidelines for Cr (VI) (0.001 mg/L), BC Working and CCME guidelines for Cr (III) are greater than graph scales.

Figure 5.1-14

hd Mining

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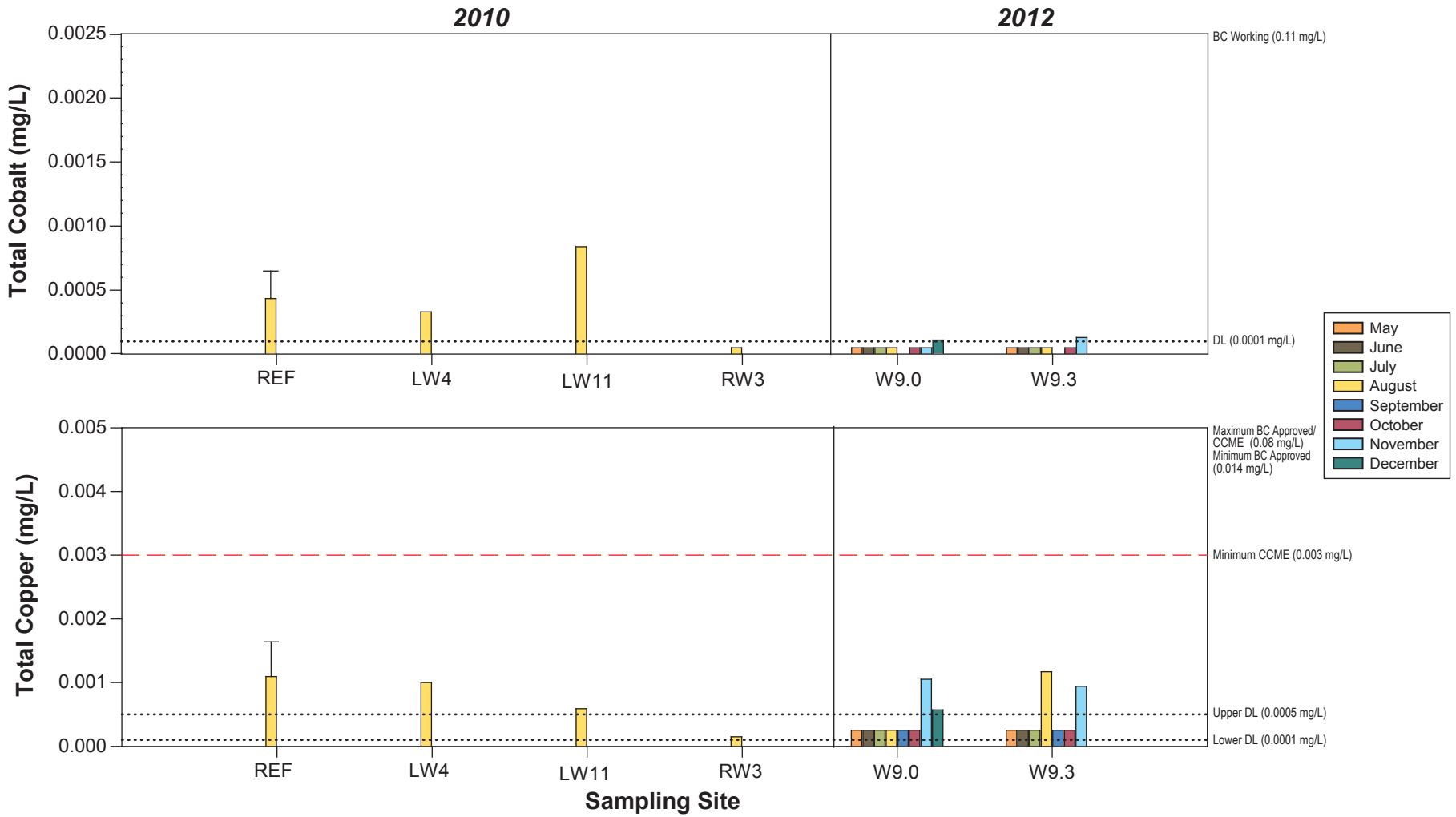
Dissolved Calcium and Total Chromium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-14

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For cobalt, BC Working guideline (0.11 mg/L) is greater than graph scales.
For copper, blue dashed lines represent the BC Approved guideline (hardness dependant; copper equation (mg/L) = (0.094 x hardness)+2)/1000), maximum value is greater than graph scales.
Red dashed lines represent the CCME guideline (hardness dependent; copper equation (mg/L) = $e^{0.8545[\ln(\text{hardness})]-1.465}$ x 0.0002), maximum value is greater than graph scales.

Figure 5.1-15

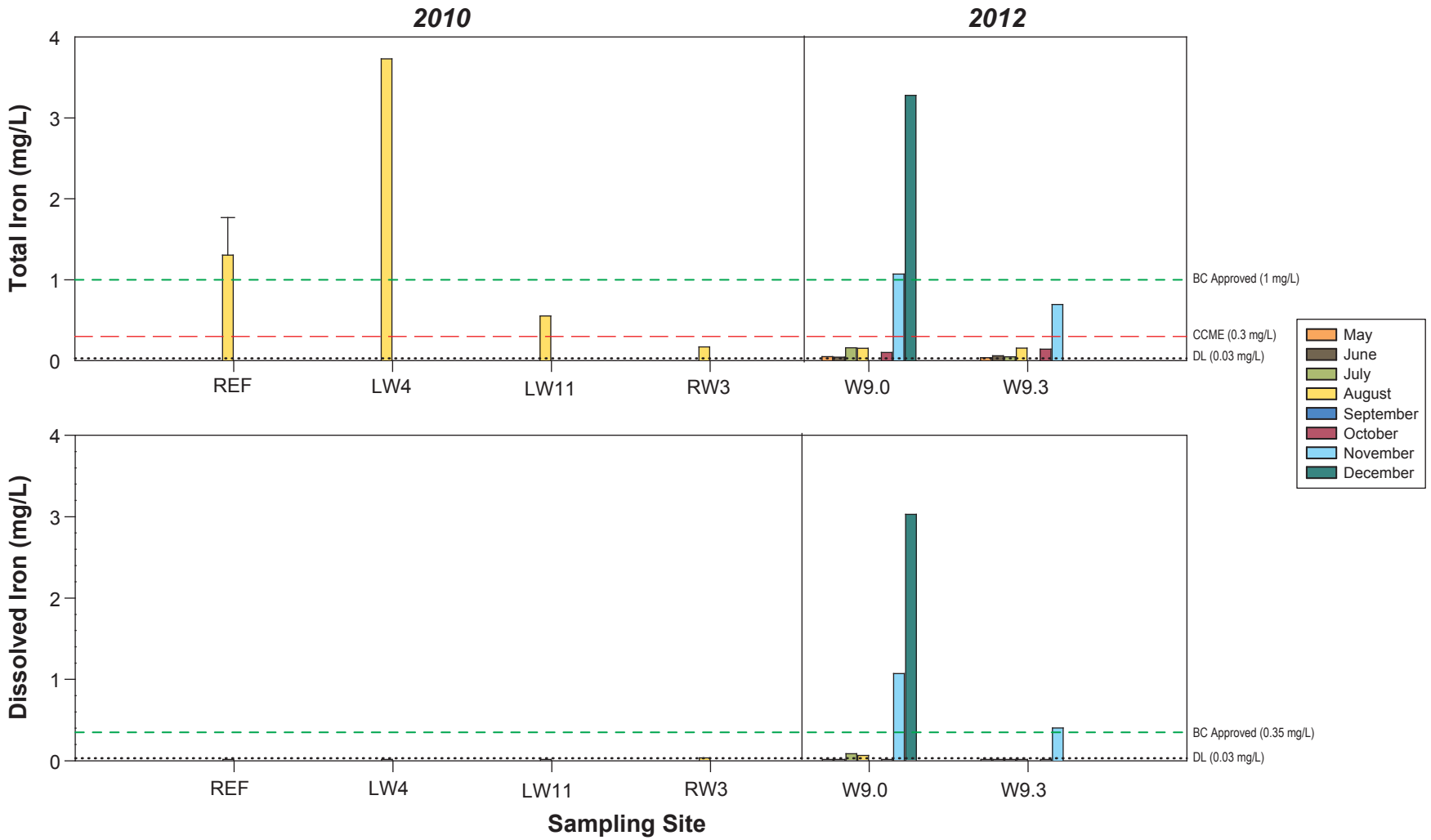
hd Mining

MURRAY RIVER COAL PROJECT

Total Cobalt and Copper Concentrations in Wetlands, 2010 to 2012

Figure 5.1-15

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For total iron, blue dashed lines represent the BC Approved guideline (1 mg/L) and red dashed lines represent the CCME guideline (0.3 mg/L).
For total iron, blue dashed lines represent the BC Approved guideline (0.35 mg/L).

Figure 5.1-16

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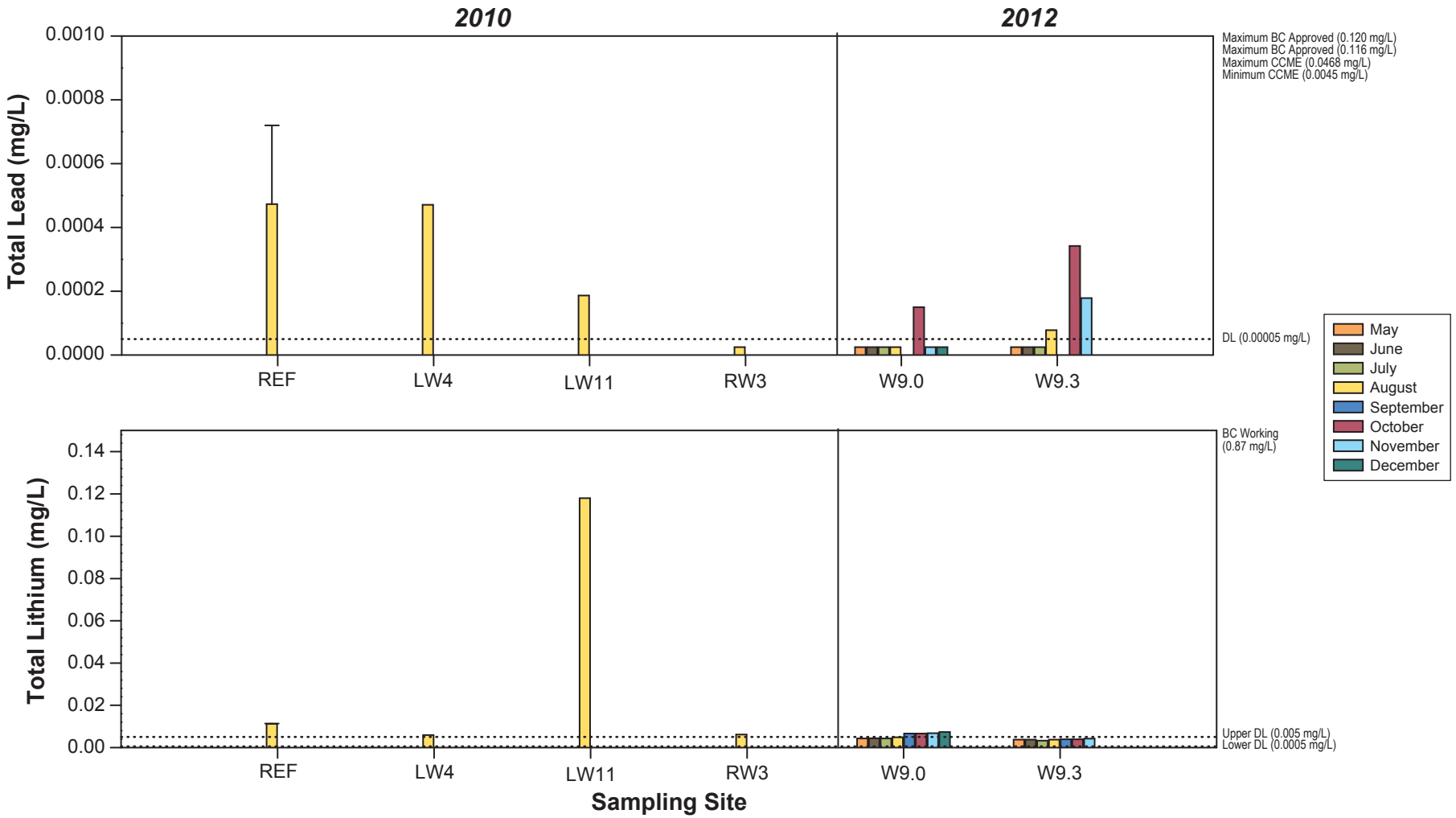
Total and Dissolved Iron Concentrations in Wetlands, 2010 to 2012

Figure 5.1-16

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For lead, BC Approved guideline (hardness dependent; lead equation (mg/L) = $e^{1.273(\ln(\text{hardness}))-1.460}/1000$) is greater than graph scales.
For lead, CCME guideline (hardness dependent; lead equation (mg/L) = $e^{1.273(\ln(\text{hardness}))-4.705}/1000$) is greater than graph scales.
For lithium, BC Working guideline (0.87 mg/L) is greater than graph scales.

Figure 5.1-17

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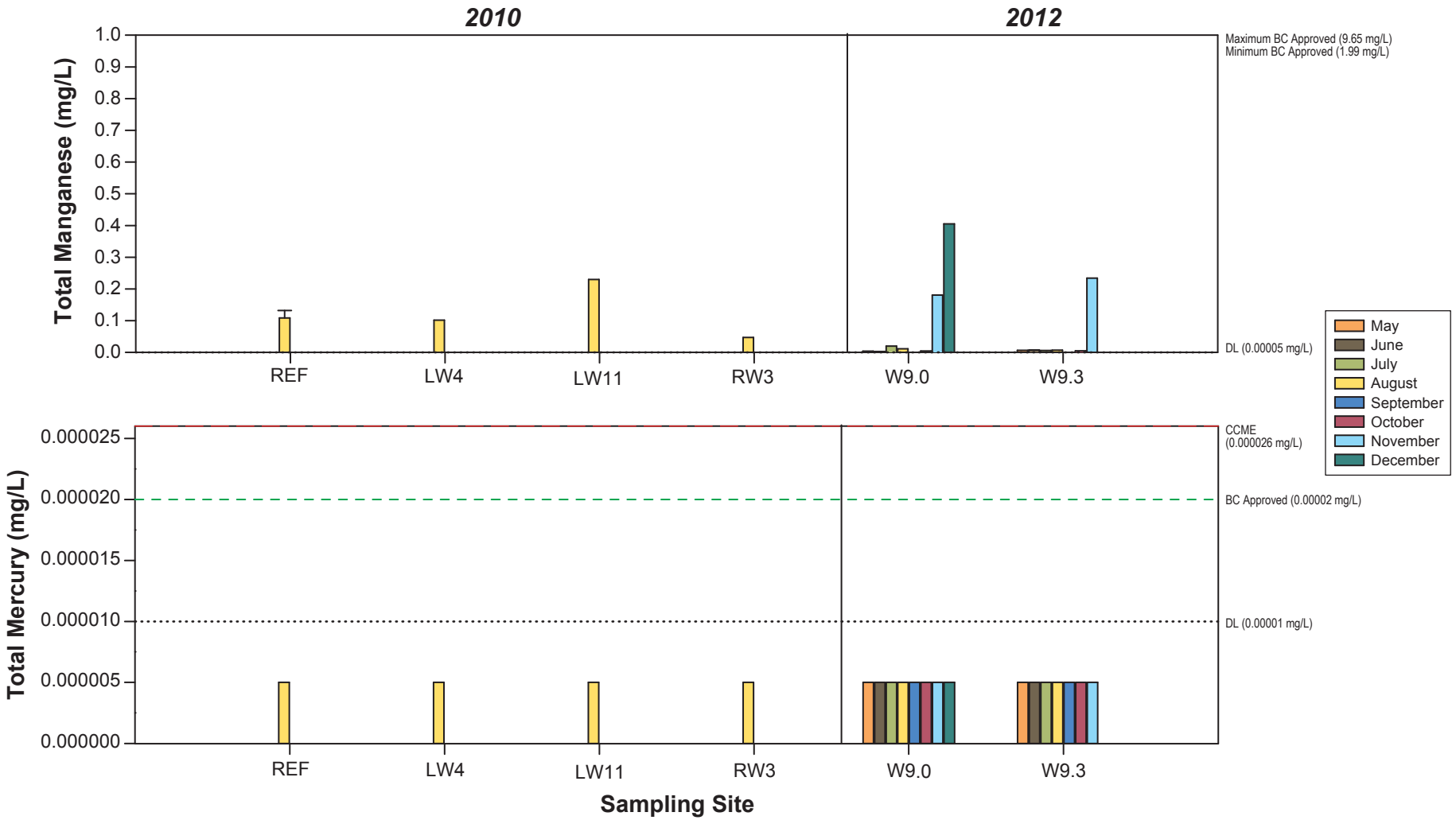
Total Lead and Lithium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-17

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For manganese, BC Approved guideline (hardness dependant; manganese equation (mg/L) = 0.01102(hardness)+0.54) is greater than graph scales.
For mercury, blue dashed lines represent BC Approved guideline (0.00002 mg/L) and red dashed lines represent CCME guideline (0.000026 mg/L).

Figure 5.1-18

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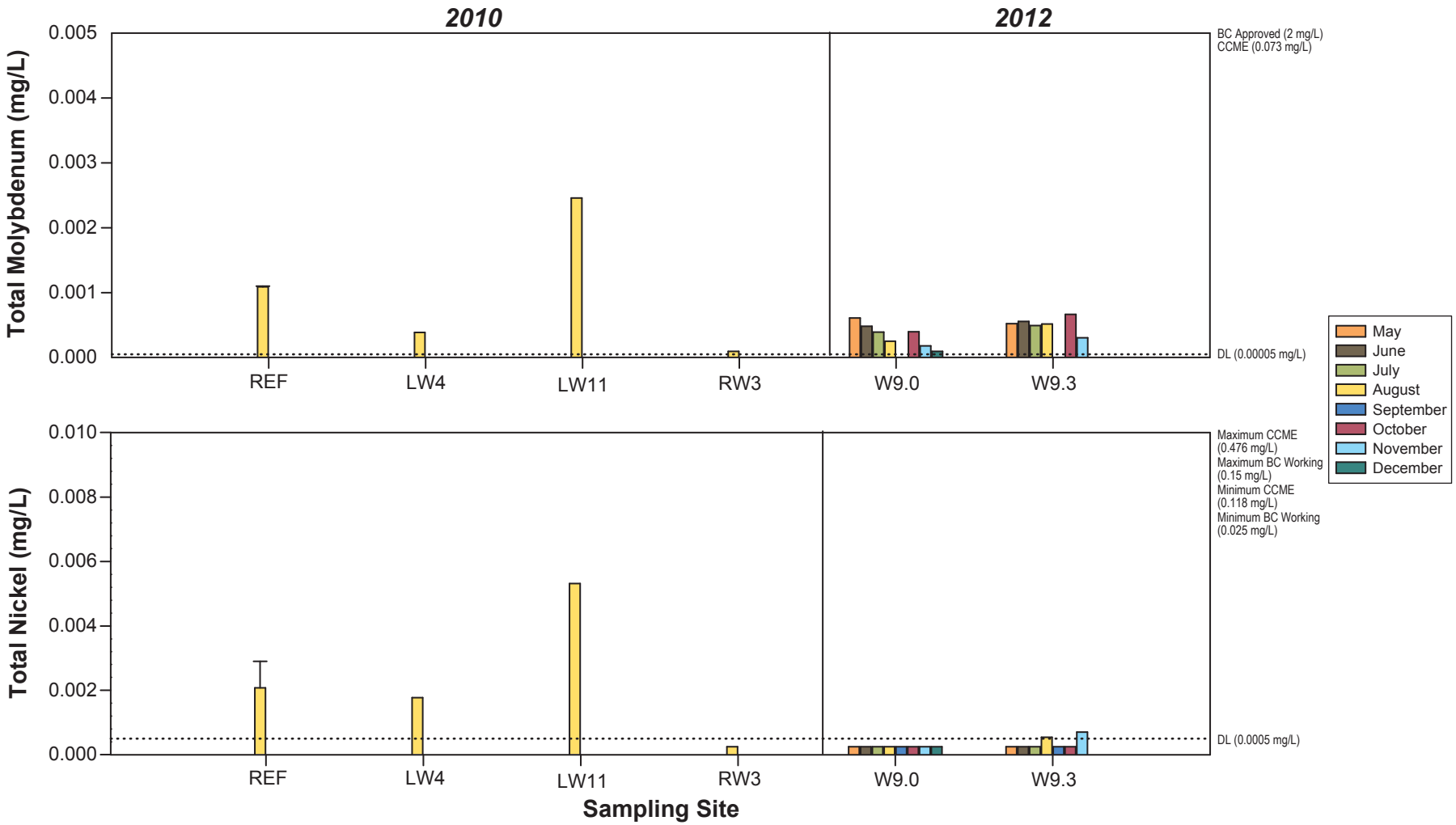
MURRAY RIVER COAL PROJECT

Total Manganese and Mercury Concentrations in Wetlands, 2010 to 2012

Figure 5.1-18

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For molybdenum, BC Approved guideline (2 mg/L) and CCME guideline (0.073 mg/L) are greater than graph scales.
For nickel, BC Working guideline (hardness dependent; 0.025 mg/L (hardness 0-60), 0.065 mg/L (hardness 60-120), 0.11 mg/L (hardness 120-180), and 0.15 mg/L (hardness >180)) is greater than graph scales.
For nickel, CCME guideline (hardness dependent; nickel equation (mg/L) = $e^{0.76(\ln(\text{hardness}))+1.06}/1000$) is greater than graph scales.

Figure 5.1-19

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Total Molybdenum and Nickel Concentrations in Wetlands, 2010 to 2012

Figure 5.1-19

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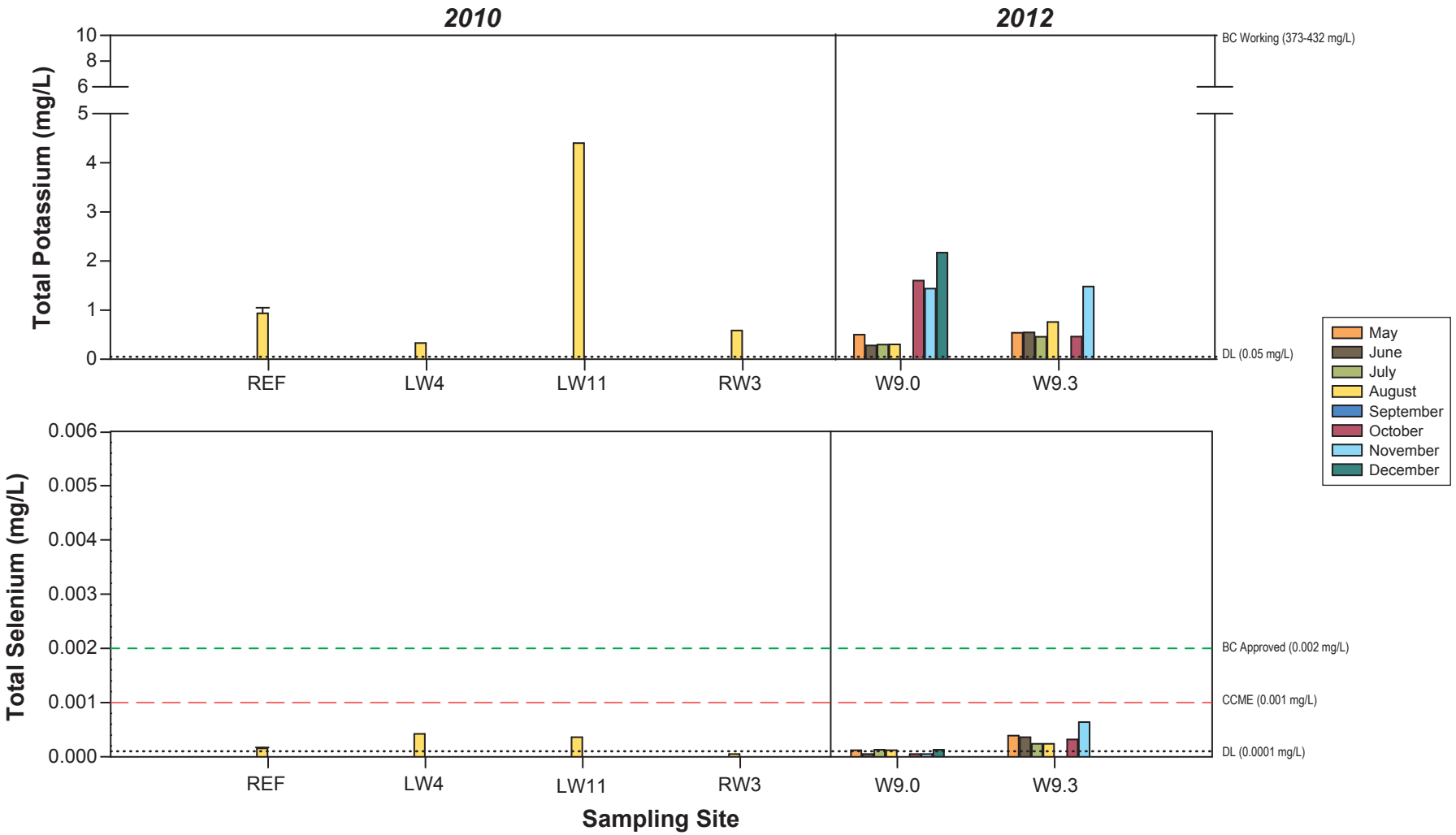

Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For potassium, BC Working guideline (373 to 432 mg/L) is greater than graph scales.
For selenium, blue dashed lines represent BC Approved guideline (0.002 mg/L) and red dashed lines represent CCME guideline (0.001 mg/L).

Figure 5.1-20

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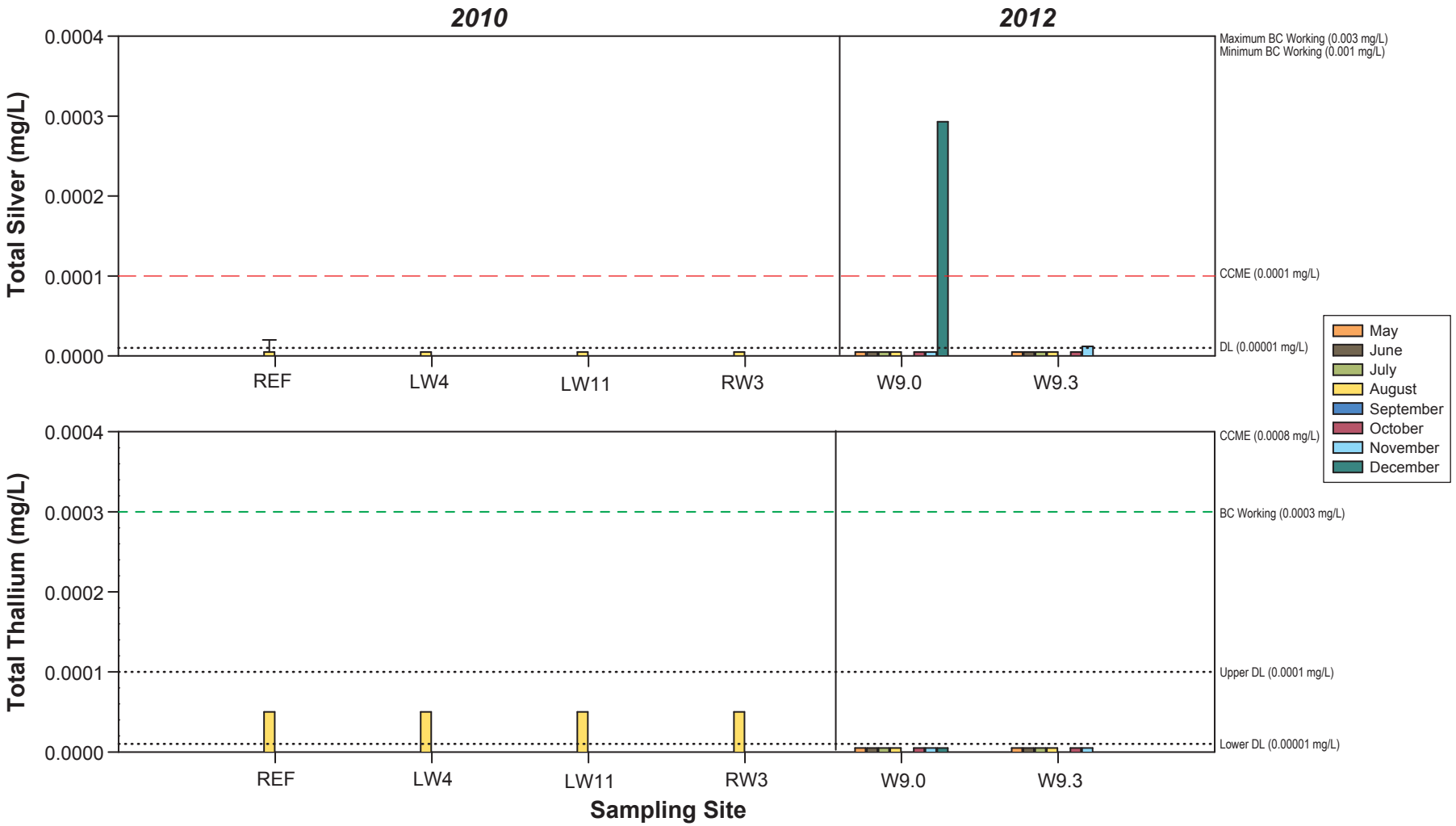
Total Potassium and Selenium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-20

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
For silver, BC Working guideline (hardness dependent; 0.001 mg/L (hardness = <100), 0.003 mg/L (>100)) is greater than graph scales.
For silver, red dashed lines represent CCME guideline (0.0001 mg/L).
For thallium, green dashed lines represent BC Working guideline (Ontario objective; 0.0003 mg/L) and CCME guideline (0.0008 mg/L) is greater than graph scales.

Figure 5.1-21

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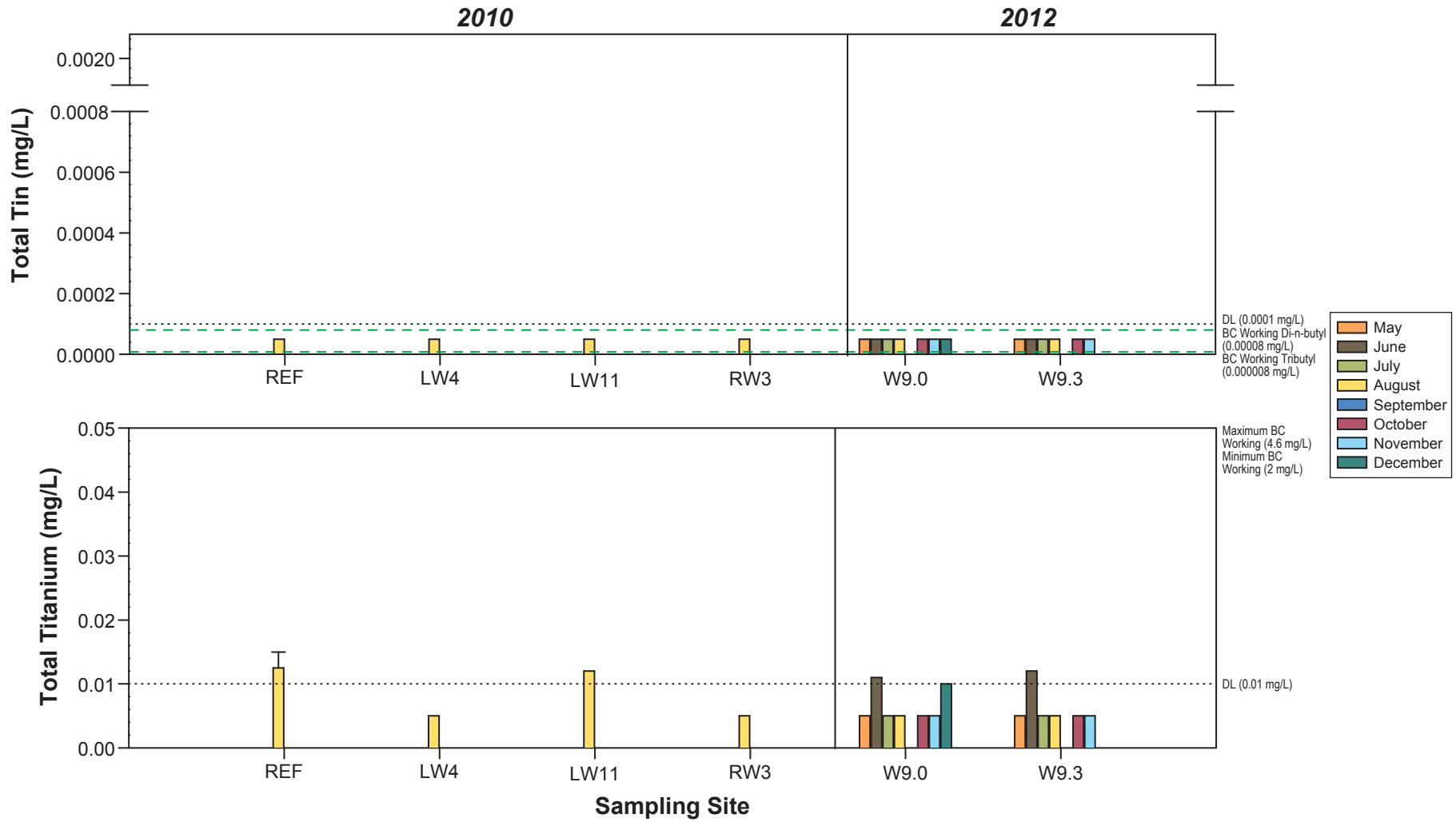
Total Silver and Thallium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-21

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For tin, green dashed lines represent BC Working guidelines (tributyl: 0.000008 mg/L; di-n-butyl: 0.00008 mg/L).
For titanium, BC Working guideline (median threshold for Scenedesmus (2 mg/L) and for Daphnia (4.6 mg/L)) is greater than graph scales.

Figure 5.1-22

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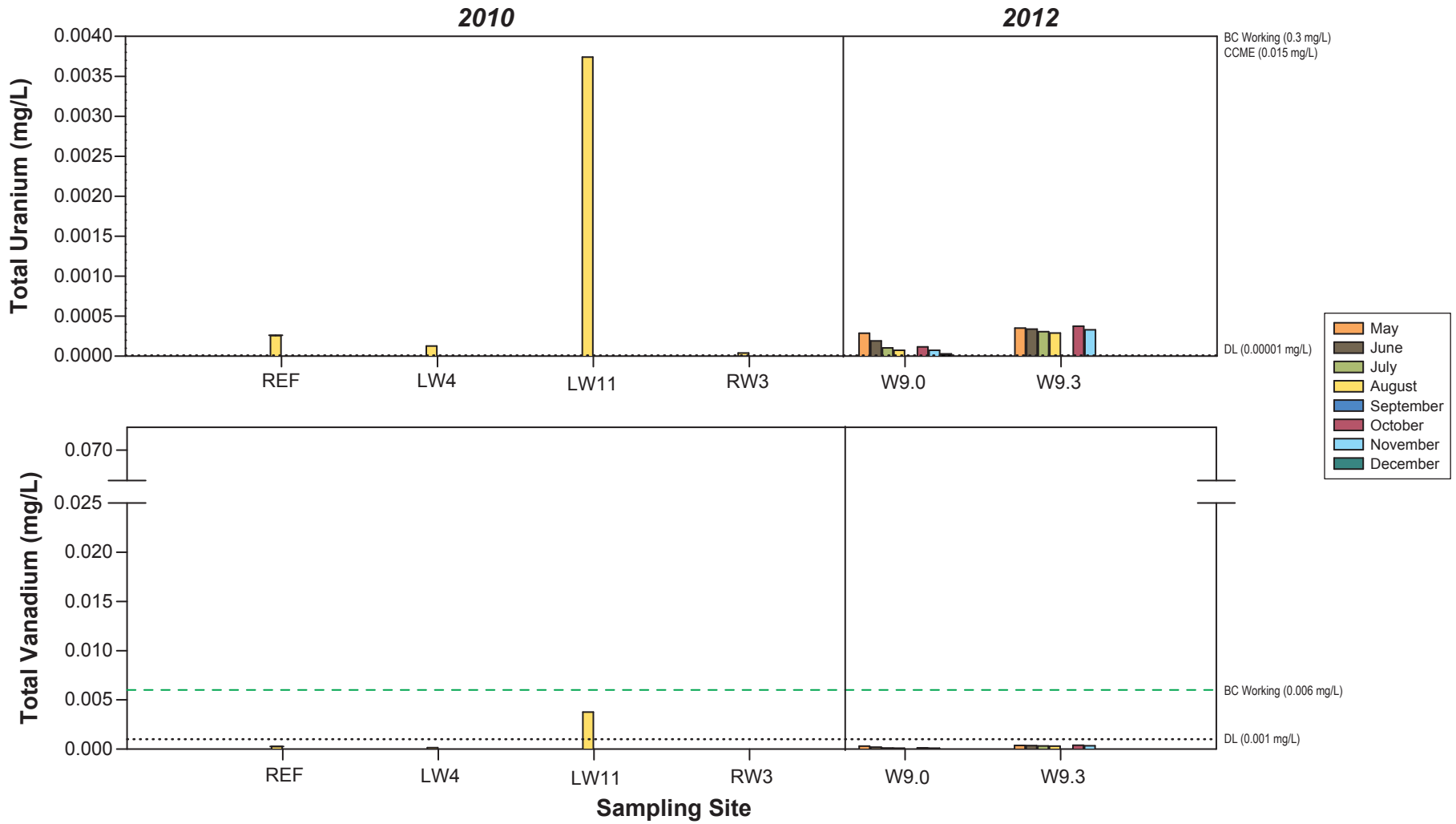
Total Tin and Titanium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-22

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL).
For uranium, BC Working guideline (0.3 mg/L) and CCME guideline (0.015 mg/L) is greater than graph scales.
For vanadium, green dashed lines represent BC Working guideline (0.006 mg/L).

Figure 5.1-23

hd Mining

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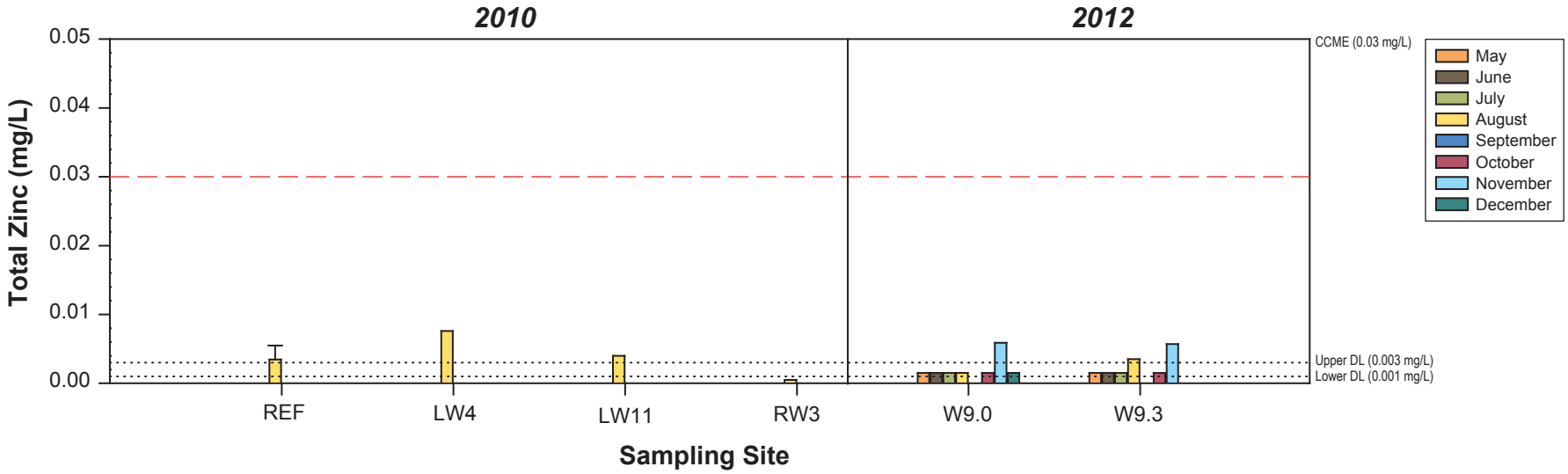
Total Uranium and Vanadium Concentrations in Wetlands, 2010 to 2012

Figure 5.1-23

Rescan Engineers & Scientists



Notes: Values represent a single sample or mean of duplicates, (REF in 2010).
Error bars represent standard error of the mean.
Black dotted lines represent realized detection limits (DL; upper and lower).
Blue dashed lines represent BC Approved guidelines (hardness dependent; zinc equation (mg/L) = 33 + 0.75(hardness-90)/1000 with minimum = 0.033 mg/L).
Red dashed lines represent CCME guideline (0.03 mg/L).

Figure 5.1-24

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Total Zinc Concentrations in Wetlands, 2010 to 2012

Figure 5.1-24

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Table 5.1-1. Percentage of CCME Guideline Exceedances and Average Factor of Exceedances in Wetland Replicates, 2010 to 2012

Parameter			Fluoride		Ammonia		Phosphorus	Cyanide (Free)		Aluminum (Al)		Cadmium (Cd)		Chromium (Cr (VI))		Iron (Fe)		Silver (Ag)	
CCME Guideline[a]			0.12[b]		pH- and Temperature-dependent[c]		Trigger Ranges	0.005		pH-dependent		Hardness-dependent[b]		0.001		0.3		0.0001	
Site	# Replicates	Year	%	Factor	%	Factor		%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor
REF	2	2010	0%	-	0%	-	-	50%	1.04	50%	7.71	0%	-	50%	1.07	100%	4.35	0%	-
LW4	1	2010	0%	-	0%	-	-	100%	3.62	100%	1.78	100%	1.04	0%	-	100%	12.43	0%	-
LW11	1	2010	100%	2.43	0%	-	-	100%	1.06	100%	1.29	0%	-	0%	-	100%	1.85	0%	-
RW3	1	2010	0%	-	100%	2.09	-	100%	1.66	0%	-	0%	-	0%	-	0%	-	0%	-
W9.0	7	2012	0%	-	14%	2.26	Oligotrophic to Hyper-eutrophic	0%	-	0%	-	0%	-	0%	-	29%	7.25	14%	2.93
W9.3	6	2012	0%	-	17%	3.78	Ultra-oligotrophic to Hyper-eutrophic	0%	-	0%	-	0%	-	0%	-	17%	2.32	0%	-

Notes:

[a] *Canadian water quality guideline for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment; accessed March 2013.*

[b] *Interim guideline.*

[c] *Calculated based on a conservative temperature of 30°C.*

Only parameters that were above guidelines are presented.

Frequency (%) represents percentage of replicates collected at each site that were higher than available guidelines.

Factor represents the average factor samples above guidelines were higher than guideline concentrations.

Table 5.1-2. Percentage of BC Guideline Exceedances and Average Factor of Exceedances in Wetland Replicates, 2010 to 2012

Parameter			Sulphate		Iron		Iron - dissolved	
BC Guideline[a]			100 mg/L		1 mg/L		0.35 mg/L	
Site	# Samples	Year	Frequency (%)	Factor	Frequency (%)	Factor	Frequency (%)	Factor
REF	2	2010	0.0%	-	50.0%	1.77	0.0%	-
LW4	1	2010	0.0%	-	100.0%	3.73	0.0%	-
LW11	1	2010	100.0%	7.98	0.0%	-	0.0%	-
RW3	1	2010	0.0%	-	0.0%	-	0.0%	-
W9.0	7	2012	0.0%	-	28.6%	2.18	28.6%	5.86
W9.3	6	2012	0.0%	-	0.0%	-	16.7%	1.15

Notes:
[a] British Columbia MOE approved guideline for the protection of freshwater aquatic life; accessed March 2013.
Frequency (%) represents the percentage of replicates collected at each site that were higher than the guideline.
Factor represents the average factor that replicates above the guideline exceeded the guideline concentration.

5.1.7 Quality Assurance and Quality Control

Results for the wetland travel and field blanks for 2010 are presented in Appendix 7-2. The RPD analysis of 2010 QA/QC field replicate water samples is presented in Appendix 7-3.

In the travel blank, only acidity was greater than the detection limit, and in the field blank, only TOC and total magnesium was greater than the detection limit. Of these, only acidity and TOC were double the detection limit. RPD calculations were performed if the replicate concentration for the parameter was at least five times higher than the detection limit (40 of 91 cases; BC MOE 2006). Of these RPD calculations, only 8 had RPDs between 20% and 50% and none had RPDs that were greater than 50%. These results indicate that the water quality data are reliable.

5.2 SEDIMENT QUALITY

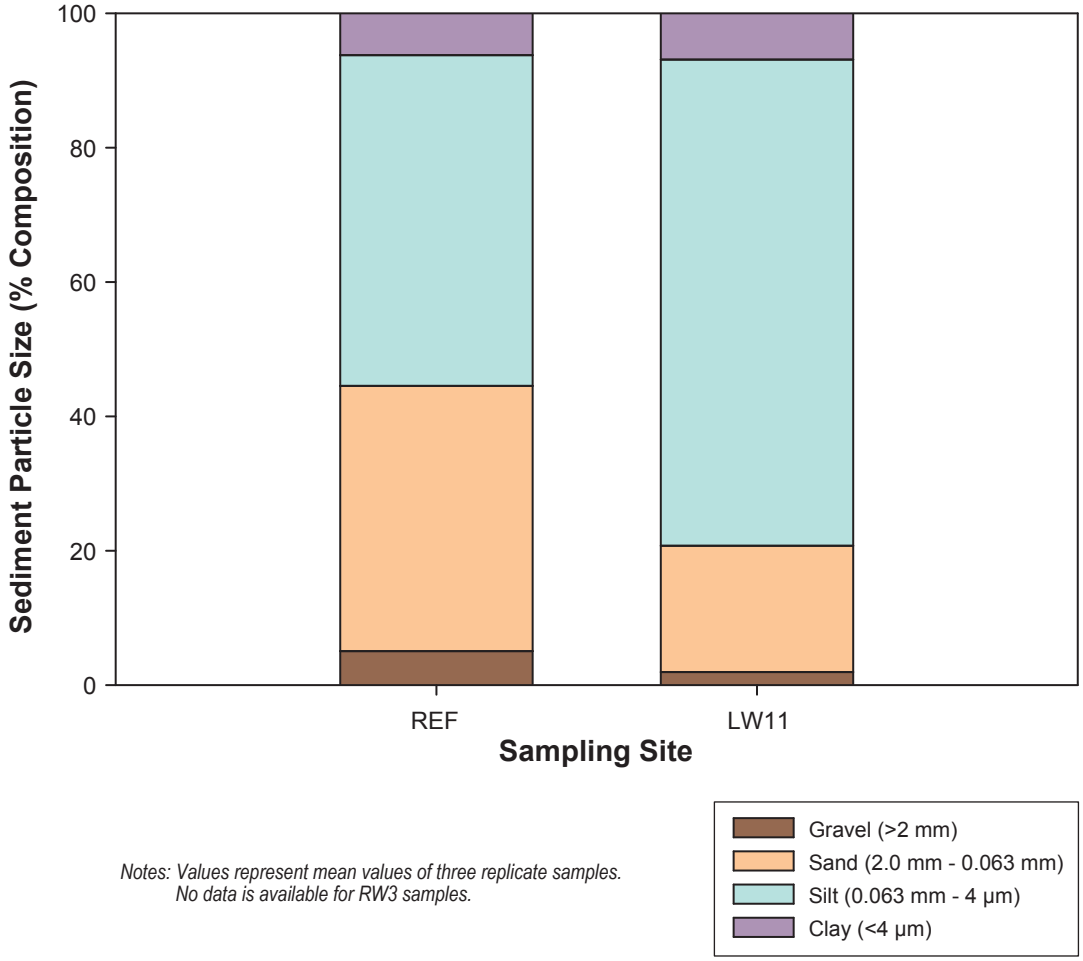
Sediment quality parameters of interest and those with CCME or BC MOE guidelines were graphed and presented in Figures 5.2-1 to 5.2-6. Wetland sediment quality data are presented in Appendix 8-1.

5.2.1 Sediment Particle Size Composition

Sediment particle size composition was analyzed for REF and LW11 (Figure 5.2-1). Sediments in both wetlands were primarily silt (0.063 mm – 4 µm), which comprised 49% of the sediment in REF and 72% in LW11. Sand (2 – 0.063 mm) was also a major constituent at both wetlands: 40% at REF and 19% at LW11. Clay (~6-7%) and gravel (~2-5%) were minor constituents of sediments in LSA wetlands.

5.2.2 Sediment Nutrients

TOC and total nitrogen content, and available phosphate concentrations had similar patterns among LSA wetlands and were always greatest at RW3, and lowest at REF. (Figure 5.2-2). TOC and total nitrogen content were over four times higher in RW3 compared to LW11 and REF. Available phosphate was below or near the detection limit of 2 mg/kg in REF and LW11 and had a mean concentration of 32.4 mg/kg at RW3.



Notes: Values represent mean values of three replicate samples.
No data is available for RW3 samples.

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Sediment Particle Size for Wetlands, 2010

Figure 5.2-1

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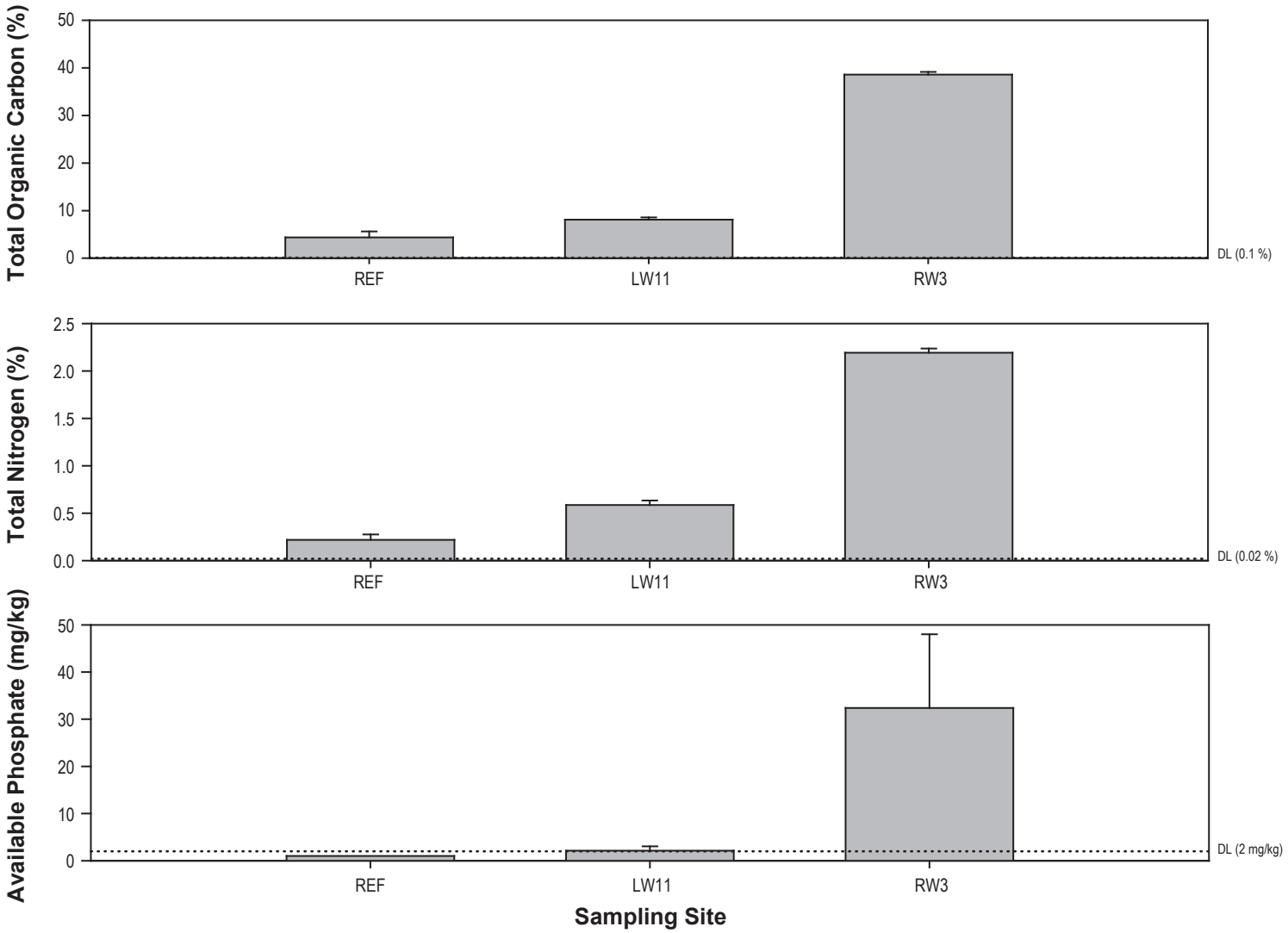

Notes: Values represent the mean of three replicates, and error bars represent standard error of the mean.
Dotted line represents the realized detection limits (DL).

Figure 5.2-2

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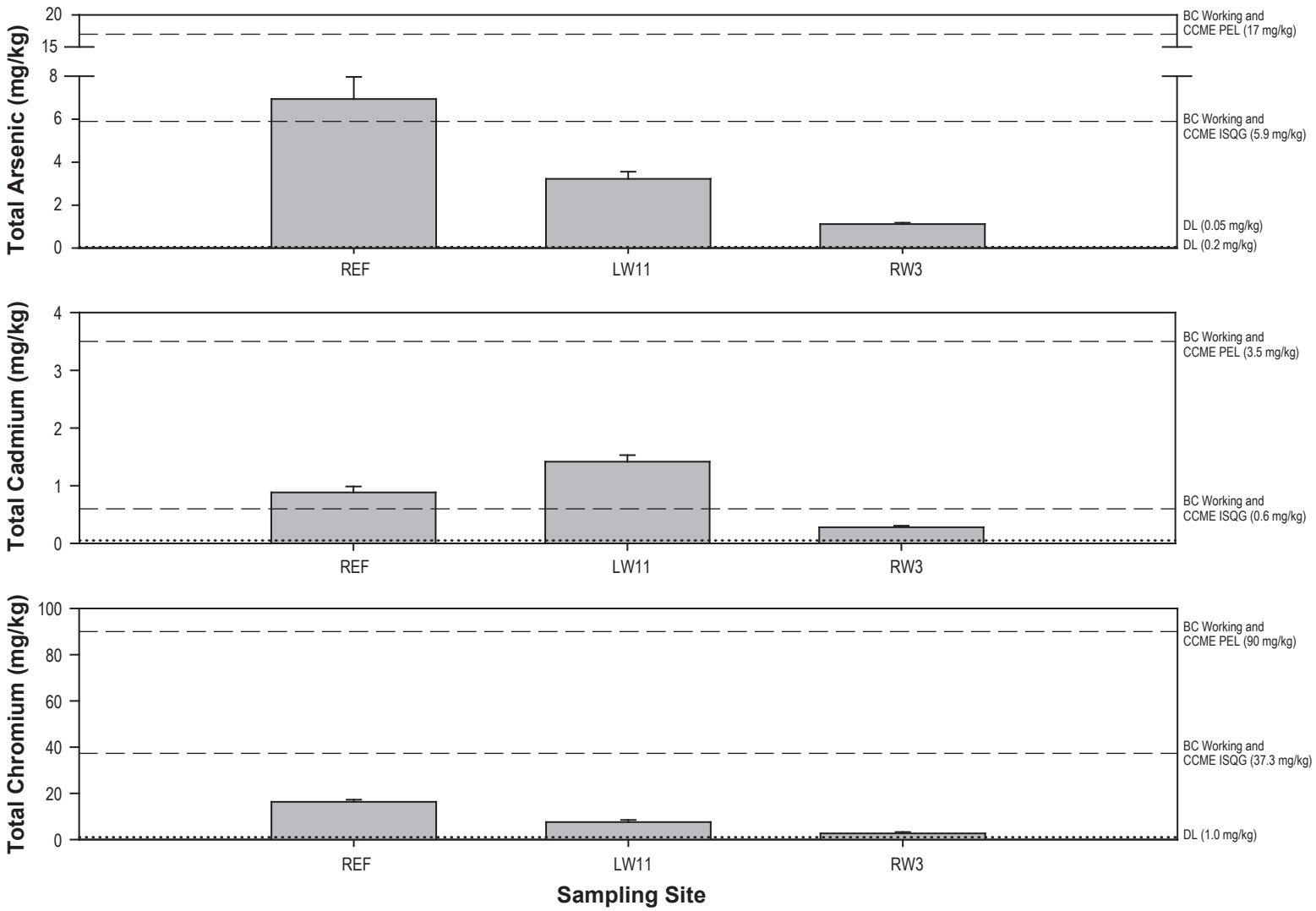
Sediment Total Organic Carbon, Total Nitrogen, and Available Phosphate Concentrations in Wetlands, 2010

Figure 5.2-2

Rescan Engineers & Scientists



Notes: Values represent the mean of three replicates, and error bars represent standard error of the mean.
Dotted line represents the realized detection limits (DL).
Dashed line represents BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 5.2-3

hdMining

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Sediment Arsenic, Cadmium and Chromium Concentrations in Wetlands, 2010

Figure 5.2-3

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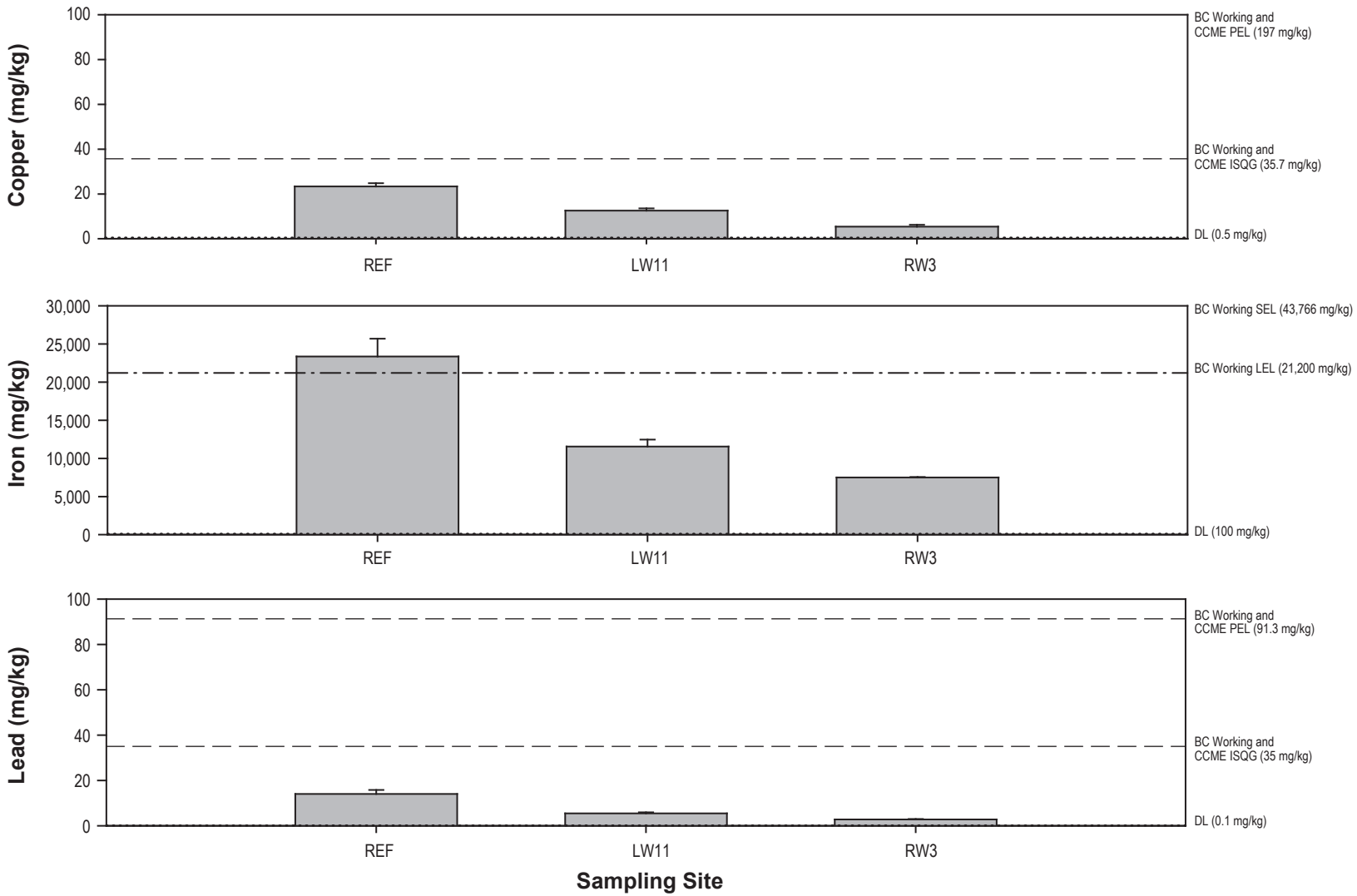


Notes: Values represent the mean of three replicates, and error bars represent standard error of the mean.
Dotted line represents the realized detection limits (DL).
Dashed line represents BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
Dotted-dashed line represents BC Working Guidelines for the lowest effect level (LEL) and severe effect level (SEL) based on a screening level concentration.

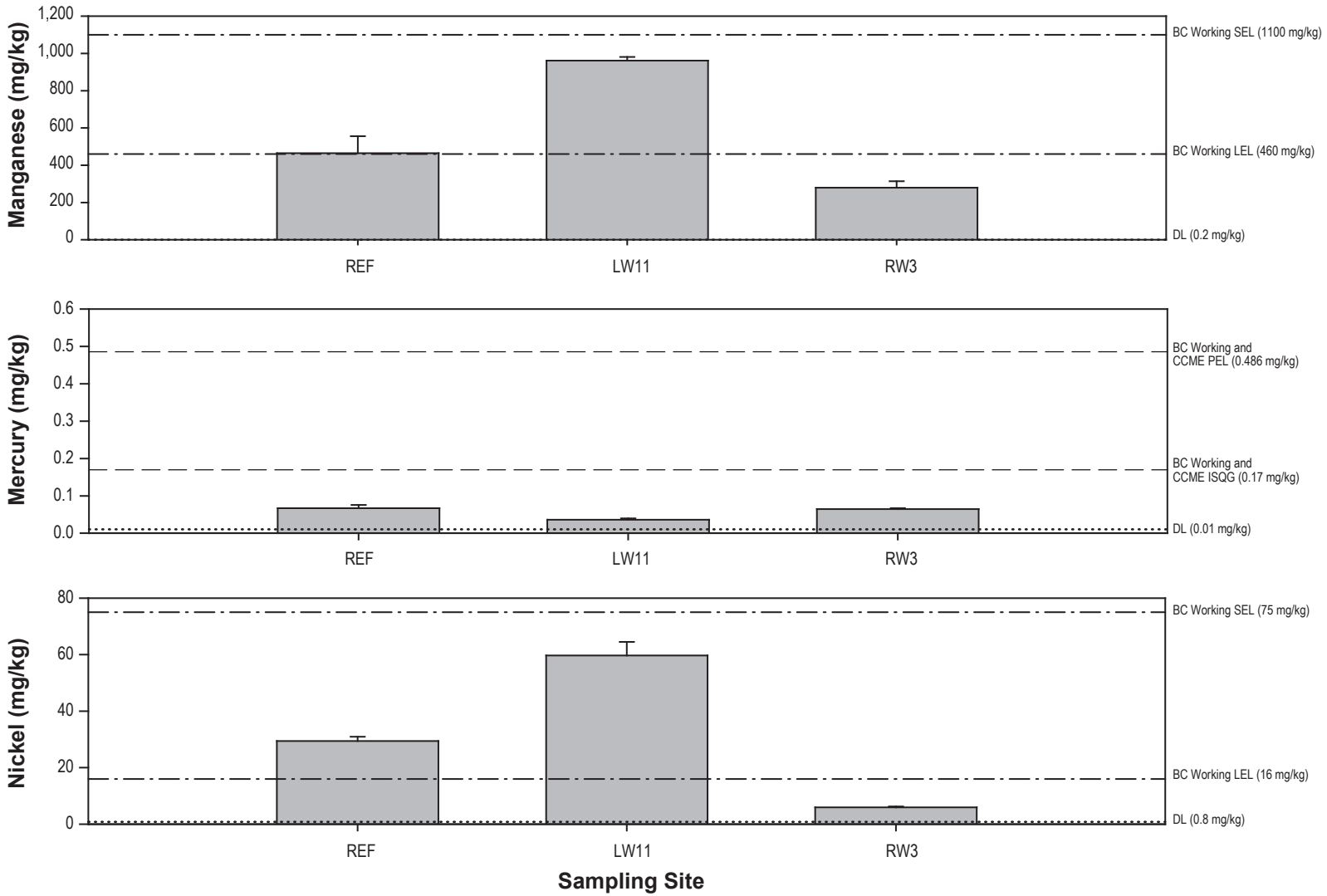
Figure 5.2-4

hdMining | MURRAY RIVER COAL PROJECT

Sediment Copper, Iron and Lead Concentrations in Wetlands, 2010

Figure 5.2-4

Rescan Engineers & Scientists



Notes: Values represent the mean of three replicates, and error bars represent standard error of the mean.
Dotted line represents the realized detection limits (DL).
Dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.
Dotted-dashed lines represent BC Working Guidelines for the lowest effect level (LEL) and sever effect level (SEL) based on a screening level concentration.

Figure 5.2-5

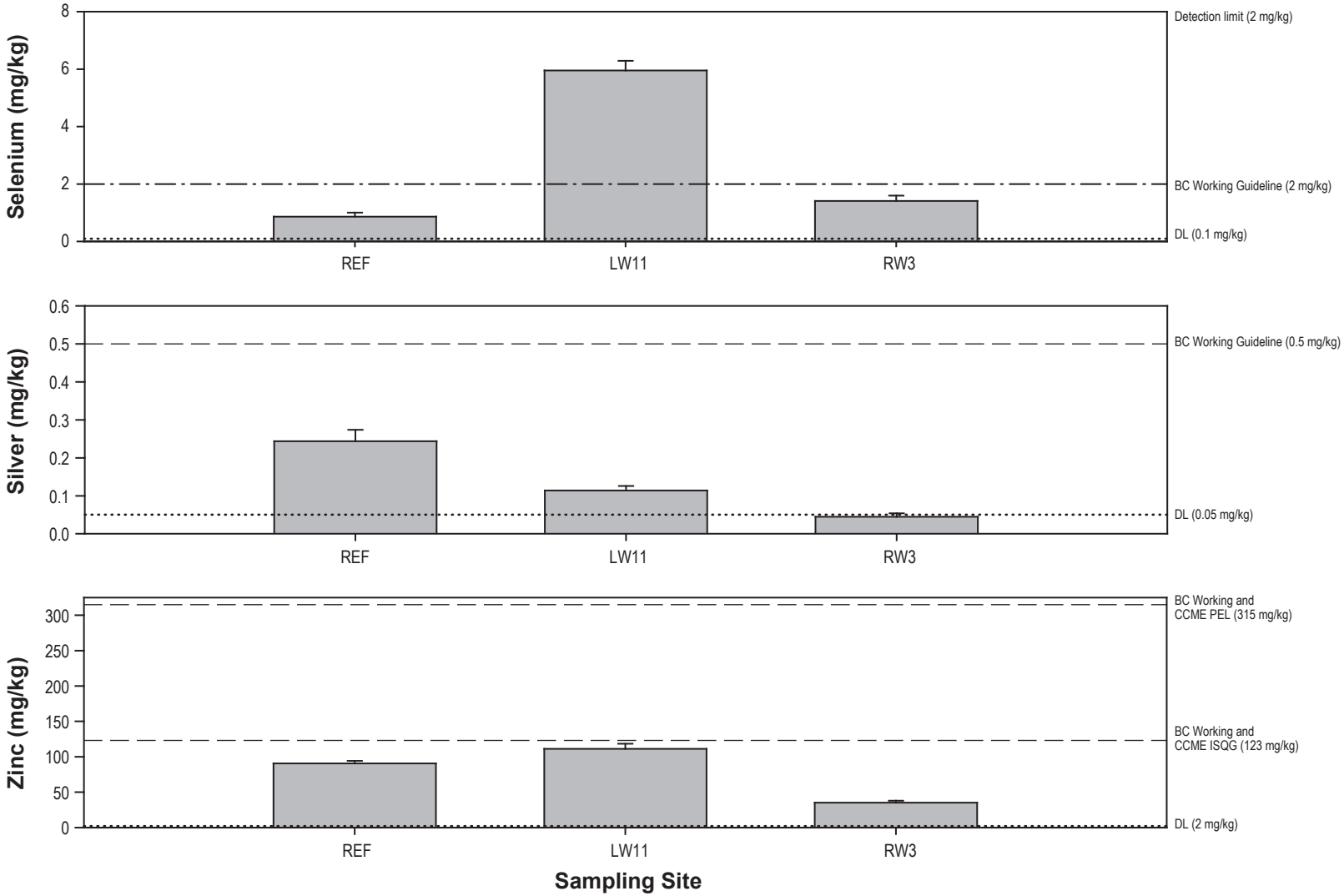
hd Mining

MURRAY RIVER COAL PROJECT

Sediment Manganese, Mercury, and Nickel Concentrations in Wetlands, 2010

Figure 5.2-5

Rescan Engineers & Scientists



Notes: Values represent the mean of three replicates, and error bars represent standard error of the mean.
Dotted line represents the realized detection limits (DL).
Dashed lines represent BC Working and CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines.

Figure 5.2-6

hdMining

MURRAY RIVER COAL PROJECT

Sediment Selenium, Silver, and Zinc Concentrations in Wetlands, 2010

Figure 5.2-6

Rescan Engineers & Scientists

5.2.3 Sediment Metals

Arsenic, chromium, copper, iron, lead, and silver concentrations at REF were double those measured at other wetland sites in the Project area (Figures 5.2-3 to 5.2-6). For example, mean iron concentrations at REF were 23,367 mg/kg, while LW11 was 11,567 mg/kg and RW3 was 7,503 mg/kg (Figure 5.2-4). LW11 had elevated manganese, nickel and selenium concentrations. Mean metal concentrations were typically lower in RW3 compared to other wetlands in the Project area.

5.2.4 Sediment Quality Guidelines

Cadmium concentrations were above the CCME ISQG, and manganese and nickel concentrations were above the BC LEL at REF and LW11 (Table 5.2-1). REF also had arsenic and iron concentrations above their respective CCME ISQG for arsenic and BC LEL for iron. Sediment from LW11 was above the BC guideline for selenium by an average factor of 2.98 (Table 5.2-1). Sediment collected from RW3 was not above any CCME or BC sediment quality guidelines.

5.3 PHYTOPLANKTON

Phytoplankton biomass (as chl *a*) and taxonomic samples were collected in August 2010 and the data are presented in Appendix 9-1 and 9-2, respectively.

5.3.1 Biomass, Density, and Community Composition

Phytoplankton biomass and density were highest in LW4 (Figure 5.3-1). Mean phytoplankton biomass in LW4 was 28 µg chl *a*/L; over three times higher than other wetland sites in the Project area. Similarly, mean phytoplankton density was 4,989 cells/mL at LW4, while other wetlands in the area had densities that were less than 650 cells/mL (Figure 5.3-1). LW4 had especially high abundances of *Dinobryon* cf *sertularia* (Chrysophyta), *Crucigenia rectangularis* (Chlorophyta), *Lyngbya* (Cyanophyta) and *Oscillatoria* cf *tenuis* (Cyanophyta; Appendix 9-2).

Phytoplankton community composition was variable among wetlands of the Murray River Project area (Figure 5.3-2). REF phytoplankton communities were unique, being primarily composed of Pyrrhophyta (59%; dinoflagellates), with Cryptophyta contributing 30% of the community. LW4 contained a relatively even and diverse distribution of phytoplankton taxa, with green algae (Chlorophyta; 34% of the community) and cyanobacteria (Cyanophyta; 31% of the community) being dominant. Cyanobacteria were common in LW11 and represented 54% of the phytoplankton community, with cryptophytes representing 32% of the community. RW3 was dominated by green algae which constituted 58% of the phytoplankton community, followed by cryptophytes (21% of the community) and cyanobacteria (20% of the community).

5.3.2 Diversity

Mean genus richness was considerably higher in LW4 (26 genera/sample), compared to other wetlands where richness ranged from 6 genera/sample (RW3) to 14 genera/sample (LW11; Figure 5.3-1). Phytoplankton diversity as indicated by Simpson's Diversity Index ranged from 0.68 at REF to 0.85 at LW4 (Figure 5.3-1).

5.4 BENTHIC INVERTEBRATES

Benthic invertebrates were collected from three wetland sites in August 2010, including REF, LW11, and RW3. Wetland benthic invertebrate taxonomic data are presented in Appendix 10-1.

Table 5.2-1. Percentage of CCME and BC Guideline Exceedances and Average Factor of Exceedances in Wetland Sediment Replicates, 2010 to 2012

Parameter		Arsenic		Cadmium		Iron		Manganese		Nickel		Selenium	
Jurisdiction		CCME[a] = BC[b]		CCME = BC		BC		BC		BC		BC	
		ISQG[c]		ISQG		LEL[d]		LEL		LEL			
Guideline		5.9		0.6		21,200		460		16		2	
Site	# Samples	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%	Factor
REF	3	66.7%	1.31	100%	1.48	66.7%	1.20	33.3%	1.38	100%	1.84	0%	-
LW11	3	0%	-	100%	2.36	0%	-	100%	2.09	100%	3.73	100%	2.98
RW3	3	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-

Notes:

[a] *Canadian sediment quality guideline for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, accessed March 2013; all units are in mg/kg.*

[b] *British Columbia working sediment guideline for the protection of freshwater aquatic life, accessed March 2013; all units are in mg/kg.*

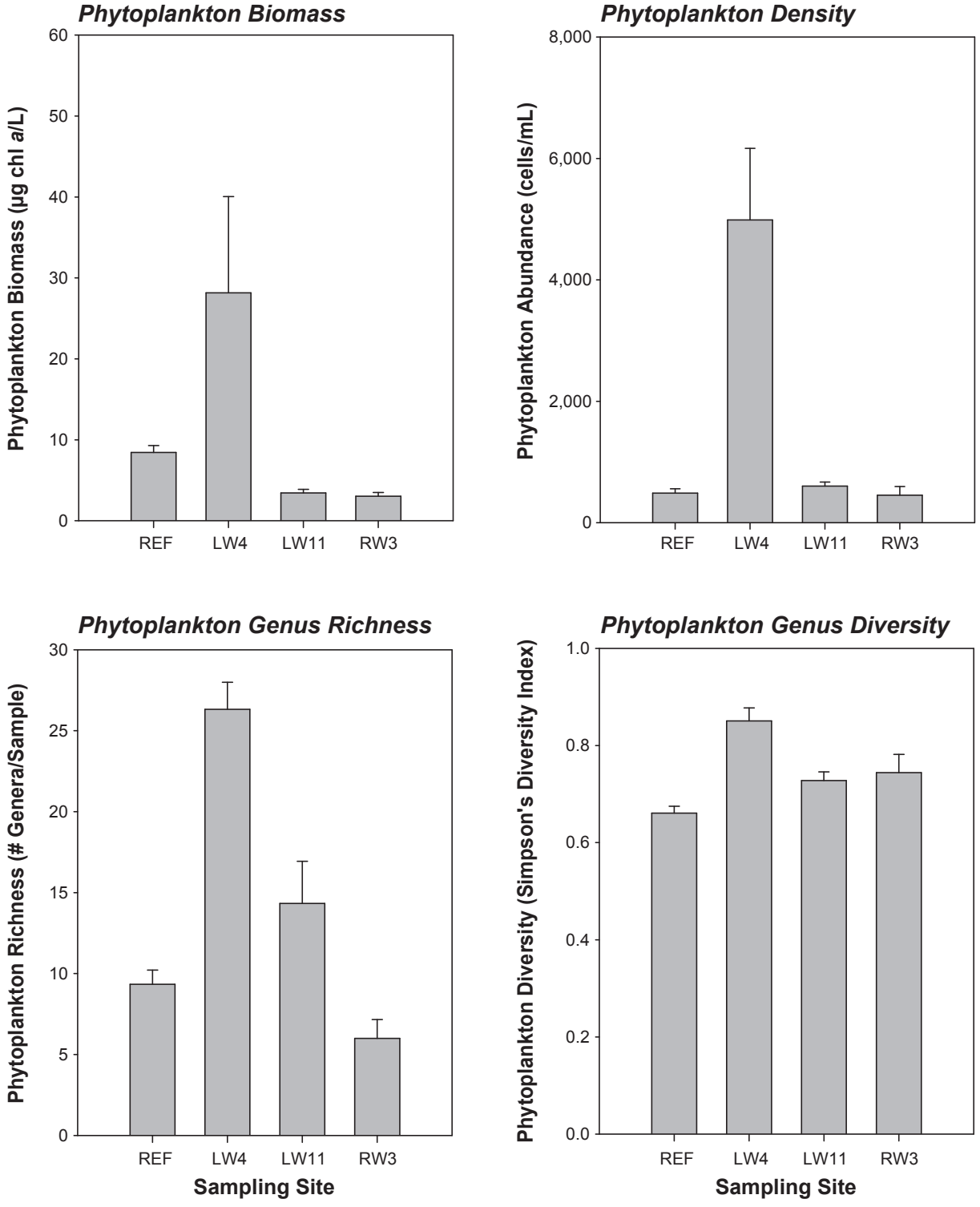
[c] *CCME interim sediment guideline.*

[d] *BC lowest effect level based on the screening level concentration.*

Frequency (%) represents percentage of samples collected at each site that were higher than available guidelines.

Factor represents the average factor samples above guidelines were higher than guideline concentrations.

All BC guidelines are working guidelines.



Notes: Values represent mean values of three replicate samples.
Error bars represent standard error of the mean.

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Phytoplankton Biomass, Density, Richness and Diversity in Wetlands, 2010

Figure 5.3-1

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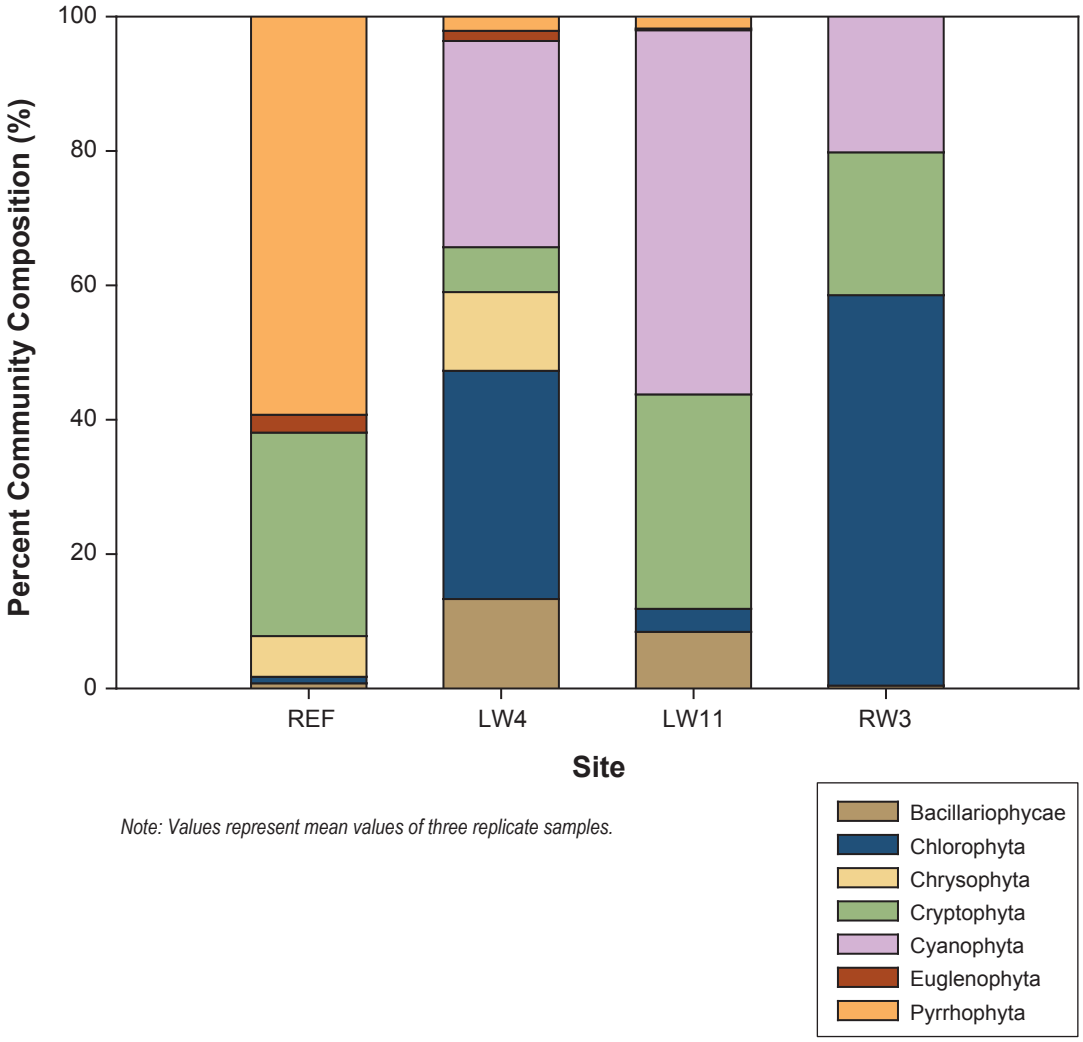

Note: Values represent mean values of three replicate samples.

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Phytoplankton Community Composition in Wetlands, 2010

Figure 5.3-2

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5.4.1 Density and Community Composition

Benthic invertebrate density was variable among wetlands of the Project area (Figure 5.4-1). Mean density ranged from 760 organisms/m^2 at REF, to 5,378 organisms/m^2 at RW3 and 14,894 organisms/m^2 at LW11.

Benthos communities were dominated by Diptera (primarily Chironomidae), which comprised 44% to 62% of wetland communities (Figure 5.4-1). In one replicate from REF, *Placobdella* sp. were abundant which resulted in a large mean Hirudinea (leech) contribution to the benthos community (Appendix 10-1). In addition to a large Diptera community, LW11 contained Gastropoda (snails; 12%), Amphipoda (scuds; 6%), Oligochaeta (7%), and Ephemeroptera (mayflies; 6%). Similarly, the benthos community at RW3 also contained scuds (21%), mayflies (11%), and molluscs (snails and clams; 14%). EPT taxa comprised less than 15% of the benthic communities in LSA wetlands. Other taxa comprised less than 6% of benthos communities, including beetles (Coleoptera), dragonflies and damselflies (Odonata) and Hydrozoa.

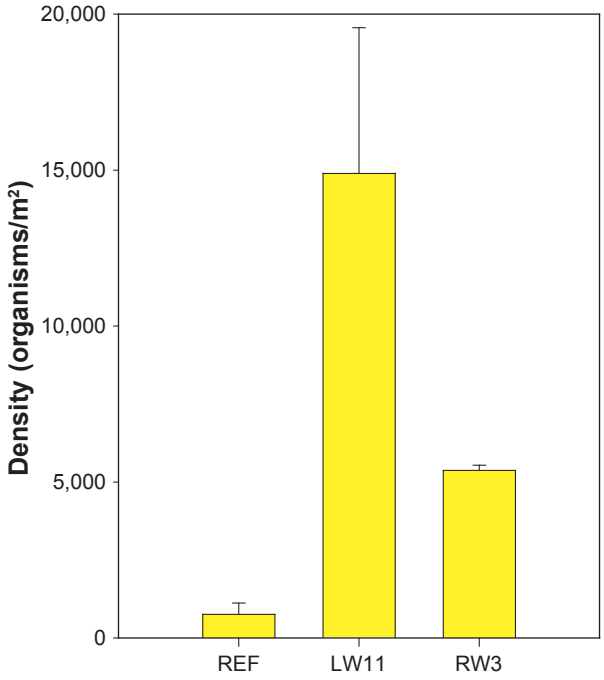
5.4.2 Richness and Diversity

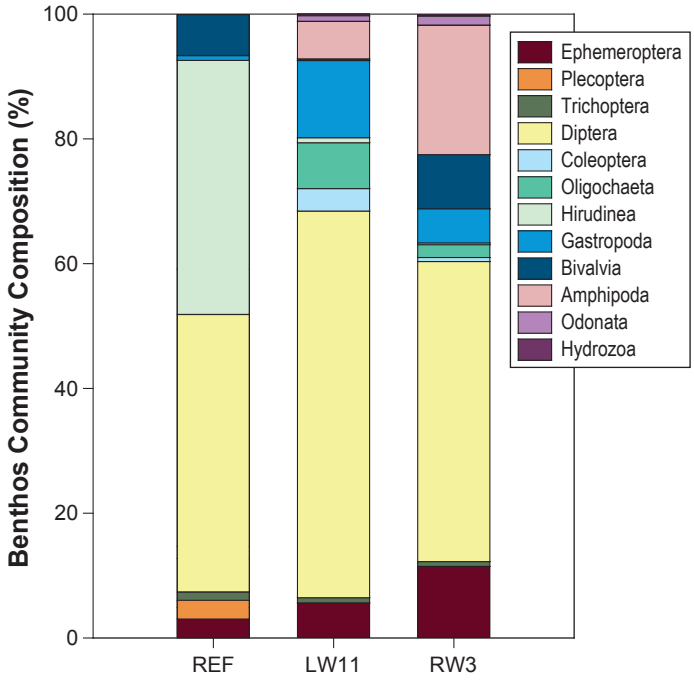
Benthos richness followed a similar pattern as density (Figure 5.4-1). Mean benthos richness was highest in LW11 with 17 families/sample and lowest in REF with 7 families/sample. EPT richness in Project area wetland replicates was low and ranged from 2 to 4 families/sample. REF benthos diversity was low, as indicated by the low Simpson's Diversity Index of 0.46 (family level), compared to 0.65 at LW11 and 0.73 at RW3.

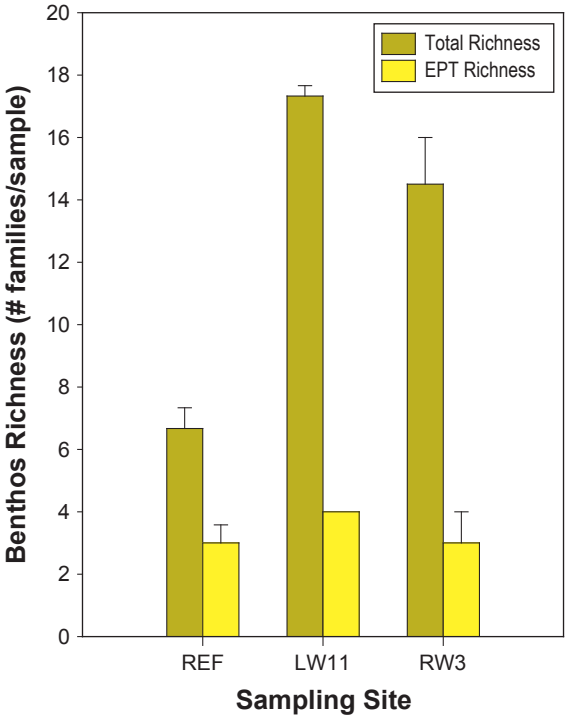
5.5 TISSUE METALS

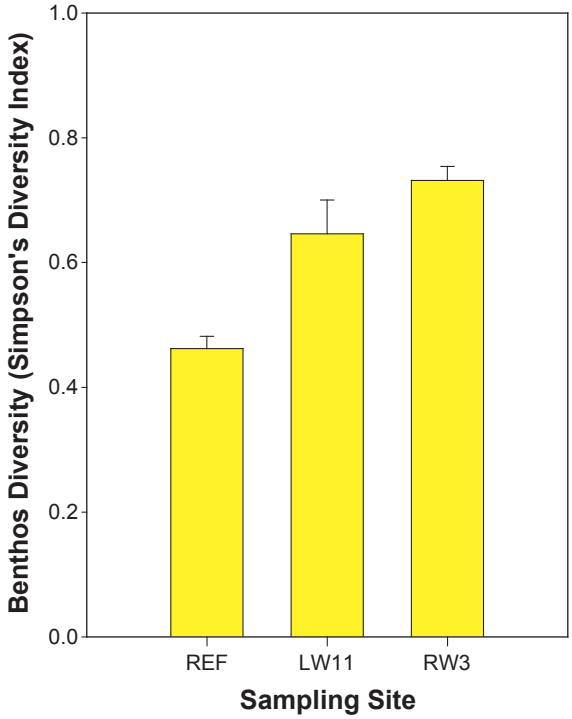
The results of the sedge tissue metal analysis are presented in Appendix 11-1. Parameters identified as contaminants of potential concern (COPC) that bioaccumulate were graphed (arsenic, cadmium, mercury and selenium) and compared with sediment metal concentrations.

Sedge tissue metal concentrations patterns reflected sediment metal levels, though tissue metal concentrations were much lower than sediment concentrations (Figures 5.5-1 and 5.5-2). REF sediment arsenic concentrations were double those found in other LSA wetlands and arsenic concentrations in REF sedge tissue was four times higher than other wetlands. Cadmium levels were elevated in REF and LW11 sediments, however, sedge tissue collected from LSA wetlands were at or below the detection limit (0.005 mg/kg). Mercury sediment concentrations and sedge concentrations patterns between sites were similar in LSA wetlands. Mean sediment selenium concentrations were high in LW11 (5.96 mg/kg) compared to other wetlands in the Project area, which were below 1.5 mg/kg. Sedge tissues reflected this, with tissue selenium concentrations at LW11 being 0.57 mg/kg (wet weight) and sedges collected from other wetlands having selenium concentrations below the detection limit of (0.2 mg/kg wet weight).









Notes: Error bars represent standard error of the mean.
The composition figure shows mean composition.
Simpson's diversity was calculated at the family level.

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Benthos Density, Community Composition, Richness and Diversity in Wetlands, 2010

Figure 5.4-1

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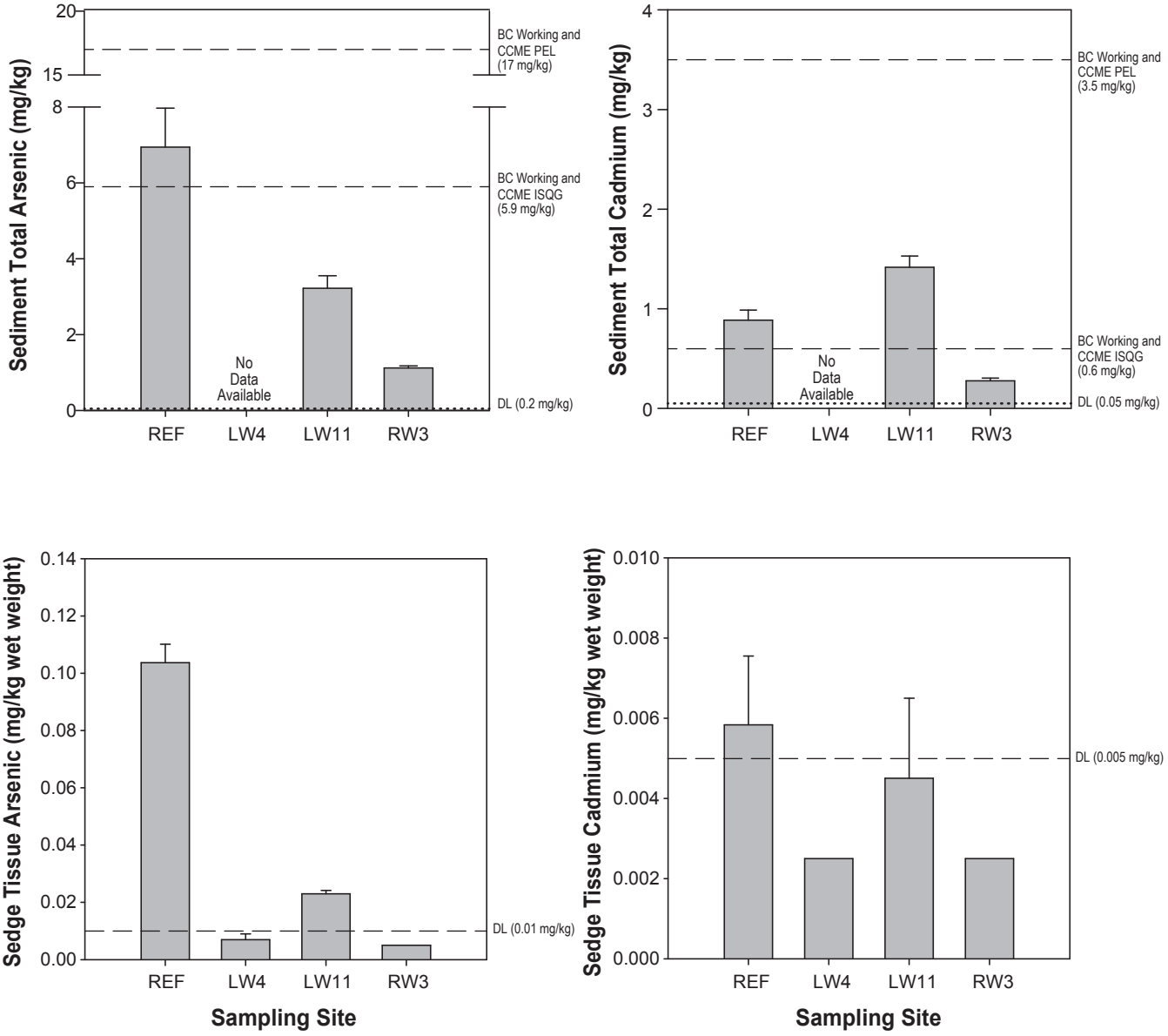

Notes: Values represent mean values of three or more replicate samples.
Error bars represent the standard error of the mean.

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Arsenic and Cadmium Concentrations in Sediment and Sedge Tissue in Streams, 2010

Figure 5.5-1

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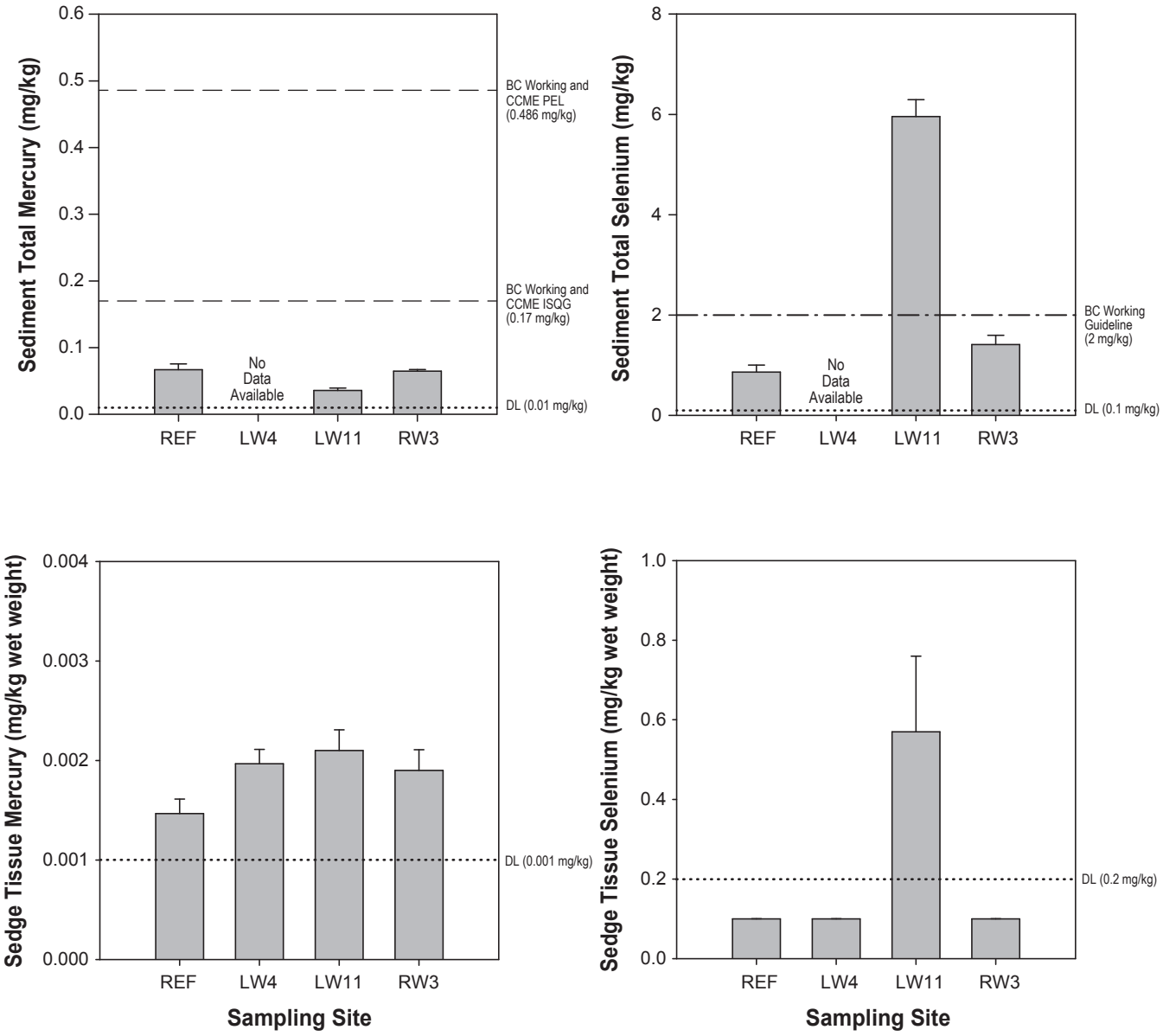

Notes: Values represent mean values of three or more replicate samples.
Error bars represent the standard error of the mean.

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Mercury and Selenium Concentrations in Sediment and Sedge Tissue in Streams, 2010

Figure 5.5-2

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6. Summary

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6. Summary

Stream Water Quality

Streams in the Project area had alkaline waters and were well buffered. Most streams contained soft water during freshet (May-June) and summer months and hard water during the autumn and winter months. Very hard waters were measured at M17 and M19 stream sites. Hardness, alkalinity, TDS and anion concentrations were typically lowest from spring (May) through the summer (September) with concentrations increasing from October to April. Conversely, turbidity and TSS had elevated high levels occurring during freshet (May-June), and lower levels measured during winter months.

Generally, nutrient concentrations were greatest during freshet. Nitrogen (total, ammonia, nitrate, nitrite) concentrations were low, while total phosphorus was variable and ranged from ultra-oligotrophic (less than 0.004 mg/L) to hyper-eutrophic concentrations (greater than 0.1 mg/L). Similarly, TOC often ranged an order of magnitude between seasons. Cyanide concentrations were variable, and often below detection limits.

Total metal concentrations were also often below their detection limits, particularly beryllium, mercury, silver, thallium, and tin. Many metals paralleled the seasonal trends observed for total suspended solids, with higher concentrations recorded during freshet in association with increased terrestrial run-off and stream flows caused by snowmelt. This included total and dissolved aluminum, total arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, potassium, titanium, vanadium, and zinc.

All streams had samples with metal concentrations greater than at least one approved BC and CCME guideline and half of the sites had metal concentrations above more than ten guidelines. Total aluminum, cadmium, hexavalent chromium, copper, and iron were commonly higher than CCME guidelines, while only total iron levels were above the BC guideline at most sites. Camp Creek sites M20-05 and M20-04, and Twenty Creek site TC-02 were above the greatest number of guidelines, by the greatest factors. For example, total aluminum concentrations at M20-04 and TC-02 were higher than the CCME guideline by a mean factor of 44 and 37, respectively. PAHs were below their detection limits at most streams, and levels were not above any CCME or BC water quality guidelines.

Stream Water Toxicity

Overall, the toxicology experiments found no impact of MR-REF and MR4 site water on survival and reproduction of the water flea *Ceriodaphnia dubia* or the rainbow trout *Oncorhynchus mykiss*. However, the water flea *Daphnia magna* had considerably reduced survivorship when site water was present at any concentration. The LC50 (lethal concentration for 50% of the sample) was less than 6.25% site water for both sites.

The duck weed *Lemna minor* may have been being inhibited by water chemistry at MR-REF, although there was no evidence of this for the downstream MR4 site. Water collected at both MR-REF and MR4 stimulated the growth of the microalgae *Pseudokirchneriella subcapitata*.

Stream Sediment Quality

Most stream sediments were composed of over 50% sand, with silt also making up a significant component. Total organic carbon (TOC) concentrations, total nitrogen and available phosphate concentrations tended to be lower in Murray River than in its tributary streams. Similarly, metal

concentrations tended to be lower in the Murray River and greater at Camp Creek (sites M20-05, M20-06, M20-04), M17 Creek, and the Reference Stream (REFST). This was similar to patterns observed in water quality. The greatest average arsenic, cadmium, selenium and zinc concentrations were measured at the reference site REFST. M20-05 had the greatest iron, lead, manganese and mercury concentrations.

All stream sites had at least one sample that above the nickel BC LEL guideline, and all stream sites except M19-01 were higher than the cadmium CCME and BC ISQG guideline. Arsenic, chromium, and zinc concentrations were higher than the guideline at a few sites. Sediments collected from the reference sites MR-REF and REFST, and from Camp Creek site at M20-05 and M20-04 were above the greatest number of guidelines (four). For stream sites with samples above guidelines, samples tended to be less than two times greater than the guideline.

Most stream sites were above the CCME and BC ISQG for the PAHs 2-methylnapthalene, phenanthrene, and naphthalene. Occasionally, chrysene, fluorine, and pyrene concentrations were higher than guidelines. Camp Creek sites M20-05 and M20-06, and MR17 Creek were above the most PAH parameter guidelines by the greatest factors.

Stream Periphyton

Periphyton biomass and densities were low and varied considerably among streams and between years. The highest periphyton biomasses were at MR4, MR7 and M20-03 in 2011, but were always less than 1 µg chl *a*/cm^2 at other sites and in other years. Periphyton densities tended to be higher in the tributary streams than in Murray River.

Overall, periphyton communities were composed largely of Bacillariophyceae (diatoms; 3-97% of the community), though Cyanophyta (blue-green algae) were often dominant or co-dominant in 2010. Chlorophyta (green algae) were dominant or co-dominant in Murray River tributary streams in 2012. Streams sampled in multiple years tended to have inter-annual variability in both richness and diversity. Richness and diversity tended to be greater in 2010 and lower in 2011.

Stream Benthos

Benthic invertebrate samples were collected with a Hess sampler in 2010 and a kick-net in 2011 and 2012. In 2010, stream benthos densities were highest at the reference tributary REFST and in 2011 and 2012, benthos densities were generally higher in Murray River tributaries. In all years, benthos communities were dominated by Ephemeroptera (mayflies), Plecoptera (stoneflies), and Diptera (true flies). Benthos richness and diversity (Simpson's Diversity Index) was generally high in LSA streams.

Stream Tissue Metals

Periphyton tissues had elevated levels of mercury and selenium in tributaries of the Murray River. Stream periphyton tissue arsenic and cadmium concentrations were similar in LSA streams, except for high levels in MR6 (arsenic) and MR7B (cadmium). Arsenic and selenium concentrations were high in stream benthic invertebrate tissues from Murray River tributaries. Cadmium and mercury levels were comparable in stream benthic invertebrate tissues, except for elevated levels in MR9 (mercury only), MR4, and M19-01. Metal concentrations in periphyton tissues were often similar to sediment concentrations while metal concentrations in benthic invertebrate tissues were typically a small fraction of sediment concentrations.

Wetland Water Quality

Wetlands in the Murray River Project area contained alkaline, hard water with high buffering capacity. Turbidity and TSS levels were low except during the winter months at W9.0 and W9.3. Nutrient levels

were low, though total phosphorus was elevated at W9.0 and W9.3 in the winter. Metal concentrations were similar among LSA wetlands, except for samples with elevated TSS. REF and LW4 had elevated TSS levels and the LW11 sample had very high TDS; accordingly, metal concentrations were elevated at these sites. Similarly, concentrations of several metals were elevated at W9.0 and W9.3 in November and December 2012 when samples had elevated TSS compared to other samples from these sites.

Total aluminum and total iron were elevated in LSA wetlands, and concentrations at most sites were above CCME guidelines. There were also sporadically high concentrations of fluoride, ammonia, cadmium, chromium, and silver above their CCME guidelines. Sulphate, total iron, and dissolved iron were occasionally higher than their BC MOE guidelines.

Wetland Sediment quality

Sediments in LSA wetlands were primarily silt (49-72%) and sand (19-40%). Organic carbon and nutrient levels were high in RW3 compared to other LSA wetlands. Sediments at REF had arsenic, chromium, iron, lead, and silver concentrations that were double those measured at other sites in the Project area while LW11 had elevated manganese, nickel, and selenium concentrations. Wetland sediment metal concentrations were above the CCME or BC MOE guidelines for arsenic, cadmium, iron, manganese, nickel, and selenium, though RW3 sediments were not higher than any applicable guideline.

Wetland Phytoplankton

Phytoplankton biomass and density were high in LSA wetlands, and very high in LW4. LW4 also had the richest and most diverse phytoplankton community which was dominated by green algae (Chlorophyta) and cyanobacteria (Cyanophyta). Cyanobacteria and Cryptophyta were common in LW11, and Pyrrhophyta (dinoflagellates) and Cryptophyta dominated the REF phytoplankton community. RW3 wetlands were dominated by green algae, followed by Cryptophyta and cyanobacteria.

Wetland Benthic Invertebrates

Benthic invertebrate density was variable among the LSA wetlands. Benthos density at LW11 was almost triple those at RW3 and 19 times higher those at REF. Benthos richness had a similar pattern. Benthos communities at LW11 and RW3 were similar and diverse while diversity (Simpson's Diversity Index) was lower at REF. Benthos communities were dominated by Diptera (primarily Chironomidae), with smaller proportions of Gastropoda (snails) and Amphipoda (scuds) and Bivalvia. EPT taxa comprised less than 15% of the benthic communities in LSA wetlands.

Wetland Tissue Metals

Sedge tissue metal concentrations reflected sediment metal levels, though tissue metal concentrations were much lower than sediment concentrations. REF had elevated sediment and sedge tissue arsenic concentrations. Sedge cadmium and mercury concentrations were below or near their detection limits. Sediment and sedge tissues from LW11 had elevated selenium concentrations compared to other wetland sites.

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Appendix 1-1

Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

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Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2010								
Month Sampled		May	May	June	June	July	August	August	October	December
Date Sampled		20-May-10	30-May-10	5-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L889661-6	L892473-2	L894623-2	L897909-1	L915316-1	L921658-4	L921658-7	R010261-01	R012173-03
Physical Tests										
Colour, True	CU	10.1	19.4	6.4	5.1	<5.0	<5.0	<5.0	-	301
Conductivity	µS/cm	188	146	207	162	174	175	174	-	162.0
Hardness (as $CaCO_3$)	mg/L	99.9	76.5	123	83.1	88.6	80.8	82.7	97.9	154.0
pH	pH	8.24	8.09	8.24	8.27	7.63	8.16	8.25	7.63	8.15
Total Suspended Solids	mg/L	54.5	5.1	7.2	9.9	3.0	4.8	4.8	3.0	<1
Total Dissolved Solids	mg/L	103	89	120	87	94	99	97	100	151
Turbidity	NTU	22.5	2.87	2.82	4.41	0.75	0.79	0.82	-	0.5
Anions and Nutrients										
Acidity (as $CaCO_3$)	mg/L	<1.0	2.6	1.2	1.1	5.8	<1.0	1.3	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	94.7	71.3	109	86.9	83.3	87.5	87.3	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	94.7	71.3	109	86.9	83.3	87.5	87.3	-	141
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.51	0.51	-	1.21
Fluoride (F)	mg/L	0.028	0.034	0.028	<0.020	0.025	0.023	0.023	-	<0.10
Nitrate (as N)	mg/L	0.0965	<0.0050	0.0642	0.0395	0.0160	0.0177	0.0186	-	0.02
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	<0.050	0.120	0.086	<0.050	0.064	<0.050	0.051	-	0.09
Total Nitrogen	mg/L	0.130	0.120	0.150	<0.060	0.080	0.050	0.070	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.0459	0.0121	0.0088	0.0101	0.0057	0.0031	0.0026	-	<0.010
Sulphate (SO_4)	mg/L	3.87	2.72	4.49	4.03	7.20	7.45	7.47	-	14.3
Cyanides										
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	<0.0010	<0.0010	<0.0010	-	<0.002
Cyanide, Total	mg/L	0.0035	0.0056	0.0017	0.0020	0.0013	0.0014	0.0011	-	<0.01
Organic Carbon										
Total Organic Carbon	mg/L	3.14	4.58	1.83	1.40	1.04	0.78	1.66	-	0.90
Total Metals										
Aluminum (Al)	mg/L	1.10	0.121	0.205	0.228	0.0254	0.0132	0.0230	0.1650	<0.050
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010
Arsenic (As)	mg/L	0.00045	<0.00010	0.00014	<0.00020	0.00012	<0.00010	0.00012	<0.0005	<0.0050
Barium (Ba)	mg/L	0.0555	0.0649	0.0539	0.0268	0.0281	0.0282	0.0300	0.0266	0.052
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.011	<0.010	<0.010	<0.010	0.011	0.010	0.010	0.012	<0.040
Cadmium (Cd)	mg/L	0.000077	0.000031	0.000020	0.000018	<0.000010	<0.000010	<0.000010	0.000	<0.00010
Calcium (Ca)	mg/L	33.3	22.4	36.7	26.1	25.2	21.4	23.3	26.3	44.900
Chromium (Cr)	mg/L	0.00170	<0.00050	0.00046	0.00049	<0.00020	0.00013	0.00017	00.0	<0.0050
Cobalt (Co)	mg/L	0.00055	<0.00010	0.00010	0.00013	<0.00010	<0.00010	<0.00010	0.00016	<0.00050
Copper (Cu)	mg/L	0.00148	0.00066	0.00053	<0.00060	<0.00030	<0.00030	<0.00030	0.0009	0.00160
Iron (Fe)	mg/L	1.33	0.114	0.193	0.249	0.054	0.044	0.060	0.4	0.11
Lead (Pb)	mg/L	0.000677	0.000053	0.000123	0.000139	<0.000050	0.000087	0.000052	0.000	0.00120
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.001700	0.006
Magnesium (Mg)	mg/L	9.20	5.84	8.28	6.86	5.91	6.16	6.61	7.83	12
Manganese (Mn)	mg/L	0.0360	0.00270	0.00673	0.0116	0.00522	0.00483	0.00610	0.01	0.0049
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2010								
Month Sampled		May	May	June	June	July	August	August	October	December
Date Sampled		20-May-10	30-May-10	5-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L889661-6	L892473-2	L894623-2	L897909-1	L915316-1	L921658-4	L921658-7	R010261-01	R012173-03
Total Metals (*cont'd*)										
Molybdenum (Mo)	mg/L	0.000588	0.000302	0.000600	0.000430	0.000549	0.000526	0.000533	0.0005	<0.0010
Nickel (Ni)	mg/L	0.00193	0.00254	0.00058	0.00063	<0.00050	<0.00050	<0.00050	0.001800	0.0021
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.648	0.287	0.341	0.285	0.251	0.272	0.303	-	-
Selenium (Se)	mg/L	<0.00020	0.00042	0.00021	<0.00020	0.00010	0.00010	<0.00010	0.0004	<0.0030
Silicon (Si)	mg/L	2.63	1.40	1.42	1.15	0.859	0.887	0.900	-	-
Silver (Ag)	mg/L	0.000044	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.850	1.3
Strontium (Sr)	mg/L	0.0779	0.0460	0.0715	0.0476	0.0707	0.0774	0.0805	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	0.00050	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	0.019	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01	<0.050
Uranium (U)	mg/L	0.000209	0.000078	0.000198	0.000143	0.000147	0.000139	0.000149	0.00015	0.00029
Vanadium (V)	mg/L	0.0041	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.0100
Zinc (Zn)	mg/L	0.0065	0.0012	0.0014	0.0013	<0.0010	<0.0010	<0.0010	0.0020	<0.010
Dissolved Metals										
Aluminum (Al)	mg/L	0.0123	0.0128	0.0066	0.0086	0.0046	0.0029	0.0027	0.016	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.001
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.0005	<0.005
Barium (Ba)	mg/L	0.0316	0.0627	0.0543	0.0234	0.0286	0.0290	0.0290	0.0257	0.0516
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.005	<0.04
Cadmium (Cd)	mg/L	0.000012	0.000023	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	27.8	21.4	36.1	23.9	26.0	22.0	22.7	25.6	41.1
Chromium (Cr)	mg/L	<0.00020	<0.00050	<0.00020	<0.00020	<0.00050	<0.00010	<0.00010	<0.0005	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00005	<0.0005
Copper (Cu)	mg/L	0.00040	0.00042	0.00043	0.00023	0.00018	0.00017	0.00013	0.0009	<0.001
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.048	<0.1
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.002	0.0051
Magnesium (Mg)	mg/L	7.42	5.60	8.06	5.68	5.78	6.30	6.32	6.51	12.6
Manganese (Mn)	mg/L	0.000277	0.000604	0.000592	0.000654	0.000075	0.000151	0.000153	0.0026	0.005
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Molybdenum (Mo)	mg/L	0.000460	0.000298	0.000521	0.000397	0.000556	0.000522	0.000536	0.0005	<0.001
Nickel (Ni)	mg/L	<0.00050	0.00081	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.270	0.251	0.280	0.198	0.267	0.291	0.285	-	-
Selenium (Se)	mg/L	<0.00020	0.00037	<0.00020	<0.00020	0.00010	<0.00010	<0.00010	<0.0003	<0.003
Silicon (Si)	mg/L	1.06	1.19	1.25	0.847	0.820	0.858	0.840	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.84	1.32
Strontium (Sr)	mg/L	0.0549	0.0453	0.0698	0.0458	0.0718	0.0786	0.0779	0.0688	0.147
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000149	0.000070	0.000192	0.000120	0.000148	0.000141	0.000139	0.00016	0.00031
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0021	<0.01

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2010								
Month Sampled		May	May	June	June	July	August	August	October	December
Date Sampled		20-May-10	30-May-10	5-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L889661-6	L892473-2	L894623-2	L897909-1	L915316-1	L921658-4	L921658-7	R010261-01	R012173-03
Hydrocarbons										
EPH10-19	mg/L	-	-	-	<0.25	-	<0.25	-	<0.1	-
EPH19-32	mg/L	-	-	-	<0.25	-	<0.25	-	<0.1	-
LEPH	mg/L	-	-	-	<0.25	-	<0.25	-	<0.1	-
HEPH	mg/L	-	-	-	<0.25	-	<0.25	-	<0.1	-
PAH	mg/L	-	-	-	-	-	-	-	<0.3	-
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	mg/L	-	-	-	<0.000050	-	<0.000030	-	<0.00005	-
Acenaphthylene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Acridine	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.0001	-
Anthracene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Benz(a)anthracene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Benzo(a)pyrene	mg/L	-	-	-	<0.000010	-	<0.000010	-	<0.00001	-
Benzo(b)fluoranthene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Benzo(g,h,i)perylene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Benzo(k)fluoranthene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Chrysene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Dibenz(a,h)anthracene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Fluoranthene	mg/L	-	-	-	<0.000050	-	0.000018	-	<0.00005	-
Fluorene	mg/L	-	-	-	<0.000050	-	0.000018	-	<0.00005	-
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.00005	-
Naphthalene	mg/L	-	-	-	<0.000050	-	<0.000070	-	<0.0003	-
Phenanthrene	mg/L	-	-	-	<0.000050	-	0.000051	-	<0.0001	-
Pyrene	mg/L	-	-	-	<0.000050	-	0.000011	-	<0.0001	-
Quinoline	mg/L	-	-	-	<0.000050	-	<0.000010	-	<0.0001	-
Surrogate: d10-Acenaphthene (SS)	mg/L	-	-	-	108	-	86	-	-	-
Surrogate: d9-Acridine (SS)	mg/L	-	-	-	99	-	79	-	-	-
Surrogate: d12-Chrysene (SS)	mg/L	-	-	-	100	-	79	-	-	-
Surrogate: d8-Naphthalene (SS)	mg/L	-	-	-	99	-	88	-	-	-
Surrogate: d10-Phenanthrene (SS)	mg/L	-	-	-	100	-	90	-	-	-

Notes:
All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2011														
Month Sampled		January	February	March	April	May	May	May	June	June	June	July	August	September	October	November
Date Sampled		4-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	11-May-11	17-May-11	25-May-11	2-Jun-11	7-Jun-12	14-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-02	L981301-1	L990825-2	L999009-8	L1004821-2	L1007262-2	L1009390-2	L1012487-2	L1015493-2	L1018864-2	L1034422-4	L1049152-2	L1064458-3	L1073725-2	L1091894-2
Physical Tests																
Colour, True	CU	5	<5.0	<5.0	<5.0	14.4	16.4	11.7	8.6	5.7	6.6	5.3	<5.0	7.7	<5.0	8.8
Conductivity	µS/cm	272	295	310	317	252	206	207	176	175	169	187	177	171	241	236
Hardness (as $CaCO_3$)	mg/L	142.0	156	160	153	134	107	107	95.8	94.8	77.4	98.0	86.7	85.5	119	130
pH	pH	8.08	8.17	8.20	8.33	8.23	8.20	8.25	8.20	8.17	8.24	8.25	8.26	8.25	8.32	8.31
Total Suspended Solids	mg/L	<1	<3.0	3.5	3.1	44.9	147	63.8	24.1	22.7	19.3	6.5	21.3	10.0	<1.0	<1.0
Total Dissolved Solids	mg/L	170	-	175	-	139	-	119	-	99	-	-	-	-	<3.0	<3.0
Turbidity	NTU	0.6	0.92	2.42	2.02	16.5	56.4	25.5	12.5	8.87	6.36	5.13	2.24	7.97	0.75	2.13
Anions and Nutrients																
Acidity (as $CaCO_3$)	mg/L	<2	1.0	3.6	<1.0	1.5	1.8	1.6	1.5	3.4	1.5	1.6	1.4	1.8	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	144	144	147	156	131	114	111	95.6	90.1	88.2	98.7	86.6	81.2	117	122
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	144	144	147	156	131	114	111	95.6	90.1	88.2	98.7	86.6	81.2	117	122
Ammonia (as N)	mg/L	<0.02	0.0067	<0.0050	0.0052	<0.0050	0.0057	<0.0050	<0.0050	<0.0050	0.0050	0.0114	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.31	1.35	1.52	1.37	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.58	0.51
Fluoride (F)	mg/L	<0.10	0.045	0.048	0.050	0.041	0.028	0.035	<0.020	<0.020	<0.020	0.034	0.029	0.026	0.040	0.040
Nitrate (as N)	mg/L	0.08	0.0882	0.0900	0.0642	0.101	0.110	0.0823	0.0600	0.0459	0.0308	0.0210	0.0148	0.0214	0.0268	0.0556
Nitrite (as N)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.1	0.053	0.080	0.096	0.189	0.210	0.158	0.100	0.184	0.109	0.099	0.145	<0.050	0.103	<0.050
Total Nitrogen	mg/L	-	0.141	0.170	0.160	0.290	0.320	0.240	0.160	0.230	0.140	0.120	0.160	0.070	0.130	0.050
Orthophosphate (as P)-Dissolved	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	-	<0.0020	<0.0020	<0.0020	<0.0020	0.0027	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.02	0.0021	0.0029	0.0047	0.0495	0.111	0.0838	0.0237	0.0233	0.0157	0.0094	0.0253	0.0156	<0.0020	0.0056
Sulphate (SO_4)	mg/L	16.5	15.5	17.1	17.1	7.61	4.66	4.61	4.11	4.06	4.09	5.62	7.02	5.80	9.80	8.49
Cyanides																
Cyanide, Weak Acid Dissociable	mg/L	<0.002	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.01	0.0016	0.0013	0.0016	<0.0020	0.0065	0.0036	0.0037	0.0035	0.0011	0.0030	<0.0020	0.0034	0.0027	0.0031
Organic Carbon																
Total Organic Carbon	mg/L	0.90	1.62	1.04	1.57	4.29	7.17	3.57	2.74	2.77	2.09	1.82	1.47	2.12	1.43	2.43
Total Metals																
Aluminum (Al)	mg/L	0.0510	0.0086	0.0845	0.0328	0.904	1.30	0.623	0.382	0.378	0.216	0.248	0.263	0.273	0.0161	0.0469
Antimony (Sb)	mg/L	<0.0010	0.00066	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.0050	<0.00010	0.00014	0.00014	0.00058	0.00084	0.00041	0.00024	0.00019	0.00015	0.00018	0.00023	0.00018	0.00010	0.00013
Barium (Ba)	mg/L	0.0786	0.0542	0.0668	0.0664	0.0672	0.0639	0.0452	0.0386	0.0331	0.0286	0.0405	0.0324	0.0260	0.0383	0.0426
Beryllium (Be)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.040	0.019	0.015	0.014	0.013	0.012	0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	0.011	<0.010
Cadmium (Cd)	mg/L	<0.00010	0.000013	0.000014	0.000019	0.000091	0.000148	0.000066	0.000038	0.000030	0.000019	0.000019	0.000025	0.000017	<0.000010	0.000016
Calcium (Ca)	mg/L	35.2	44.4	45.9	43.6	42.6	37.9	33.0	30.1	28.9	26.2	29.5	26.5	25.7	34.3	35.8
Chromium (Cr)	mg/L	<0.0050	0.00020	0.00022	0.00016	0.00163	0.00223	0.00114	0.00064	0.00080	0.00053	0.00056	0.00053	0.00062	0.00019	0.00017
Cobalt (Co)	mg/L	<0.00050	<0.00010	<0.00010	<0.00010	0.00053	0.00094	0.00037	0.00021	0.00018	0.00010	0.00011	0.00015	0.00016	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.0020	<0.00050	<0.00050	<0.00050	0.00159	0.00259	0.00119	0.00080	0.00107	<0.00050	<0.00050	0.00050	0.00061	<0.00050	<0.00050
Iron (Fe)	mg/L	0.11	0.101	0.190	0.187	1.42	2.02	0.878	0.473	0.376	0.235	0.261	0.349	0.310	0.062	0.104
Lead (Pb)	mg/L	<0.0010	<0.000050	0.000070	<0.000050	0.000728	0.00136	0.000495	0.000273	0.000231	0.000120	0.000136	0.000225	0.000202	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0068	0.0063	0.0072	0.0067	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00099	0.00193	0.00237	0.00159	0.00342	0.00285
Magnesium (Mg)	mg/L	13.1	11.6	13.4	11.3	10.5	9.72	7.98	7.38	7.13	6.07	7.29	6.98	6.52	9.00	9.36
Manganese (Mn)	mg/L	0.01	0.00512	0.00648	0.00913	0.0476	0.0652	0.0220	0.0141	0.0116	0.00762	0.00880	0.0132	0.0112	0.00453	0.00478
Mercury (Hg)	mg/L	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2011														
Month Sampled		January	February	March	April	May	May	May	June	June	June	July	August	September	October	November
Date Sampled		4-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	11-May-11	17-May-11	25-May-11	2-Jun-11	7-Jun-12	14-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-02	L981301-1	L990825-2	L999009-8	L1004821-2	L1007262-2	L1009390-2	L1012487-2	L1015493-2	L1018864-2	L1034422-4	L1049152-2	L1064458-3	L1073725-2	L1091894-2
Total Metals (*cont'd*)																
Molybdenum (Mo)	mg/L	0.0016	0.000886	0.000955	0.000970	0.000762	0.000630	0.000577	0.000521	0.000525	0.000533	0.000611	0.000539	0.000473	0.000678	0.000621
Nickel (Ni)	mg/L	<0.0020	<0.00050	<0.00050	<0.00050	0.00220	0.00355	0.00163	0.00097	0.00082	0.00053	0.00058	0.00059	0.00061	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.20	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.5	0.486	0.554	0.501	0.667	0.817	0.529	0.391	0.346	0.276	0.306	0.374	0.329	0.328	0.328
Selenium (Se)	mg/L	<0.0050	0.00022	0.00024	0.00025	0.00026	0.00024	0.00018	0.00011	0.00015	0.00012	0.00013	0.00044	0.00010	0.00014	0.00016
Silicon (Si)	mg/L	<5.0	1.66	1.80	1.66	2.71	3.16	2.13	1.69	1.62	1.30	1.35	1.28	1.34	1.18	1.33
Silver (Ag)	mg/L	<0.00050	<0.000010	<0.000010	<0.000010	0.000012	0.000021	<0.000010	<0.000010	<0.000010	0.000044	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	1.910	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.2	0.164	0.186	0.171	0.108	0.0755	0.0664	0.0569	0.0569	0.0535	0.0673	0.0753	0.0560	0.0981	0.102
Thallium (Tl)	mg/L	0.00044	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	0.000015	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.050	<0.010	<0.010	<0.010	0.016	0.025	0.012	0.013	0.015	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00059	0.000284	0.000322	0.000302	0.000272	0.000284	0.000197	0.000155	0.000145	0.000143	0.000170	0.000175	0.000144	0.000217	0.000208
Vanadium (V)	mg/L	<0.010	<0.0010	<0.0010	<0.0010	0.0042	0.0056	0.0028	0.0016	0.0016	0.0011	<0.0010	0.0012	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.040	<0.0030	<0.0030	<0.0030	0.0081	0.0115	0.0070	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																
Aluminum (Al)	mg/L	<0.05	<0.0030	<0.0030	<0.0030	0.0112	0.0257	0.0179	0.0178	0.0141	0.0102	0.0059	0.0042	0.0119	0.0043	0.0075
Antimony (Sb)	mg/L	<0.001	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.005	<0.00010	<0.00010	<0.00010	0.00012	0.00011	0.00011	0.00011	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00011	<0.00010
Barium (Ba)	mg/L	0.0745	0.0535	0.0634	0.0647	0.0508	0.0372	0.0389	0.0289	0.0281	0.0252	0.0343	0.0273	0.0228	0.0367	0.0455
Beryllium (Be)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.04	0.011	0.014	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0001	<0.000010	<0.000010	<0.000010	0.000019	0.000013	0.000014	0.000012	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000012
Calcium (Ca)	mg/L	23.5	43.3	43.2	43.0	38.4	30.1	30.5	27.2	26.9	21.4	27.8	24.0	24.0	32.6	36.5
Chromium (Cr)	mg/L	<0.005	<0.00010	0.00011	<0.00010	<0.00010	0.00013	0.00013	0.00013	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.002	<0.00050	<0.00050	<0.00050	0.00064	0.00079	0.00069	0.00082	0.00063	0.00060	0.00080	0.00076	<0.00050	0.00079	<0.00050
Iron (Fe)	mg/L	<0.1	<0.030	<0.030	<0.030	0.045	0.046	0.035	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.039
Lead (Pb)	mg/L	<0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000081	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0046	0.0064	0.0071	0.0066	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00113	0.00173	0.00230	0.00153	0.00329	0.00304
Magnesium (Mg)	mg/L	12.2	11.6	12.7	11.1	9.34	7.71	7.59	6.77	6.72	5.81	6.92	6.53	6.21	9.00	9.53
Manganese (Mn)	mg/L	0.0049	0.00455	0.00290	0.00597	0.00564	0.00557	0.00302	0.00300	0.00249	0.00254	0.00295	0.00270	0.00157	0.00378	0.00298
Mercury (Hg)	mg/L	<0.0002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0011	0.000849	0.000938	0.000764	0.000658	0.000498	0.000502	0.000472	0.000450	0.000388	0.000573	0.000481	0.000376	0.000658	0.000606
Nickel (Ni)	mg/L	<0.002	<0.00050	<0.00050	<0.00050	0.00059	0.00072	0.00052	0.00051	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.463	0.481	0.500	0.493	0.368	0.344	0.312	0.306	0.216	0.206	0.224	0.289	0.245	0.344	0.337
Selenium (Se)	mg/L	<0.005	0.00022	0.00024	0.00028	0.00023	0.00020	0.00020	0.00014	0.00012	0.00013	0.00013	0.00017	<0.00010	0.00016	0.00018
Silicon (Si)	mg/L	<5	1.71	1.61	1.63	1.44	1.17	1.21	1.05	0.979	0.909	0.981	0.873	0.969	1.17	1.33
Silver (Ag)	mg/L	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.05	2.0	2.0	2.3	2.2	2.2	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0
Strontium (Sr)	mg/L	0.165	0.159	0.176	0.166	0.103	0.0663	0.0655	0.0527	0.0540	0.0450	0.0679	0.0721	0.0568	0.0965	0.101
Thallium (Tl)	mg/L	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00046	0.000272	0.000305	0.000287	0.000204	0.000151	0.000152	0.000118	0.000117	0.000095	0.000140	0.000134	0.000125	0.000200	0.000211
Vanadium (V)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.04	<0.0030	<0.0030	<0.0030	0.0033	0.0054	0.0031	0.0042	0.0032	<0.0030	0.0031	0.0036	<0.0030	0.0044	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 sample which was analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-11	12-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-4	L1117841-2	L1127031-2	L1137305-2	L1148502-2	L1154387-2	L1157872-2	L1162268-2	L1162268-9	L1166580-2	L1169751-2	L1174000-2	L1184612-2	L1197851-7	L1228768-2	L1243937-2	L1251738-2
Physical Tests																		
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	10.4	9.7	6.9	10.0	9.2	6.0	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	283	308	309	310	238	195	192	163	163	150	146	2280	143	158	197	238	325
Hardness (as $CaCO_3$)	mg/L	154	156	169	162	125	102	102	87.1	87.6	83.5	71.8	80.5	71.7	87.4	106	131	182
pH	pH	8.14	8.24	8.24	8.31	8.26	8.26	8.30	8.21	8.21	8.24	8.23	11.92	8.18	8.13	8.23	8.16	8.26
Total Suspended Solids	mg/L	305	<3.0	58.0	4.7	29.2	58.0	12.0	25.7	23.0	10.0	11.9	64.4	9.1	<3.0	<3.0	<3.0	6.6
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	52.8	1.82	25.6	2.51	10.5	20.2	7.80	14.6	14.1	7.18	6.55	41.1	4.62	1.39	0.68	0.89	1.87
Anions and Nutrients																		
Acidity (as $CaCO_3$)	mg/L	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.3	1.3	1.6	2.9	<1.0	1.8	2.1	1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	148	156	155	157	122	99.2	98.9	85.5	88.4	84.1	78.9	<1.0	73.7	88.0	101	129	171
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	392	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	256	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	148	156	155	157	122	99.2	98.9	85.5	88.4	84.1	78.9	648	73.7	88.0	101	129	171
Ammonia (as N)	mg/L	0.0083	<0.0050	0.0276	0.0195	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<1.0	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.98	1.19	2.32	1.14	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<0.50	<0.50	0.58	0.98	1.52
Fluoride (F)	mg/L	0.049	0.056	0.047	0.059	0.040	0.030	0.030	0.026	0.027	0.024	0.022	<0.40	0.024	0.032	0.035	0.044	0.058
Nitrate (as N)	mg/L	0.0874	0.0859	0.0736	0.0627	0.0929	0.0834	0.0721	0.0573	0.0562	0.0527	0.0418	<0.10	0.0154	0.0132	0.0409	0.0708	0.112
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.163	<0.050	0.466	<0.050	0.067	0.097	0.058	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.059	0.069	0.063
Total Nitrogen	mg/L	0.250	0.060	0.540	0.060	0.160	0.180	0.130	0.070	0.070	0.060	0.060	<0.050	0.050	<0.050	0.100	-	0.152
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0034	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.265	0.0027	0.0778	0.0065	0.0350	0.0461	0.0157	0.0240	0.0350	0.0210	0.0129	0.0096	0.0050	0.0028	0.0026	0.0055	0.0032
Sulphate (SO_4)	mg/L	11.1	14.0	14.9	14.2	5.31	3.93	4.17	3.50	3.49	3.55	3.33	<10	4.41	6.66	9.35	12.6	18.5
Cyanides																		
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0045	0.0012	0.0011	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																		
Total Organic Carbon	mg/L	5.11	1.68	3.12	1.86	3.43	3.97	3.02	2.36	2.44	1.91	1.69	1.38	1.08	1.07	1.40	1.06	1.36
Total Metals																		
Aluminum (Al)	mg/L	1.77	0.0212	0.841	0.0618	0.457	0.897	0.201	0.459	0.440	0.270	0.214	0.117	0.140	0.0374	0.0211	0.0225	0.0041
Antimony (Sb)	mg/L	0.00011	<0.00010	0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00101	0.00012	0.00071	0.00013	0.00028	0.00052	0.00017	0.00028	0.00029	0.00020	0.00026	0.00017	0.00017	0.00013	0.00010	0.00017	0.00013
Barium (Ba)	mg/L	0.0749	0.0556	0.0731	0.0675	0.0587	0.0441	0.0333	0.0312	0.0319	0.0279	0.0221	0.0258	0.0244	0.0306	0.0347	0.0452	0.0602
Beryllium (Be)	mg/L	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.018	0.011	0.014	0.014	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	0.014
Cadmium (Cd)	mg/L	0.000197	0.000013	0.000125	0.000015	0.000040	0.000071	0.000022	0.000035	0.000037	0.000025	0.000026	0.000020	0.000013	<0.000010	<0.000010	0.000012	0.000010
Calcium (Ca)	mg/L	51.1	44.6	47.5	46.6	40.2	31.6	29.6	26.5	27.0	25.4	21.6	24.2	21.5	25.2	30.4	38.3	52.4
Chromium (Cr)	mg/L	0.00324	0.00021	0.00163	0.00027	0.00073	0.00150	0.00040	0.00084	0.00080	0.00052	0.00048	0.00029	0.00033	0.00014	0.00012	0.00012	0.00016
Cobalt (Co)	mg/L	0.00106	<0.00010	0.00061	<0.00010	0.00022	0.00054	0.00011	0.00026	0.00027	0.00017	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00340	<0.00050	0.00480	<0.00050	0.00078	0.00133	<0.00050	0.00079	0.00081	0.00054	0.00126	0.00063	<0.00050	<0.00050	<0.00050	<0.00050	0.00125
Iron (Fe)	mg/L	2.89	0.131	2.17	0.205	0.551	1.27	0.263	0.575	0.613	0.352	0.337	0.171	0.197	0.068	0.068	0.084	<0.030
Lead (Pb)	mg/L	0.00168	0.000159	0.000993	0.000051	0.000281	0.000626	0.000122	0.000326	0.000332	0.000243	0.000252	0.000170	0.000114	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00611	0.00513	0.00655	0.00581	0.00230	0.00200	0.00133	0.00158	0.00145	0.00112	0.00104	0.00101	0.00068	0.00227	0.00263	0.00451	0.00703
Magnesium (Mg)	mg/L	13.7	11.2	12.7	12.0	9.55	8.43	7.09	6.26	6.38	5.97	5.10	5.56	5.02	6.20	7.65	10.0	13.9
Manganese (Mn)	mg/L	0.0712	0.00560	0.104	0.00956	0.0153	0.0336	0.00777	0.0152	0.0158	0.0111	0.0111	0.00763	0.00694	0.00443	0.00435	0.00431	0.00505
Mercury (Hg)	mg/L	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-11	12-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-4	L1117841-2	L1127031-2	L1137305-2	L1148502-2	L1154387-2	L1157872-2	L1162268-2	L1162268-9	L1166580-2	L1169751-2	L1174000-2	L1184612-2	L1197851-7	L1228768-2	L1243937-2	L1251738-2
Total Metals (*cont'd*)																		
Molybdenum (Mo)	mg/L	0.00102	0.000920	0.000985	0.000911	0.000635	0.000576	0.000490	0.000490	0.000479	0.000497	0.000397	0.000522	0.000466	0.000540	0.000621	0.000801	0.00109
Nickel (Ni)	mg/L	0.00409	<0.00050	0.00238	<0.00050	0.00106	<0.0025	0.00059	0.00102	0.00108	0.00075	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.03	0.442	0.982	0.487	0.454	0.556	0.302	0.371	0.368	0.301	0.248	0.245	0.237	0.271	0.305	0.386	0.630
Selenium (Se)	mg/L	0.00031	0.00020	0.00027	0.00023	0.00022	0.00018	0.00014	0.00014	0.00014	0.00013	<0.00010	<0.00010	<0.00010	0.00011	0.00015	0.00018	0.00024
Silicon (Si)	mg/L	4.09	1.55	2.97	1.57	2.27	2.41	1.36	1.72	1.76	1.35	1.07	1.04	1.05	0.913	1.11	1.35	1.91
Silver (Ag)	mg/L	0.000028	<0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000062	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	2.7	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.3
Strontium (Sr)	mg/L	0.149	0.149	0.171	0.162	0.0910	0.0625	0.0585	0.0493	0.0497	0.0506	0.0400	0.0503	0.0534	0.0726	0.0857	0.132	0.191
Thallium (Tl)	mg/L	0.000076	<0.000010	0.000035	<0.000010	0.000017	0.000030	<0.000010	0.000016	0.000017	0.000012	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.024	<0.010	0.016	<0.010	0.017	0.022	<0.010	0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000412	0.000305	0.000333	0.000319	0.000243	0.000200	0.000155	0.000149	0.000158	0.000150	0.000114	0.000134	0.000125	0.000150	0.000190	0.000258	0.000330
Vanadium (V)	mg/L	0.0082	<0.0010	0.0038	<0.0010	0.0017	0.0037	<0.0010	0.0020	0.0020	0.0013	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0220	0.0043	0.0333	<0.0030	0.0042	0.0071	<0.0030	0.0042	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																		
Aluminum (Al)	mg/L	0.0032	<0.0030	0.0041	0.0040	0.0105	0.0163	0.0091	0.0157	0.0185	0.0133	0.0106	0.0085	0.0054	0.0042	0.0044	0.0038	0.0569
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	0.00010	0.00011	0.00010	0.00011	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00010	<0.00010	0.00016
Barium (Ba)	mg/L	0.0490	0.0546	0.0554	0.0655	0.0436	0.0325	0.0307	0.0262	0.0263	0.0245	0.0197	0.0237	0.0232	0.0297	0.0344	0.0430	0.0631
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013
Cadmium (Cd)	mg/L	0.000016	0.000012	0.000026	0.000010	0.000014	0.000012	<0.000010	0.000012	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000020
Calcium (Ca)	mg/L	43.1	43.9	47.4	45.4	35.3	29.2	29.3	25.2	25.3	24.3	20.7	23.3	20.4	24.7	29.9	36.4	51.7
Chromium (Cr)	mg/L	0.00015	0.00013	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00010	0.00010	0.00011	0.00010	<0.00010	0.00021	0.00010	0.00030	0.00012
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00052	0.00243	0.00073	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00077	<0.00050	0.00078	<0.00050	<0.00050	0.00078	<0.00050
Iron (Fe)	mg/L	<0.030	0.031	<0.030	<0.030	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.207
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000085
Lithium (Li)	mg/L	0.00410	0.00550	0.00643	0.00619	0.00180	0.00134	0.00110	0.00092	0.00094	0.00096	0.00079	0.00107	0.00085	0.00244	0.00270	0.00447	0.00700
Magnesium (Mg)	mg/L	11.3	11.3	12.4	11.9	8.85	7.02	7.04	5.88	5.90	5.54	4.88	5.39	5.02	6.24	7.60	9.82	12.9
Manganese (Mn)	mg/L	0.00381	0.00498	0.00511	0.00638	0.00377	0.00422	0.00175	0.00200	0.00198	0.00187	0.00248	0.00188	0.00298	0.00265	0.00281	0.00388	0.0103
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000822	0.000894	0.000890	0.000854	0.000548	0.000465	0.000594	0.000432	0.000431	0.000458	0.000365	0.000442	0.000437	0.000524	0.000581	0.000738	0.000971
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00053	<0.00050	0.00053	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.450	0.454	0.628	0.477	0.311	0.283	0.232	0.203	0.205	0.194	0.192	0.188	0.206	0.273	0.290	0.405	0.597
Selenium (Se)	mg/L	0.00021	0.00024	0.00026	0.00026	0.00018	0.00014	0.00015	0.00011	0.00013	0.00011	<0.00010	0.00011	<0.00010	<0.00010	0.00013	0.00017	0.00026
Silicon (Si)	mg/L	1.56	1.59	1.57	1.51	1.17	1.09	1.06	0.909	0.928	0.841	0.806	0.801	0.737	0.840	1.06	1.32	1.96
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	2.3	3.3	2.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.7	2.0
Strontium (Sr)	mg/L	0.143	0.148	0.171	0.155	0.0813	0.0608	0.0571	0.0471	0.0475	0.0482	0.0404	0.0476	0.0522	0.0701	0.0829	0.126	0.185
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000281	0.000288	0.000282	0.000283	0.000198	0.000155	0.000102	0.000118	0.000121	0.000119	0.000086	0.000112	0.000099	0.000131	0.000171	0.000222	0.000313
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0095	0.0031	0.0128	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR1 - 2010					MR1 - 2011
Month Sampled		May	May	June	June	October	January
Date Sampled		20-May-10	20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	4-Jan-11
Lab Sample ID	Units	L889661-4	L889661-5	L894623-3	L897909-2	R010261-02	R101042-03
Physical Tests							
Colour, True	CU	11.7	11.5	7.0	5.3	-	5
Conductivity	µS/cm	178	179	185	160	-	275
Hardness (as $CaCO_3$)	mg/L	95.1	96.0	98.3	83.1	99.9	133.0
pH	pH	8.21	8.22	8.24	8.26	7.63	8.06
Total Suspended Solids	mg/L	70.5	68.5	8.2	12.9	3.0	<1
Total Dissolved Solids	mg/L	98	97	104	91	094	177
Turbidity	NTU	31.5	31.9	3.95	7.47	-	0.7
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	1.4	1.3	1.8	1.0	-	<2
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	91.4	91.7	98.8	85.7	-	145
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	-	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	-	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	91.4	91.7	98.8	85.7	-	145
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	-	1.42
Fluoride (F)	mg/L	0.028	0.028	0.024	0.021	-	<0.10
Nitrate (as N)	mg/L	0.0879	0.0906	0.0535	0.0388	-	0.08
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	0.0011	-	<0.01
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	0.067	<0.050	-	0.08
Total Nitrogen	mg/L	0.130	0.130	0.120	<0.060	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.0728	0.0671	0.0086	0.0153	-	<0.01
Sulphate (SO_4)	mg/L	3.80	3.80	4.64	3.98	-	16.3
Cyanides							
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	-	<0.002
Cyanide, Total	mg/L	0.0036	0.0039	0.0024	0.0013	-	<0.01
Organic Carbon							
Total Organic Carbon	mg/L	2.95	2.98	1.64	1.45	-	0.80
Total Metals							
Aluminum (Al)	mg/L	1.33	1.30	0.140	0.312	0.1890	0.0540
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010
Arsenic (As)	mg/L	0.00057	0.00053	0.00013	<0.00020	<0.0005	<0.0050
Barium (Ba)	mg/L	0.0543	0.0534	0.0350	0.0294	0.0288	0.078
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.0010
Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	0.011	<0.040
Cadmium (Cd)	mg/L	0.000083	0.000074	0.000019	0.000020	0.000	<0.00010
Calcium (Ca)	mg/L	32.0	31.4	29.6	26.5	27.2	32.900000
Chromium (Cr)	mg/L	0.00191	0.00179	0.00039	0.00072	<0.0005	<0.0050
Cobalt (Co)	mg/L	0.00071	0.00065	0.00010	0.00017	0.00016	<0.00050
Copper (Cu)	mg/L	0.00171	0.00177	0.00049	<0.00070	0.0007	<0.0020
Iron (Fe)	mg/L	1.57	1.52	0.192	0.354	0.28	0.11000
Lead (Pb)	mg/L	0.000846	0.000775	0.000136	0.000200	0.000	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.002000	0.0069
Magnesium (Mg)	mg/L	8.89	8.66	6.73	6.84	7.8	12.2000
Manganese (Mn)	mg/L	0.0447	0.0413	0.00747	0.0136	0.01	00.0
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00020
Molybdenum (Mo)	mg/L	0.000559	0.000573	0.000536	0.000444	0.0004	0.0014
Nickel (Ni)	mg/L	0.00237	0.00215	0.00055	0.00078	0.001100	<0.0020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	-	<0.20
Potassium (K)	mg/L	0.723	0.705	0.293	0.331	-	0.43
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.0004	<0.0050
Silicon (Si)	mg/L	2.73	2.80	1.14	1.29	-	<5.0
Silver (Ag)	mg/L	0.000014	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	0.790	1.860
Strontium (Sr)	mg/L	0.0750	0.0727	0.0573	0.0488	-	0.2
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	0.00037
Tin (Sn)	mg/L	<0.00010	<0.00010	0.00072	<0.00010	-	<0.0020

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR1 - 2010					MR1 - 2011
Month Sampled		May	May	June	June	October	January
Date Sampled		20-May-10	20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	4-Jan-11
Lab Sample ID	Units	L889661-4	L889661-5	L894623-3	L897909-2	R010261-02	R101042-03
Total Metals (*cont'd*)							
Titanium (Ti)	mg/L	0.022	0.022	<0.010	<0.010	0.01	<0.050
Uranium (U)	mg/L	0.000208	0.000206	0.000167	0.000141	0.00015	0.00052
Vanadium (V)	mg/L	0.0047	0.0046	<0.0010	0.0011	<0.001	<0.010
Zinc (Zn)	mg/L	0.0076	0.0075	0.0015	0.0017	0.0030	<0.040
Dissolved Metals							
Aluminum (Al)	mg/L	0.0161	0.0168	0.0084	0.0093	0.017	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.001
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.0005	<0.005
Barium (Ba)	mg/L	0.0306	0.0307	0.0335	0.0248	0.028	0.0803
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.001
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	0.005	<0.04
Cadmium (Cd)	mg/L	0.000011	0.000011	<0.000010	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	26.3	26.6	28.6	23.9	26.3	23.4
Chromium (Cr)	mg/L	<0.00020	<0.00020	<0.00030	0.00021	<0.0005	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00005	<0.0005
Copper (Cu)	mg/L	0.00032	0.00063	0.00039	0.00025	0.0005	<0.002
Iron (Fe)	mg/L	<0.030	0.031	<0.030	<0.030	0.046	<0.1
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.002	0.0048
Magnesium (Mg)	mg/L	7.13	7.20	6.53	5.67	6.8	12.3
Manganese (Mn)	mg/L	0.000378	0.000330	0.000645	0.000784	0.0025	0.0053
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0002
Molybdenum (Mo)	mg/L	0.000448	0.000451	0.000545	0.000401	0.0004	0.0012
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	-	<0.2
Potassium (K)	mg/L	0.277	0.275	0.236	0.201	-	0.442
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.0005	<0.005
Silicon (Si)	mg/L	1.02	1.04	0.995	0.867	-	<5
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	1.16	2.12
Strontium (Sr)	mg/L	0.0524	0.0536	0.0549	0.0466	0.0713	0.163
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.002
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000139	0.000141	0.000159	0.000118	0.00016	0.00046
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0039	<0.04

Notes:

All parameters analyzed by ALS Environmental, except the October 2010 and January 2011 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR2 - 2010				MR2 - 2011
Month Sampled		May	June	June	October	January
Date Sampled		20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	5-Jan-11
Lab Sample ID	Units	L889661-3	L894623-4	L897909-3	R010261-03	R101042-04
Physical Tests						
Colour, True	CU	12.0	6.7	5.3	-	<5
Conductivity	µS/cm	178	186	159	-	281
Hardness (as $CaCO_3$)	mg/L	95.5	96.9	83.8	105.0	134.0
pH	pH	8.20	8.28	8.26	7.70	8.07
Total Suspended Solids	mg/L	77.5	8.2	15.9	4.0	<1
Total Dissolved Solids	mg/L	95	106	78	100	167
Turbidity	NTU	31.2	4.43	6.84	-	0.7
Anions and Nutrients						
Acidity (as $CaCO_3$)	mg/L	1.5	<1.0	1.3	-	<2
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	93.9	94.4	83.3	-	147
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	93.9	94.4	83.3	-	147
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	-	1.3
Fluoride (F)	mg/L	0.027	0.024	<0.020	-	<0.10
Nitrate (as N)	mg/L	0.0901	0.0532	0.0370	-	0.08
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	0.060	0.087	<0.050	-	0.08
Total Nitrogen	mg/L	0.150	0.140	<0.060	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-
Phosphorus-Total	mg/L	0.0600	0.0085	0.0161	-	<0.01
Sulphate (SO_4)	mg/L	3.82	4.64	3.94	-	15.9
Cyanides						
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	<0.002
Cyanide, Total	mg/L	0.0047	0.0024	0.0014	-	<0.01
Organic Carbon						
Total Organic Carbon	mg/L	3.57	1.93	1.56	-	0.90
Total Metals						
Aluminum (Al)	mg/L	1.34	0.144	0.336	0.1900	0.054
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010
Arsenic (As)	mg/L	0.00057	0.00015	<0.00020	<0.0005	<0.0050
Barium (Ba)	mg/L	0.0564	0.0362	0.0301	0.0322	0.0801
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	-	<0.0010
Boron (B)	mg/L	<0.010	<0.010	<0.010	0.011	<0.040
Cadmium (Cd)	mg/L	0.000085	0.000017	0.000025	0.000	<0.00010
Calcium (Ca)	mg/L	31.5	29.9	26.4	28.1	33.200000
Chromium (Cr)	mg/L	0.00190	0.00042	0.00062	00.0	<0.0050
Cobalt (Co)	mg/L	0.00071	<0.00010	0.00019	0.00017	<0.00050
Copper (Cu)	mg/L	0.00178	0.00050	<0.00070	0.0013	<0.0020
Iron (Fe)	mg/L	1.62	0.188	0.366	0.29	0.11
Lead (Pb)	mg/L	0.000875	0.000146	0.000239	0.000	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	0.002200	0.0065
Magnesium (Mg)	mg/L	8.89	6.82	6.82	8.49	12.4
Manganese (Mn)	mg/L	0.0451	0.00752	0.0148	-	00.0
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.00020
Molybdenum (Mo)	mg/L	0.000584	0.000529	0.000423	0.0005	0.0015
Nickel (Ni)	mg/L	0.00241	0.00055	0.00082	0.001200	<0.0020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	-	<0.20
Potassium (K)	mg/L	0.732	0.303	0.339	-	0.41
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	0.0004	<0.0050
Silicon (Si)	mg/L	2.75	1.16	1.27	-	<5.0
Silver (Ag)	mg/L	0.000011	<0.000010	<0.000010	<0.00005	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR2 - 2010				MR2 - 2011
Month Sampled		May	June	June	October	January
Date Sampled		20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	5-Jan-11
Lab Sample ID	Units	L889661-3	L894623-4	L897909-3	R010261-03	R101042-04
Total Metals (*cont'd*)						
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	0.880	1.840
Strontium (Sr)	mg/L	0.0730	0.0581	0.0484	-	0.1
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00002	0.00039
Tin (Sn)	mg/L	<0.00010	0.00065	<0.00010	-	<0.0020
Titanium (Ti)	mg/L	0.021	<0.010	<0.010	0.014	<0.050
Uranium (U)	mg/L	0.000215	0.000166	0.000138	0.00017	0.00054
Vanadium (V)	mg/L	0.0049	<0.0010	0.0012	<0.001	<0.010
Zinc (Zn)	mg/L	0.0078	0.0015	0.0019	0.0020	<0.040
Dissolved Metals						
Aluminum (Al)	mg/L	0.0169	0.0087	0.0091	0.016	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.0001	<0.001
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.0005	<0.005
Barium (Ba)	mg/L	0.0314	0.0340	0.0253	0.0287	0.0742
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	-	<0.001
Boron (B)	mg/L	<0.010	<0.010	<0.010	0.005	<0.04
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	26.3	28.2	24.3	25.3	23.3
Chromium (Cr)	mg/L	<0.00020	<0.00030	<0.00020	<0.0005	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00005	<0.0005
Copper (Cu)	mg/L	0.00034	0.00032	0.00021	0.0005	<0.002
Iron (Fe)	mg/L	0.032	<0.030	<0.030	0.045	<0.1
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	0.0021	0.0044
Magnesium (Mg)	mg/L	7.22	6.46	5.62	6.72	12.4
Manganese (Mn)	mg/L	0.000377	0.000476	0.000971	0.0026	0.0061
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.0002
Molybdenum (Mo)	mg/L	0.000455	0.000561	0.000403	0.0004	<0.001
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.0008	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	-	<0.2
Potassium (K)	mg/L	0.276	0.240	0.200	-	0.444
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	0.0004	<0.005
Silicon (Si)	mg/L	1.01	0.985	0.855	-	<5
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	1.1	2.1
Strontium (Sr)	mg/L	0.0536	0.0558	0.0471	0.0668	0.159
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	-	<0.002
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000146	0.000148	0.000115	0.00016	0.00031
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	0.0024	<0.04

Notes:

All parameters analyzed by ALS Environmental, except the October 2010 and January 2011 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9 - 2010				MR9 - 2011										
Month Sampled		May	June	June	October	January	February	March	April	May	June	July	August	September	October	November
Date Sampled		20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	5-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	17-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L889661-2	L894624-3	L897909-4	R010261-04	R101042-05	L981301-2	L990825-3	L999009-9	L1007262-5	L1015493-9	L1034422-5	L1049152-3	L1064458-5	L1073725-3	L1091894-3
Physical Tests																
Colour, True	CU	12.8	-	5.6	-	<5	<5.0	<5.0	<5.0	19.8	6.2	5.9	<5.0	7.4	<5.0	10.0
Conductivity	µS/cm	179	-	155	-	289	299	313	316	201	176	195	205	173	248	236
Hardness (as $CaCO_3$)	mg/L	97.0	96.8	84.3	101.0	138	158	158	153	104	95.3	102	102	86.7	121	126
pH	pH	8.17	-	8.05	7.53	8.07	8.18	8.18	8.13	8.19	8.18	8.23	8.29	8.27	8.30	8.11
Total Suspended Solids	mg/L	108	-	24.4	8.0	<1	<3.0	<3.0	5.1	180	<3.0	28.5	18.0	14.0	<1.0	<1.0
Total Dissolved Solids	mg/L	98	-	104	68	178	-	190	-	-	100	-	-	-	4.0	6.0
Turbidity	NTU	43.2	-	12.0	-	1.1	0.85	1.33	5.92	76.7	12.8	15.3	6.54	9.33	4.03	5.96
Anions and Nutrients																
Acidity (as $CaCO_3$)	mg/L	1.7	-	3.7	-	<2	1.0	3.7	2.6	<1.0	3.2	1.6	1.2	1.4	<1.0	2.4
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	95.7	-	81.6	-	148	153	147	162	107	92.1	102	100	86.9	119	118
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	-	<2.0	-	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	-	<2.0	-	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	95.7	-	81.6	-	148	153	147	162	107	92.1	102	100	86.9	119	118
Ammonia (as N)	mg/L	<0.0050	<0.010	0.0056	-	<0.02	<0.0050	<0.0050	<0.0050	0.0061	<0.0050	0.0076	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	-	<0.050	-	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	-	<0.50	-	1.29	1.33	1.56	1.34	<0.50	<0.50	<0.50	0.53	<0.50	0.59	0.58
Fluoride (F)	mg/L	0.029	-	0.021	-	<0.10	0.046	0.052	0.049	0.035	<0.020	0.036	0.036	0.027	0.041	0.041
Nitrate (as N)	mg/L	0.0805	-	0.0365	-	0.08	0.0863	0.0871	0.0594	0.108	0.0454	0.0198	0.0147	0.0198	0.0238	0.0605
Nitrite (as N)	mg/L	<0.0010	-	0.0019	-	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.070	0.090	0.075	-	<0.05	<0.050	0.073	0.121	0.282	0.135	0.100	0.105	<0.050	0.106	<0.050
Total Nitrogen	mg/L	0.150	0.120	0.113	-	-	0.134	0.160	0.180	0.390	0.180	0.120	0.120	<0.050	0.130	0.080
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	<0.0020	<0.0020	<0.0020	0.0043	0.0024	<0.0020	<0.0020	<0.0020	<0.0020	0.0025
Phosphorus-Total	mg/L	0.0822	-	0.0422	-	<0.01	<0.0020	<0.0020	0.0067	0.204	0.0334	0.0238	0.0129	0.0164	0.0045	0.0108
Sulphate (SO_4)	mg/L	3.87	-	3.97	-	16.1	14.9	16.6	16.1	4.57	4.16	5.66	8.05	5.82	9.73	8.95
Cyanides																
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	<0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0025	<0.0011
Cyanide, Total	mg/L	0.0040	0.0024	0.0022	-	<0.01	0.0014	<0.0010	0.0019	0.0071	0.0026	0.0032	<0.0020	0.0034	<0.0020	0.0038
Organic Carbon																
Total Organic Carbon	mg/L	3.19	1.89	1.54	-	0.80	1.49	1.10	1.70	9.16	2.65	1.96	1.18	2.11	1.46	2.67
Total Metals																
Aluminum (Al)	mg/L	1.71	0.217	0.521	0.3280	0.0790	0.0079	0.0185	0.178	2.78	0.518	0.604	0.291	0.383	0.134	0.139
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	<0.0010	<0.00010	<0.00010	<0.00010	0.00017	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00072	0.00015	<0.00030	<0.0005	<0.0050	<0.00010	0.00013	0.00020	0.00141	0.00025	0.00032	0.00021	0.00021	0.00014	0.00017
Barium (Ba)	mg/L	0.0690	0.0409	0.0344	0.034	0.0852	0.0615	0.0696	0.0768	0.108	0.0386	0.0530	0.0427	0.0295	0.0444	0.0435
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	-	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.011	<0.010	<0.010	0.026	<0.040	0.016	0.015	0.013	0.013	<0.010	0.011	<0.010	<0.010	0.011	<0.010
Cadmium (Cd)	mg/L	0.000107	0.000020	0.000033	0.000	<0.00010	0.000012	0.000013	0.000025	0.000230	0.000034	0.000033	0.000020	0.000019	<0.000010	0.000014
Calcium (Ca)	mg/L	32.9	30.5	27.4	26.900000	34.1	44.6	44.3	43.7	38.5	27.6	31.4	29.8	25.4	35.2	33.9
Chromium (Cr)	mg/L	0.00256	0.00049	0.00092	00.0	<0.0050	0.00021	0.00015	0.00035	0.00471	0.00094	0.00111	0.00054	0.00081	0.00034	0.00029
Cobalt (Co)	mg/L	0.00092	0.00014	0.00026	0.00022	<0.00050	<0.00010	<0.00010	0.00011	0.00167	0.00026	0.00030	0.00016	0.00019	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00229	0.00057	<0.00090	0.0009	<0.0020	0.00853	<0.00050	<0.00050	0.00435	0.00110	0.00096	0.00160	0.00067	<0.00050	0.00057
Iron (Fe)	mg/L	2.05	0.261	0.568	0.43000	0.14	0.116	0.132	0.360	4.04	0.585	0.693	0.318	0.397	0.179	0.218
Lead (Pb)	mg/L	0.00117	0.000172	0.000334	0.000	<0.0010	0.000497	<0.000050	0.000118	0.00223	0.000300	0.000340	0.000296	0.000230	0.000089	0.000102
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	0.0023	0.0066	0.0062	0.0072	0.0066	<0.0050	<0.0050	0.00262	0.00290	0.00185	0.00378	0.00306
Magnesium (Mg)	mg/L	9.37	6.96	7.13	8.2100	12.9	11.6	13.0	11.2	10.2	6.99	7.80	7.64	6.49	9.32	9.33
Manganese (Mn)	mg/L	0.0546	0.00880	0.0183	00.0	0.01	0.00736	0.00763	0.0139	0.0959	0.0145	0.0168	0.0124	0.0123	0.00790	0.00806
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9 - 2010				MR9 - 2011										
Month Sampled		May	June	June	October	January	February	March	April	May	June	July	August	September	October	November
Date Sampled		20-May-10	5-Jun-10	14-Jun-10	16-Oct-10	5-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	17-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L889661-2	L894624-3	L897909-4	R010261-04	R101042-05	L981301-2	L990825-3	L999009-9	L1007262-5	L1015493-9	L1034422-5	L1049152-3	L1064458-5	L1073725-3	L1091894-3
Total Metals (*cont'd*)																
Molybdenum (Mo)	mg/L	0.000598	0.000529	0.000442	0.0004	0.0015	0.000829	0.000917	0.000960	0.000752	0.000492	0.000634	0.000609	0.000449	0.000684	0.000609
Nickel (Ni)	mg/L	0.00305	0.00070	0.00109	0.001400	<0.0020	<0.00050	<0.00050	0.00056	0.00625	0.00107	0.00117	0.00054	0.00073	<0.00050	0.00056
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	-	<0.20	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.859	0.334	0.404	-	0.38	0.467	0.509	0.533	1.34	0.396	0.459	0.392	0.372	0.381	0.377
Selenium (Se)	mg/L	0.00023	<0.00020	<0.00020	0.00030	<0.0050	0.00022	0.00026	0.00028	0.00032	0.00014	0.00018	0.00032	0.00011	0.00017	0.00014
Silicon (Si)	mg/L	3.24	1.33	1.59	-	<5.0	1.69	1.64	1.86	6.07	1.72	1.98	1.41	1.50	1.40	1.52
Silver (Ag)	mg/L	0.000018	<0.000010	<0.000010	0.00007	<0.00050	<0.000010	<0.000010	<0.000010	0.000046	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	0.960	1.930	<2.0	2.2	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.0785	0.0593	0.0500	-	0.2	0.156	0.179	0.159	0.0768	0.0550	0.0708	0.0867	0.0556	0.0969	0.0988
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00002	0.00042	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000014	0.000010	0.000011	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	0.00014	<0.00010	-	<0.0020	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.027	<0.010	<0.010	0.02	<0.050	<0.010	<0.010	<0.010	0.055	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000234	0.000173	0.000150	0.00016	0.0006	0.000276	0.000307	0.000306	0.000336	0.000142	0.000187	0.000191	0.000142	0.000218	0.000210
Vanadium (V)	mg/L	0.0060	<0.0010	0.0018	00.0	<0.010	<0.0010	<0.0010	<0.0010	0.0110	0.0019	0.0020	<0.0010	0.0012	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0105	0.0015	0.0026	0.004	<0.040	<0.0030	<0.0030	<0.0030	0.0202	0.0039	0.0054	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																
Aluminum (Al)	mg/L	0.0156	0.0087	0.0098	0.016	<0.05	<0.0030	<0.0030	0.0037	0.0334	0.0162	0.0089	0.0043	0.0128	0.0051	0.0072
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.0001	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.0005	<0.005	0.00015	<0.00010	<0.00010	0.00013	<0.00010	0.00011	0.00011	0.00011	<0.00010	0.00011
Barium (Ba)	mg/L	0.0359	0.0372	0.0276	0.031	0.0764	0.0612	0.0674	0.0736	0.0450	0.0325	0.0407	0.0375	0.0257	0.0418	0.0439
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	-	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	0.005	<0.04	0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000012	<0.000010	<0.000010	<0.00001	<0.0001	<0.000010	<0.000010	<0.000010	0.000015	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	0.000010
Calcium (Ca)	mg/L	26.6	28.0	24.2	26.6	23.3	44.2	42.5	42.9	29.2	26.9	29.1	28.5	24.4	33.4	35.0
Chromium (Cr)	mg/L	<0.00020	<0.00020	0.00021	0.0008	<0.005	<0.00010	<0.00010	<0.00010	0.00013	0.00011	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	0.00006	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00036	0.00030	0.00025	0.0009	<0.002	<0.00050	<0.00050	<0.00050	0.00081	0.00063	0.00086	0.00096	<0.00050	0.00058	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	0.053	<0.1	<0.030	<0.030	<0.030	0.059	<0.030	<0.030	<0.030	<0.030	<0.030	0.042
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.0001	<0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	0.0019	0.0045	0.0062	0.0071	0.0065	<0.0050	<0.0050	0.00194	0.00285	0.00168	0.00349	0.00327
Magnesium (Mg)	mg/L	7.42	6.49	5.78	6.89	12.6	11.6	12.6	11.1	7.57	6.84	7.19	7.51	6.25	9.11	9.48
Manganese (Mn)	mg/L	0.000374	0.000730	0.00100	0.0033	0.0064	0.00703	0.00666	0.00849	0.00638	0.00259	0.00353	0.00281	0.00181	0.00498	0.00444
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.0002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000451	0.000523	0.000401	0.0005	<0.001	0.000833	0.000882	0.000740	0.000477	0.000435	0.000584	0.000598	0.000384	0.000644	0.000628
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.0016	<0.002	<0.00050	<0.00050	<0.00050	0.00065	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	-	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.299	0.243	0.210	-	0.447	0.447	0.482	0.492	0.355	0.231	0.240	0.322	0.254	0.343	0.346
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	0.0003	<0.005	0.00024	0.00026	0.00030	0.00022	0.00014	0.00016	0.00019	0.00011	0.00017	0.00018
Silicon (Si)	mg/L	1.03	1.00	0.878	-	<5	1.73	1.60	1.60	1.24	1.02	1.07	0.980	0.982	1.20	1.38
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.00005	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	1.05	2.2	2.2	2.1	2.3	<2.0	<2.0	2.2	2.3	<2.0	2.5	<2.0
Strontium (Sr)	mg/L	0.0549	0.0561	0.0476	0.0708	0.159	0.160	0.170	0.158	0.0650	0.0546	0.0711	0.0859	0.0569	0.0956	0.101
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	-	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.005	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000144	0.000157	0.000120	0.00015	0.00031	0.000277	0.000302	0.000286	0.000152	0.000115	0.000153	0.000163	0.000130	0.000193	0.000211
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.001	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	0.0038	<0.04	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0039	0.0041	<0.0030	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental (Vancouver, BC), except the October 2010 and January 2011 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9 - 2012										
Month Sampled		January	February	March	April	May	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	26-Jun-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-5	L1117841-3	L1127031-3	L1137305-3	L1148502-3	L1169751-3	L1184612-3	L1197851-8	L1228768-3	L1243937-3	L1251738-3
Physical Tests												
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	12.5	5.4	<5.0	<5.0	5.4	<5.0	<5.0
Conductivity	µS/cm	301	314	310	309	225	149	146	166	199	244	275
Hardness (as $CaCO_3$)	mg/L	156	160	171	162	122	74.4	72.1	91.1	108	136	142
pH	pH	8.14	8.25	8.26	8.30	8.30	8.25	8.19	8.27	8.18	8.17	8.23
Total Suspended Solids	mg/L	4.7	<3.0	16.0	<3.0	41.2	22.6	11.8	4.4	<3.0	4.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	2.66	1.37	8.86	2.24	17.2	14.0	5.77	4.87	1.50	1.93	2.77
Anions and Nutrients												
Acidity (as $CaCO_3$)	mg/L	1.1	<1.0	<1.0	<1.0	<1.0	2.2	1.7	<1.0	1.3	<1.0	1.3
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	157	158	160	159	127	77.8	74.0	91.2	104	133	140
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	157	158	160	159	127	77.8	74.0	91.2	104	133	140
Ammonia (as N)	mg/L	0.0055	<0.0050	0.0069	0.0179	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.81	1.19	1.74	1.15	<0.50	<0.50	<0.50	<0.50	0.54	0.98	1.21
Fluoride (F)	mg/L	0.052	0.056	0.051	0.058	0.041	0.024	0.025	0.033	0.036	0.045	0.049
Nitrate (as N)	mg/L	0.105	0.0944	0.174	0.0593	0.0862	0.0403	0.0124	0.0121	0.0390	0.0701	0.0878
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	0.074	<0.050	<0.050	<0.050	<0.050	0.076	<0.050
Total Nitrogen	mg/L	0.070	0.050	0.090	0.060	0.160	0.050	<0.050	<0.050	0.070	-	0.141
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.0011	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	0.0022	0.0021	<0.0020	0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.0037	0.0033	0.0161	0.0036	0.0511	0.0237	0.0089	0.0029	0.0022	0.0049	0.0020
Sulphate (SO_4)	mg/L	11.5	13.5	14.4	13.8	5.36	3.40	4.43	6.79	9.30	12.4	14.2
Cyanides												
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0015	0.0016	0.0015	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon												
Total Organic Carbon	mg/L	1.75	1.61	1.41	1.87	3.78	1.77	1.09	1.00	1.56	1.13	1.13
Total Metals												
Aluminum (Al)	mg/L	0.0650	0.0154	0.115	0.0635	0.846	0.376	0.230	0.120	0.0627	0.0703	0.0310
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00014	0.00012	0.00015	0.00016	0.00041	0.00026	0.00020	0.00018	0.00014	0.00020	0.00012
Barium (Ba)	mg/L	0.0608	0.0631	0.0648	0.0720	0.0623	0.0284	0.0302	0.0365	0.0406	0.0553	0.0561
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.015	0.011	0.012	0.015	0.011	<0.010	0.011	<0.010	<0.010	<0.010	0.010
Cadmium (Cd)	mg/L	0.000014	0.000017	<0.000020	0.000015	0.000053	0.000033	0.000018	0.000011	0.000013	0.000013	0.000012
Calcium (Ca)	mg/L	45.7	46.2	46.3	46.4	38.8	21.9	22.4	26.2	32.1	41.1	43.8
Chromium (Cr)	mg/L	0.00038	0.00016	0.00037	0.00021	0.00111	0.00071	0.00049	0.00023	0.00014	0.00018	0.00013
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00037	0.00025	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	0.00129	<0.00050	0.00118	0.00076	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.132	0.120	0.247	0.200	0.941	0.543	0.300	0.174	0.122	0.131	0.114
Lead (Pb)	mg/L	0.000077	<0.000050	0.000103	0.000064	0.000495	0.000320	0.000183	0.000111	0.000055	0.000078	<0.000050
Lithium (Li)	mg/L	0.00442	0.00538	0.00585	0.00629	0.00277	0.00118	0.00118	0.00248	0.00285	0.00480	0.00574
Magnesium (Mg)	mg/L	11.8	11.4	12.6	12.0	9.54	5.00	5.10	6.55	7.90	10.8	10.5
Manganese (Mn)	mg/L	0.00642	0.00694	0.0119	0.0103	0.0238	0.0155	0.00959	0.00743	0.00614	0.00623	0.00599
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9 - 2012										
Month Sampled		January	February	March	April	May	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	26-Jun-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-5	L1117841-3	L1127031-3	L1137305-3	L1148502-3	L1169751-3	L1184612-3	L1197851-8	L1228768-3	L1243937-3	L1251738-3
Total Metals (*cont'd*)												
Molybdenum (Mo)	mg/L	0.000863	0.000852	0.000871	0.000883	0.000661	0.000406	0.000452	0.000521	0.000639	0.000809	0.000814
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00078	0.00057	0.00161	0.00087	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.412	0.444	0.516	0.490	0.549	0.314	0.268	0.299	0.312	0.430	0.433
Selenium (Se)	mg/L	0.00025	0.00025	0.00023	0.00023	0.00025	<0.00010	<0.00010	0.00012	0.00015	0.00021	0.00023
Silicon (Si)	mg/L	1.63	1.56	1.71	1.56	2.86	1.36	1.24	1.10	1.21	1.50	1.59
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.144	0.147	0.161	0.156	0.0907	0.0403	0.0535	0.0739	0.0894	0.136	0.146
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000022	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	0.027	0.014	0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000300	0.000297	0.000293	0.000302	0.000244	0.000121	0.000131	0.000159	0.000198	0.000274	0.000279
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0025	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0040	0.0054	0.0087	<0.0030	0.0057	0.0034	0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals												
Aluminum (Al)	mg/L	0.0043	<0.0030	0.0131	<0.0030	0.0098	0.0144	0.0088	0.0048	0.0046	0.0034	0.0039
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	0.00011	0.00011	0.00012	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	0.00011
Barium (Ba)	mg/L	0.0564	0.0631	0.0631	0.0702	0.0495	0.0232	0.0263	0.0344	0.0387	0.0500	0.0529
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	0.000016	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	43.8	45.0	47.8	45.2	34.8	21.4	20.5	26.0	30.8	37.6	40.1
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00010	<0.00010	<0.00010	0.00015	<0.00010	0.00011
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00053	0.00132	0.00066	<0.00050	0.00089	0.00076	<0.00050	<0.00050	0.00082	0.00058
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00416	0.00564	0.00627	0.00651	0.00203	0.00086	0.00075	0.00267	0.00273	0.00469	0.00561
Magnesium (Mg)	mg/L	11.3	11.6	12.5	12.0	8.53	5.12	5.05	6.34	7.65	10.3	10.2
Manganese (Mn)	mg/L	0.00449	0.00666	0.0113	0.00854	0.00416	0.00290	0.00387	0.00336	0.00360	0.00496	0.00554
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000830	0.000829	0.000844	0.000817	0.000569	0.000379	0.000382	0.000542	0.000600	0.000711	0.000782
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.419	0.481	0.605	0.485	0.308	0.205	0.208	0.280	0.286	0.416	0.430
Selenium (Se)	mg/L	0.00025	0.00026	0.00029	0.00029	0.00020	<0.00010	0.00010	<0.00010	0.00015	0.00019	0.00023
Silicon (Si)	mg/L	1.57	1.62	1.56	1.49	1.18	0.829	0.772	0.886	1.08	1.35	1.50
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	2.5	3.2	3.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.6	2.9
Strontium (Sr)	mg/L	0.141	0.147	0.165	0.151	0.0812	0.0411	0.0500	0.0727	0.0853	0.125	0.136
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000289	0.000284	0.000289	0.000273	0.000194	0.000089	0.000095	0.000134	0.000170	0.000231	0.000225
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0032	0.0085	0.0063	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2010								
Month Sampled		May	May	May	June	June	July	August	October	December
Date Sampled		20-May-10	31-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10
Lab Sample ID	Units	L889661-1	L892473-1	L892473-8	L894624-1	L897909-5	L915316-2	L921658-1	R010261-05	R012173-04
Physical Tests										
Colour, True	CU	13.1	8.6	8.9	7.0	5.9	<5.0	<5.0	-	-
Conductivity	µS/cm	187	212	208	198	159	185	185	-	316
Hardness (as $CaCO_3$)	mg/L	100	107	107	101	84.5	94.6	89.5	104	167.0
pH	pH	8.04	8.34	8.27	8.28	8.13	8.18	7.48	7.47	8.12
Total Suspended Solids	mg/L	105	12.1	17.6	10.2	27.4	6.0	5.3	8.0	<1
Total Dissolved Solids	mg/L	107	127	119	113	95	102	107	120	164
Turbidity	NTU	51.1	9.02	10.4	4.89	14.4	2.74	2.69	-	0.7
Anions and Nutrients										
Acidity (as $CaCO_3$)	mg/L	2.9	<1.0	<1.0	<1.0	2.3	2.2	<1.0	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	91.4	67.3	102	102	83.1	84.6	88.3	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	91.4	67.3	102	102	83.1	84.6	88.3	-	146
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.51	0.61	-	1.26
Fluoride (F)	mg/L	0.031	0.030	0.030	0.026	0.022	0.027	0.025	-	<0.10
Nitrate (as N)	mg/L	0.102	0.0842	0.0823	0.0506	0.0469	0.0207	0.0173	-	0.02
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	0.109	0.066	0.058	0.059	0.064	<0.050	0.053	-	0.06
Total Nitrogen	mg/L	0.210	0.150	0.140	0.110	0.112	0.070	0.070	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.102	0.0136	0.0177	0.0127	0.0294	0.0049	0.0048	-	<0.010
Sulphate (SO_4)	mg/L	5.84	7.08	7.15	5.55	5.16	8.87	9.05	-	16.7
Cyanides										
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	-	<0.0010	<0.0010	-	<0.002
Cyanide, Total	mg/L	0.0041	0.0033	0.0031	0.0025	0.0025	0.0012	0.0016	-	<0.01
Organic Carbon										
Total Organic Carbon	mg/L	4.23	2.42	2.62	1.91	1.70	1.08	2.08	-	0.80
Total Metals										
Aluminum (Al)	mg/L	2.12	0.315	0.288	0.230	0.656	0.120	0.0998	0.295	0.057
Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010
Arsenic (As)	mg/L	0.00092	0.00021	0.00020	0.00018	<0.00040	0.00013	0.00017	0.00060	<0.0050
Barium (Ba)	mg/L	0.0778	0.0470	0.0485	0.0450	0.0372	0.0355	0.0387	0.0338	0.0617
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.011	0.010	0.011	<0.010	<0.010	0.012	0.011	0.021	<0.040
Cadmium (Cd)	mg/L	0.000122	0.000029	0.000033	0.000025	0.000038	0.000012	0.000015	0.000	<0.00010
Calcium (Ca)	mg/L	33.9	33.1	32.9	31.5	28.2	27.2	27.4	27.600000	46.000
Chromium (Cr)	mg/L	0.00318	0.00075	0.00057	0.00048	0.00120	<0.00050	0.00026	00.0	<0.0050
Cobalt (Co)	mg/L	0.00110	0.00018	0.00018	0.00015	0.00034	<0.00010	<0.00010	0.00021	<0.00050
Copper (Cu)	mg/L	0.00268	0.00064	0.00068	0.00061	0.00101	<0.00050	<0.00040	0.0008	<0.0010
Iron (Fe)	mg/L	2.59	0.353	0.382	0.299	0.711	0.207	0.144	0.41	0.14
Lead (Pb)	mg/L	0.00138	0.000192	0.000227	0.000193	0.000402	0.000130	0.000090	0.0002	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0023	0.0059
Magnesium (Mg)	mg/L	9.81	7.98	7.83	7.16	7.53	6.51	7.32	8.48	12.5
Manganese (Mn)	mg/L	0.0629	0.0115	0.0116	0.0102	0.0221	0.00967	0.00922	00.0	0.0069
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2010								
Month Sampled		May	May	May	June	June	July	August	October	December
Date Sampled		20-May-10	31-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10
Lab Sample ID	Units	L889661-1	L892473-1	L892473-8	L894624-1	L897909-5	L915316-2	L921658-1	R010261-05	R012173-04
Total Metals (*cont'd*)										
Molybdenum (Mo)	mg/L	0.000684	0.000593	0.000636	0.000572	0.000463	0.000530	0.000580	0.0004	<0.0010
Nickel (Ni)	mg/L	0.00372	0.00093	0.00086	0.00073	0.00125	<0.00050	<0.00050	0.00150	0.0021
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	1.01	0.400	0.394	0.351	0.465	0.309	0.355	-	-
Selenium (Se)	mg/L	0.00036	0.00028	0.00024	<0.00020	<0.00020	0.00012	0.00022	0.00030	<0.0030
Silicon (Si)	mg/L	4.04	1.52	1.54	1.37	1.72	1.07	1.13	-	-
Silver (Ag)	mg/L	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.050	1.65
Strontium (Sr)	mg/L	0.0820	0.0692	0.0696	0.0618	0.0510	0.0740	0.0855	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	0.00067	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	0.038	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.02	<0.050
Uranium (U)	mg/L	0.000255	0.000198	0.000201	0.000183	0.000159	0.000164	0.000160	0.00016	0.00028
Vanadium (V)	mg/L	0.0075	0.0012	0.0011	<0.0010	0.0021	<0.0010	<0.0010	<0.001	<0.0100
Zinc (Zn)	mg/L	0.0124	0.0020	0.0022	0.0018	0.0031	<0.0010	<0.0010	0.003	<0.010
Dissolved Metals										
Aluminum (Al)	mg/L	0.0247	0.0090	0.0096	0.0079	0.0098	0.0035	0.0028	0.013	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.001
Arsenic (As)	mg/L	0.00013	<0.00010	0.00011	<0.00010	<0.00010	0.00012	0.00011	<0.0005	<0.005
Barium (Ba)	mg/L	0.0391	0.0408	0.0415	0.0431	0.0285	0.0349	0.0345	0.0326	0.0616
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.005	<0.04
Cadmium (Cd)	mg/L	0.000011	0.000011	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	27.3	31.0	30.8	29.3	24.3	27.6	24.6	27	42.4
Chromium (Cr)	mg/L	<0.00020	<0.00050	<0.00050	<0.00020	<0.00020	<0.00050	<0.00010	<0.0005	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00006	<0.0005
Copper (Cu)	mg/L	0.00043	0.00025	0.00026	0.00030	0.00027	0.00025	0.00015	0.0003	<0.001
Iron (Fe)	mg/L	0.040	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.046	<0.1
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0022	0.0069
Magnesium (Mg)	mg/L	7.80	7.28	7.25	6.75	5.77	6.23	6.85	6.9	13
Manganese (Mn)	mg/L	0.000542	0.00221	0.00201	0.000897	0.000614	0.000145	0.000566	0.0026	0.007
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Molybdenum (Mo)	mg/L	0.000472	0.000593	0.000568	0.000513	0.000423	0.000568	0.000554	0.0005	<0.001
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.318	0.269	0.277	0.244	0.217	0.289	0.307	-	-
Selenium (Se)	mg/L	<0.00020	0.00024	0.00023	<0.00020	<0.00020	0.00012	0.00011	0.0003	<0.003
Silicon (Si)	mg/L	1.09	1.09	1.10	1.05	0.869	0.845	0.918	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.783	1.61
Strontium (Sr)	mg/L	0.0650	0.0660	0.0679	0.0577	0.0473	0.0745	0.0818	0.0667	0.143
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000154	0.000172	0.000167	0.000166	0.000124	0.000153	0.000151	0.00016	0.00033
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2011																		
Month Sampled		January	February	March	April	April	May	May	May	May	June	June	June	June	June	July	August	September	October	November
Date Sampled		5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	26-Apr-11	11-May-11	18-May-11	25-May-11	25-May-11	2-Jun-11	2-Jun-11	7-Jun-11	14-Jun-11	14-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-06	L981301-3	L990825-6	L999009-3	L999009-5	L1004821-4	L1006884-7	L1009390-4	L1009390-6	L1012487-5	L1012487-8	L1015493-4	L1018864-3	L1018864-5	L1034422-14	L1049771-6	L1064458-13	L1073725-11	L1091894-9
Physical Tests																				
Colour, True	CU	<5	<5.0	<5.0	<5.0	<5.0	15.7	18.8	12.9	13.3	9.6	9.4	6.7	7.1	7.1	6.8	8.8	7.7	<5.0	9.4
Conductivity	µS/cm	302	309	338	338	338	257	205	212	214	191	190	185	180	179	212	145	176	254	244
Hardness (as $CaCO_3$)	mg/L	135	161	172	175	170	135	104	109	109	98.5	102	99.7	90.0	91.0	106	70.1	87.6	126	132
pH	pH	8.06	8.17	8.03	8.29	8.31	8.22	8.15	8.27	8.26	8.21	8.22	8.21	8.25	8.25	8.24	8.16	8.25	8.33	8.30
Total Suspended Solids	mg/L	<1	<3.0	<3.0	4.3	5.3	78.3	176	84.4	83.8	29.5	32.8	37.3	48.7	36.7	19.1	164	32.7	<1.0	<1.0
Total Dissolved Solids	mg/L	192	-	192	-	-	151	-	115	117	-	-	102	-	-	-	-	-	3.3	8.0
Turbidity	NTU	1.2	2.94	4.83	3.85	3.68	33.4	66.0	34.1	32.5	20.7	21.3	14.8	15.8	14.5	10.5	62.5	14.5	3.58	7.12
Anions and Nutrients																				
Acidity (as $CaCO_3$)	mg/L	<2	1.1	6.5	<1.0	<1.0	1.6	2.4	1.4	1.5	1.5	1.4	<1.0	1.4	<1.0	<1.0	2.6	1.6	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	150	153	154	168	157	126	106	112	110	96.8	100	96.3	91.7	92.5	109	72.9	87.1	120	125
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	150	153	154	168	157	126	106	112	110	96.8	100	96.3	91.7	92.5	109	72.9	87.1	121	125
Ammonia (as N)	mg/L	<0.02	<0.0050	<0.0050	0.0076	0.0076	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0080	0.0076	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.44	1.49	2.00	1.76	1.77	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.68	0.96
Fluoride (F)	mg/L	<0.10	0.046	0.048	0.051	0.052	0.045	0.033	0.039	0.040	0.035	0.034	<0.020	<0.020	<0.020	0.038	0.020	0.027	0.042	0.042
Nitrate (as N)	mg/L	0.08	0.0875	0.126	0.0576	0.0577	0.108	0.101	0.0707	0.0695	0.0555	0.0541	0.0441	0.0304	0.0303	0.0367	0.0189	0.0208	0.0239	0.0533
Nitrite (as N)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.08	<0.050	0.074	0.122	0.102	0.172	0.399	0.169	0.161	0.095	0.096	0.306	0.120	0.130	0.143	0.171	0.089	0.086	<0.050
Total Nitrogen	mg/L	-	0.120	0.200	0.180	0.160	0.280	0.500	0.240	0.230	0.150	0.150	0.350	0.150	0.160	0.180	0.190	0.110	0.110	0.050
Orthophosphate (as P)-Dissolved	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	-	<0.0020	<0.0020	<0.0020	<0.0020	0.0023	0.0034	0.0028	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0027
Phosphorus-Total	mg/L	0.01	0.0039	0.0032	0.0063	0.0054	0.0649	0.074	0.078	0.084	0.0366	0.0335	0.0301	0.0431	0.0238	0.0179	0.123	0.0280	0.0047	0.0092
Sulphate (SO_4)	mg/L	19.2	18.2	26.8	26.2	26.1	9.35	6.67	5.96	5.97	5.08	5.04	4.98	4.83	4.77	9.29	5.55	6.54	12.4	9.51
Cyanides																				
Cyanide, Weak Acid Dissociable	mg/L	<0.002	<0.0010	<0.0010	<0.0011	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.01	0.0016	<0.0010	0.0017	0.0018	<0.0020	0.0080	0.0054	0.0053	0.0040	0.0037	0.0026	0.0012	0.0027	0.0024	0.0036	0.0035	0.0028	0.0031
Organic Carbon																				
Total Organic Carbon	mg/L	0.90	1.52	1.96	1.52	1.39	4.52	7.15	4.06	4.21	3.05	3.12	3.71	2.27	2.48	2.41	3.32	2.14	1.62	2.62
Total Metals																				
Aluminum (Al)	mg/L	0.078	0.0595	0.112	0.0878	0.0864	0.214	2.06	1.15	1.10	0.688	0.628	0.555	0.662	0.541	0.373	2.03	0.535	0.0874	0.113
Antimony (Sb)	mg/L	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.0050	0.00024	0.00013	0.00019	0.00020	0.00030	0.00117	0.00064	0.00057	0.00036	0.00034	0.00028	0.00033	0.00029	0.00024	0.00097	0.00027	0.00013	0.00014
Barium (Ba)	mg/L	0.0933	0.0636	0.0749	0.0792	0.0769	0.0757	0.0817	0.0744	0.0718	0.0568	0.0550	0.0453	0.0427	0.0427	0.0489	0.0499	0.0317	0.0445	0.0523
Beryllium (Be)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.040	0.015	0.016	0.014	0.014	0.012	0.012	0.011	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.00010	0.000016	0.000012	0.000016	0.000017	0.000063	0.000169	0.000111	0.000101	0.000047	0.000052	0.000039	0.000045	0.000040	0.000025	0.000108	0.000022	<0.000010	0.000015
Calcium (Ca)	mg/L	33.2	46.1	47.3	49.3	48.7	43.5	34.4	35.5	36.1	32.4	31.9	29.2	27.3	27.0	30.5	26.5	25.9	33.0	35.7
Chromium (Cr)	mg/L	<0.0050	0.00025	0.00026	0.00017	0.00021	0.00065	0.00332	0.00205	0.00188	0.00115	0.00103	0.00102	0.00126	0.00110	0.00069	0.00298	0.00102	0.00032	0.00024
Cobalt (Co)	mg/L	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	0.00034	0.00130	0.00067	0.00066	0.00035	0.00035	0.00027	0.00033	0.00028	0.00019	0.00124	0.00025	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.0020	<0.00050	<0.00050	<0.00050	<0.00050	0.00114	0.00333	0.00218	0.00337	0.00114	0.00164	0.00105	0.00214	0.00181	0.00063	0.00295	0.00084	<0.00050	<0.00050
Iron (Fe)	mg/L	0.13	0.186	0.222	0.258	0.257	0.511	3.04	1.58	1.46	0.826	0.788	0.637	0.808	0.707	0.429	2.88	0.558	0.149	0.181
Lead (Pb)	mg/L	<0.0010	0.000064	0.000072	0.000083	0.000084	0.000557	0.00170	0.000966	0.000887	0.000448	0.000451	0.000337	0.000406	0.000351	0.000223	0.00169	0.000333	0.000071	0.000089
Lithium (Li)	mg/L	0.0067	0.0067	0.0084	0.0086	0.0083	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00170	0.00158	0.00250	0.00375	0.00153	0.00342	0.00330
Magnesium (Mg)	mg/L	12.7	12.3	14.5	13.8	13.6	10.4	10.2	8.88	8.95	8.12	7.93	7.38	6.57	6.68	7.87	7.44	6.49	9.40	9.78
Manganese (Mn)	mg/L	0.0083	0.0106	0.0113	0.0157	0.0157	0.0365	0.0771	0.0359	0.0380	0.0208	0.0210	0.0155	0.0183	0.0170	0.0124	0.0759	0.0154	0.00800	0.00872
Mercury (Hg)	mg/L	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2011																		
Month Sampled		January	February	March	April	April	May	May	May	May	June	June	June	June	June	July	August	September	October	November
Date Sampled		5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	26-Apr-11	11-May-11	18-May-11	25-May-11	25-May-11	2-Jun-11	2-Jun-11	7-Jun-11	14-Jun-11	14-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-06	L981301-3	L990825-6	L999009-3	L999009-5	L1004821-4	L1006884-7	L1009390-4	L1009390-6	L1012487-5	L1012487-8	L1015493-4	L1018864-3	L1018864-5	L1034422-14	L1049771-6	L1064458-13	L1073725-11	L1091894-9
Total Metals (*cont'd*)																				
Molybdenum (Mo)	mg/L	0.0013	0.000897	0.000960	0.000960	0.000922	0.000784	0.000730	0.000602	0.000606	0.000536	0.000525	0.000495	0.000531	0.000559	0.000597	0.000404	0.000450	0.000640	0.000612
Nickel (Ni)	mg/L	<0.0020	<0.00050	<0.00050	0.00054	0.00052	0.00121	0.00475	0.00275	0.00272	0.00158	0.00158	0.00115	0.00137	0.00128	0.00088	0.00363	0.00089	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.20	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.35	0.471	0.565	0.562	0.559	0.439	1.05	0.789	0.771	0.532	0.506	0.411	0.449	0.413	0.393	0.888	0.427	0.365	0.400
Selenium (Se)	mg/L	<0.0050	0.00026	0.00032	0.00039	0.00033	0.00025	0.00029	0.00024	0.00023	0.00015	0.00014	0.00017	0.00015	0.00013	0.00027	0.00014	0.00011	0.00017	0.00016
Silicon (Si)	mg/L	<5.0	1.90	1.96	1.75	1.72	1.78	4.22	3.45	3.27	2.49	2.09	1.83	2.02	1.87	1.57	4.09	1.76	1.25	1.58
Silver (Ag)	mg/L	<0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000033	0.000018	0.000013	<0.000010	<0.000010	<0.000010	0.000034	0.000021	<0.000010	0.000015	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.24	2.3	3.1	3.1	3.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.2	0.167	0.184	0.190	0.186	0.114	0.0790	0.0718	0.0722	0.0626	0.0607	0.0587	0.0564	0.0554	0.0712	0.0580	0.0589	0.0941	0.100
Thallium (Tl)	mg/L	0.00039	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000019	0.000017	0.000011	0.000046	0.000013	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	0.038	0.025	0.024	0.023	0.016	0.013	0.013	0.014	<0.010	0.051	0.014	<0.010	<0.010
Uranium (U)	mg/L	0.00049	0.000297	0.000348	0.000349	0.000343	0.000258	0.000349	0.000247	0.000234	0.000180	0.000173	0.000152	0.000163	0.000164	0.000188	0.000227	0.000159	0.000211	0.000206
Vanadium (V)	mg/L	<0.010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	0.0081	0.0047	0.0045	0.0026	0.0025	0.0020	0.0026	0.0021	0.0014	0.0056	0.0016	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.040	<0.0030	<0.0030	<0.0030	<0.0030	0.0043	0.0154	0.0097	0.0084	0.0050	0.0050	0.0041	0.0055	0.0039	0.0057	0.0105	<0.0030	<0.0030	<0.0030
Dissolved Metals																				
Aluminum (Al)	mg/L	<0.05	<0.0030	0.0037	<0.0030	<0.0030	0.0145	0.0346	0.0207	0.0204	0.0189	0.0195	0.0145	0.0120	0.0116	0.0089	0.0221	0.0166	0.0042	0.0098
Antimony (Sb)	mg/L	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.005	0.00015	<0.00010	0.00012	0.00013	0.00016	0.00014	0.00013	0.00013	0.00011	0.00011	<0.00010	0.00011	<0.00010	0.00012	0.00013	0.00011	<0.00010	0.00011
Barium (Ba)	mg/L	0.077	0.0604	0.0697	0.0735	0.0737	0.0613	0.0444	0.0484	0.0489	0.0425	0.0436	0.0373	0.0350	0.0344	0.0417	0.0229	0.0262	0.0435	0.0528
Beryllium (Be)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.04	<0.010	0.014	0.011	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0001	0.000024	<0.000010	<0.000010	0.000011	0.000022	0.000013	0.000012	0.000011	0.000011	0.000011	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	24	44.6	45.7	47.9	46.4	38.5	28.2	30.8	30.9	27.9	28.9	28.1	25.8	26.0	29.8	19.7	24.6	34.7	36.7
Chromium (Cr)	mg/L	<0.005	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00015	0.00012	0.00012	<0.00010	0.00012	0.00011	<0.00010	0.00010	0.00012	0.00011	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.002	0.00100	<0.00050	<0.00050	<0.00050	0.00084	0.00090	0.00071	0.00071	<0.00050	0.00070	0.00065	0.00067	0.00078	0.00082	0.00099	0.00054	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.1	<0.030	<0.030	0.050	<0.030	0.047	0.059	0.043	0.042	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.034	<0.030	<0.030	0.039
Lead (Pb)	mg/L	<0.001	<0.000050	<0.000050	<0.000050	<0.000050	0.000183	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0053	0.0066	0.0080	0.0081	0.0080	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00138	0.00139	0.00222	0.00133	0.00132	0.00348	0.00348
Magnesium (Mg)	mg/L	12.9	12.0	14.1	13.4	13.1	9.41	8.09	7.77	7.77	7.01	7.23	7.19	6.19	6.32	7.68	5.08	6.38	9.42	9.72
Manganese (Mn)	mg/L	0.0081	0.00936	0.00899	0.0118	0.0113	0.00666	0.00633	0.00351	0.00368	0.00280	0.00322	0.00276	0.00367	0.00318	0.00400	0.00380	0.00226	0.00539	0.00553
Mercury (Hg)	mg/L	0.00062	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	<0.001	0.000839	0.000869	0.000897	0.000878	0.000638	0.000495	0.000499	0.000493	0.000463	0.000472	0.000463	0.000448	0.000458	0.000570	0.000315	0.000389	0.000661	0.000611
Nickel (Ni)	mg/L	<0.002	<0.00050	<0.00050	<0.00050	<0.00050	0.00089	0.00070	0.00059	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	0.00061	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.394	0.455	0.506	0.530	0.526	0.391	0.364	0.373	0.375	0.252	0.281	0.238	0.229	0.229	0.266	0.246	0.267	0.359	0.368
Selenium (Se)	mg/L	<0.005	0.00025	0.00030	0.00035	0.00038	0.00032	0.00021	0.00022	0.00021	0.00018	0.00018	0.00015	0.00014	0.00013	0.00026	0.00010	0.00012	0.00019	0.00018
Silicon (Si)	mg/L	<5	1.73	1.63	1.56	1.56	1.47	1.23	1.30	1.33	1.09	1.13	1.04	0.973	0.970	1.07	0.786	1.01	1.22	1.46
Silver (Ag)	mg/L	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.47	2.6	3.0	3.3	3.3	2.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.158	0.163	0.176	0.178	0.178	0.105	0.0708	0.0666	0.0670	0.0555	0.0568	0.0580	0.0559	0.0552	0.0723	0.0515	0.0602	0.101	0.102
Thallium (Tl)	mg/L	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00039	0.000287	0.000331	0.000325	0.000322	0.000210	0.000158	0.000152	0.000149	0.000131	0.000128	0.000124	0.000123	0.000123	0.000171	0.000090	0.000121	0.000214	0.000213
Vanadium (V)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.04	0.0055	<0.0030	<0.0030	<0.0030	0.0034	0.0062	0.0032	0.0031	<0.0030	0.0031	<0.0030	<0.0030	0.0046	0.0033	0.0042	<0.0030	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 sample which was analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2012																						
Month Sampled		January	February	March	March	April	May	May	May	May	June	June	June	June	June	July	July	July	August	October	November	November	December	December
Date Sampled		24-Jan-12	20-Feb-12	20-Mar-12	20-Mar-12	18-Apr-12	16-May-12	16-May-12	28-May-12	28-May-12	5-Jun-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	23-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	28-Nov-12	18-Dec-12	18-Dec-12
Lab Sample ID	Units	L1108712-13	L1117841-18	L1127031-9	L1127031-10	L1137305-9	L1148502-9	L1148502-15	L1154387-4	L1154387-8	L1157872-4	L1157872-6	L1162268-4	L1166580-5	L1169751-9	L1174000-5	L1184612-9	L1184612-20	L1197851-2	L1228768-4	L1243937-9	L1243937-17	L1251738-4	L1251738-13
Physical Tests																								
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	12.6	12.6	11.2	11.4	8.0	8.1	10.1	6.6	5.6	<5.0	<5.0	<5.0	<5.0	5.6	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	307	328	326	324	319	230	231	194	195	197	197	168	159	151	162	146	147	177	203	256	256	281	285
Hardness (as $CaCO_3$)	mg/L	158	165	164	177	167	123	124	100	101	102	96.5	91.0	83.7	76.6	81.9	71.1	73.9	94.9	104	138	138	147	150
pH	pH	8.16	8.32	8.31	8.30	8.32	8.30	8.31	8.25	8.26	8.30	8.28	8.22	8.20	8.28	8.23	8.22	8.10	8.31	8.17	8.17	8.09	8.09	8.20
Total Suspended Solids	mg/L	4.7	<3.0	5.3	4.0	4.7	87.9	77.2	103	99.3	20.0	18.7	70.3	37.3	24.6	11.1	8.4	12.4	5.2	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	3.41	1.41	2.34	2.48	2.16	28.8	28.3	40.7	33.1	13.8	12.6	30.5	16.8	16.1	6.75	4.32	5.46	4.32	1.45	1.39	1.39	2.18	2.05
Anions and Nutrients																								
Acidity (as $CaCO_3$)	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	1.7	1.1	2.2	1.0	<1.0	1.6	1.4	<1.0	1.3	1.5	1.2	2.9	1.8
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	157	159	161	160	157	120	128	102	100	101	97.5	89.5	88.1	77.1	79.3	76.9	74.8	91.4	105	131	135	143	139
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	4.5	<1.0	<1.0	2.1	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	157	163	161	160	160	120	128	102	100	101	97.5	89.5	88.1	77.1	79.3	76.9	74.8	91.4	105	131	135	143	139
Ammonia (as N)	mg/L	<0.0050	<0.0050	0.0082	0.0070	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.20	1.35	2.69	2.29	1.33	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.57	0.62	1.09	1.09	1.39	1.38
Fluoride (F)	mg/L	0.050	0.056	0.049	0.049	0.059	0.041	0.041	0.033	0.032	0.033	0.034	0.030	0.028	0.024	0.027	0.026	0.026	0.035	0.036	0.044	0.042	0.050	0.050
Nitrate (as N)	mg/L	0.0757	0.103	0.0729	0.0730	0.0531	0.0910	0.0896	0.0802	0.0822	0.0702	0.0709	0.0596	0.0533	0.0427	0.0320	0.0126	0.0139	0.0133	0.0382	0.0704	0.0708	0.0862	0.0809
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	0.157	0.077	<0.050	0.069	0.050	<0.050	0.068	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.060	0.052	0.064	<0.050
Total Nitrogen	mg/L	0.060	0.110	0.230	0.150	0.060	0.160	0.140	0.130	0.150	0.110	0.100	0.060	0.060	0.070	<0.050	<0.050	<0.050	<0.050	0.080	-	-	0.124	0.126
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	0.0021	<0.0020	<0.0020	0.0025	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	0.0022	0.0024	0.0021	0.0024	0.0022	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.0046	0.0033	0.0065	0.0039	0.0036	0.092	0.0860	0.094	0.095	0.0300	0.0209	0.0773	0.0370	0.0273	0.0114	0.0047	0.0071	0.0039	0.0035	0.0023	0.0038	0.0032	0.0034
Sulphate (SO_4)	mg/L	13.2	17.1	18.9	18.9	16.5	5.65	5.67	5.04	5.06	5.74	5.64	4.77	4.77	4.28	5.71	5.57	5.38	8.90	10.6	14.1	14.1	16.8	16.8
Cyanides																								
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0013	0.0015	0.0016	<0.0010	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																								
Total Organic Carbon	mg/L	1.90	1.65	2.11	1.76	1.86	3.69	3.82	4.03	4.77	2.90	3.43	2.79	2.07	2.05	1.33	1.09	1.19	0.94	1.45	1.11	1.12	0.92	1.15
Total Metals																								
Aluminum (Al)	mg/L	0.0555	0.0199	0.0315	0.0309	0.0556	1.21	1.08	1.41	1.29	0.413	0.464	0.206	0.524	0.653	0.182	0.266	0.0071	0.146	0.0549	0.0328	0.0339	0.0450	0.0430
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00016	<0.00010	<0.00010	0.00012	0.00011	0.00011	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00014	0.00011	0.00014	0.00013	0.00014	0.00072	0.00059	0.00082	0.00080	0.00025	0.00029	0.00029	0.00033	0.00036	0.00018	0.00021	0.00012	0.00018	0.00013	0.00018	0.00022	0.00014	0.00018
Barium (Ba)	mg/L	0.0654	0.0666	0.0672	0.0696	0.0750	0.0773	0.0717	0.0615	0.0619	0.0410	0.0423	0.0434	0.0381	0.0322	0.0317	0.0301	0.0279	0.0385	0.0395	0.0552	0.0552	0.0592	0.0589
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.014	0.011	0.014	0.012	0.013	0.011	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	0.011
Cadmium (Cd)	mg/L	0.000018	0.000015	<0.000050	<0.000040	0.000013	0.000100	0.000096	0.000100	0.000114	0.000031	0.000029	0.000080	0.000036	0.000044	0.000021	0.000022	<0.000010	0.000014	0.000017	<0.000010	0.000011	0.000014	0.000012
Calcium (Ca)	mg/L	47.3	46.7	46.6	46.8	47.8	39.6	38.2	33.4	33.7	29.3	29.2	31.1	29.1	22.9	25.7	22.4	20.8	27.9	29.3	40.2	39.6	43.8	43.3
Chromium (Cr)	mg/L	0.00151	<0.00010	0.00030	0.00027	0.00022	0.00210	0.00170	0.00216	0.00207	0.00070	0.00082	0.00046	0.00089	0.00105	0.00037	0.00051	0.00018	0.00027	0.00016	0.00011	0.00015	0.00017	0.00016
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00075	0.00067	0.00088	0.00092	0.00020	0.00022	0.00033	0.00032	0.00035	0.00014	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00053	<0.00050	0.00259	0.00190	<0.00050	0.00214	0.00253	0.00226	0.00231	0.00075	0.00076	0.00114	0.00089	0.00104	0.00053	0.00059	0.00056	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	0.00051
Iron (Fe)	mg/L	0.202	0.128	0.174	0.166	0.202	1.84	1.57	2.16	2.10	0.509	0.540	0.370	0.735	0.850	0.246	0.336	<0.030	0.183	0.131	0.100	0.097	0.142	0.185
Lead (Pb)	mg/L	0.000070	<0.000050	0.000150	0.000126	<0.000050	0.00104	0.000903	0.00113	0.00111	0.000260	0.000283	0.000596	0.000498	0.000450	0.000192	0.000242	<0.000050	0.000116	0.000104	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00495	0.00591	0.00667	0.00619	0.00654	0.00322	0.00295	0.00283	0.00300	0.00164	0.00170	0.00142	0.00174	0.00135	0.00133	0.00153	0.00102	0.00289	0.00288	0.00483	0.00478	0.00633	0.00631
Magnesium (Mg)	mg/L	11.6	12.0	12.6	13.4	12.5	10.4	9.97	9.00	9.02	7.22	7.15	7.62	6.56	5.64	5.99	5.06	5.06	7.24	7.74	10.6	10.4	10.9	11.0
Manganese (Mn)	mg/L	0.00954	0.00775	0.00991	0.00990	0.00999	0.0445	0.0407	0.0495	0.0486	0.0125	0.0130	0.0277	0.0182	0.0203	0.00972	0.0119	0.00266	0.00903	0.00637	0.00552	0.00557	0.00709	0.00704
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3 - 2012																						
Month Sampled		January	February	March	March	April	May	May	May	May	June	June	June	June	June	July	July	July	August	October	November	November	December	December
Date Sampled		24-Jan-12	20-Feb-12	20-Mar-12	20-Mar-12	18-Apr-12	16-May-12	16-May-12	28-May-12	28-May-12	5-Jun-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	23-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	28-Nov-12	18-Dec-12	18-Dec-12
Lab Sample ID	Units	L1108712-13	L1117841-18	L1127031-9	L1127031-10	L1137305-9	L1148502-9	L1148502-15	L1154387-4	L1154387-8	L1157872-4	L1157872-6	L1162268-4	L1166580-5	L1169751-9	L1174000-5	L1184612-9	L1184612-20	L1197851-2	L1228768-4	L1243937-9	L1243937-17	L1251738-4	L1251738-13
Total Metals (*cont'd*)																								
Molybdenum (Mo)	mg/L	0.00101	0.000862	0.000914	0.000836	0.000880	0.000683	0.000649	0.000603	0.000612	0.000484	0.000521	0.000363	0.000540	0.000416	0.000481	0.000456	0.000438	0.000582	0.000583	0.000770	0.000758	0.000837	0.000861
Nickel (Ni)	mg/L	0.00106	<0.00050	0.00064	0.00062	<0.00050	0.00295	0.00269	0.00335	<0.0035	0.00104	0.00108	0.00117	0.00133	0.00332	0.00054	0.00061	<0.00050	0.00062	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.423	0.460	0.635	0.585	0.504	0.720	0.640	0.709	0.672	0.407	0.417	0.288	0.409	0.420	0.268	0.290	0.201	0.332	0.306	0.400	0.395	0.455	0.444
Selenium (Se)	mg/L	0.00025	0.00024	0.00022	0.00023	0.00024	0.00026	0.00026	0.00026	0.00028	0.00012	0.00017	0.00019	0.00017	0.00014	0.00014	0.00011	<0.00010	0.00014	0.00016	0.00019	0.00020	0.00020	0.00022
Silicon (Si)	mg/L	1.71	1.57	1.62	1.63	1.55	3.25	3.24	3.42	3.20	1.76	2.10	1.29	2.04	1.79	1.19	1.26	0.765	1.16	1.20	1.40	1.41	1.60	1.57
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	0.000040	<0.000010	0.000019	0.000015	0.000019	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	2.2	3.0	2.7	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	2.2	
Strontium (Sr)	mg/L	0.147	0.150	0.156	0.162	0.160	0.0875	0.0845	0.0660	0.0667	0.0592	0.0612	0.0564	0.0581	0.0425	0.0550	0.0563	0.0534	0.0790	0.0812	0.133	0.130	0.148	0.147
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000044	0.000034	0.000044	0.000045	0.000013	0.000016	0.000012	0.000020	0.000020	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.026	0.030	0.030	0.029	0.011	0.019	<0.010	0.019	0.018	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000302	0.000317	0.000316	0.000306	0.000310	0.000283	0.000278	0.000233	0.000238	0.000156	0.000171	0.000194	0.000185	0.000140	0.000148	0.000141	0.000116	0.000168	0.000183	0.000264	0.000255	0.000278	0.000277
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0047	0.0037	0.0054	0.0050	0.0016	0.0018	0.0012	0.0023	0.0024	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0049	0.0039	0.0193	0.0206	<0.0030	0.0106	0.0092	0.0108	0.0113	0.0041	0.0040	0.0037	0.0040	0.0059	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																								
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0039	0.0047	<0.0030	0.0100	0.0113	0.0119	0.0123	0.0154	0.0140	0.0210	0.0169	0.0139	0.0098	0.0062	0.0831	0.0046	0.0041	<0.0030	0.0032	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00011	0.00010	0.00010	0.00012	0.00012	0.00011	0.00012	0.00011	0.00011	0.00011	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00013	<0.00010	<0.00010	0.00010	0.00012	0.00011
Barium (Ba)	mg/L	0.0580	0.0655	0.0617	0.0643	0.0737	0.0546	0.0546	0.0397	0.0401	0.0369	0.0357	0.0321	0.0305	0.0250	0.0278	0.0260	0.0304	0.0365	0.0393	0.0516	0.0527	0.0563	0.0575
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	0.011	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	0.010
Cadmium (Cd)	mg/L	0.000011	0.000014	0.000062	0.000026	<0.000010	0.000013	0.000013	0.000011	0.000012	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	0.000011	<0.000010	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011
Calcium (Ca)	mg/L	45.0	46.4	45.6	49.8	46.5	34.6	35.3	28.9	28.7	29.1	27.6	25.8	23.8	22.2	23.5	20.0	21.5	26.9	29.0	38.5	38.2	41.5	42.3
Chromium (Cr)	mg/L	0.00011	<0.00010	0.00014	0.00013	<0.00010	0.00029	0.00012	<0.00010	<0.00010	0.00010	0.00011	0.00010	0.00013	0.00011	<0.00010	<0.00010	0.00012	<0.00010	0.00010	<0.00010	<0.00010	0.00020	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00072	0.00303	0.00260	0.00074	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00058	<0.00050	<0.00050	0.00059	0.00061	<0.00050	<0.00050	<0.00050	0.00080	0.00073	0.00065	0.00068
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.051	0.032	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.169	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000148	<0.000050	<0.000050	<0.000050	<0.000050	0.000107	<0.000050
Lithium (Li)	mg/L	0.00492	0.00623	0.00706	0.00693	0.00701	0.00198	0.00207	0.00139	0.00137	0.00127	0.00129	0.00124	0.00103	0.00096	0.00125	0.00120	0.00148	0.00287	0.00284	0.00493	0.00480	0.00619	0.00622
Magnesium (Mg)	mg/L	11.2	12.0	12.3	12.8	12.4	8.94	8.78	6.85	7.10	7.13	6.73	6.46	5.87	5.14	5.64	5.14	4.93	6.76	7.66	10.2	10.3	10.6	10.9
Manganese (Mn)	mg/L	0.00595	0.00741	0.00970	0.00932	0.00842	0.00536	0.00519	0.00518	0.00521	0.00199	0.00199	0.00313	0.00245	0.00231	0.00323	0.00294	0.00830	0.00386	0.00415	0.00502	0.00524	0.00657	0.00662
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000803	0.000818	0.000857	0.000862	0.000835	0.000574	0.000533	0.000435	0.000432	0.000454	0.000449	0.000435	0.000454	0.000386	0.000422	0.000410	0.000353	0.000535	0.000569	0.000711	0.000699	0.000793	0.000801
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00074	0.00068	<0.00050	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.432	0.491	0.725	0.654	0.498	0.323	0.328	0.269	0.280	0.247	0.240	0.246	0.214	0.194	0.214	0.202	0.211	0.291	0.289	0.400	0.411	0.481	0.450
Selenium (Se)	mg/L	0.00024	0.00025	0.00026	0.00029	0.00029	0.00021	0.00019	0.00019	0.00019	0.00017	0.00018	0.00019	0.00017	0.00011	0.00017	0.00010	0.00010	0.00012	0.00015	0.00021	0.00020	0.00021	0.00023
Silicon (Si)	mg/L	1.59	1.57	1.58	1.58	1.50	1.23	1.24	1.09	1.12	1.07	1.05	1.04	0.915	0.812	0.867	0.789	0.990	0.913	1.09	1.34	1.39	1.53	1.52
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.2	2.8	4.7	4.2	3.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.9	2.8	3.3	3.4
Strontium (Sr)	mg/L	0.141	0.149	0.155	0.170	0.153	0.0793	0.0804	0.0572	0.0569	0.0581	0.0572	0.0527	0.0481	0.0410	0.0510	0.0514	0.0525	0.0749	0.0807	0.128	0.125	0.139	0.143
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000284	0.000296	0.000288	0.000296	0.000273	0.000203	0.000204	0.000158	0.000151	0.000137	0.000136	0.000130	0.000118	0.000096	0.000114	0.000108	0.000129	0.000131	0.000170	0.000231	0.000228	0.000245	0.000247
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0060	0.0058	0.0313	0.0238	<0.0030	<0.0030	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0059	<0.0030	0.0035	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2010						
Month Sampled		May	May	June	July	August	October	December
Date Sampled		20-May-10	31-May-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10
Lab Sample ID	Units	L889661-7	L892473-3	L897909-6	L915316-3	L921658-2	R010261-06	R012173-05
Physical Tests								
Colour, True	CU	13.4	10.3	6.4	<5.0	<5.0	-	-
Conductivity	µS/cm	177	203	162	187	188	-	322
Hardness (as $CaCO_3$)	mg/L	97.3	105	84.8	95.4	87.8	109	188
pH	pH	7.82	8.23	8.17	8.16	8.04	7.59	8.11
Total Suspended Solids	mg/L	115	18.1	24.4	4.5	4.3	10	1.0
Total Dissolved Solids	mg/L	103	122	96	102	112	250	176
Turbidity	NTU	66.8	20.7	16.1	1.91	2.65	-	3.8
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	3.7	1.2	2.4	2.5	3.8	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	93.7	104	84.4	86.1	96.2	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	93.7	104	84.4	86.1	96.2	-	148
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0053	0.0273	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	0.52	0.61	-	1.48
Fluoride (F)	mg/L	0.028	0.032	0.023	0.028	0.025	-	<0.10
Nitrate (as N)	mg/L	0.0916	0.0694	0.0361	0.0193	0.0180	-	0.02
Nitrite (as N)	mg/L	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	<0.050	0.081	0.077	0.091	0.052	-	0.07
Total Nitrogen	mg/L	0.120	0.150	0.114	0.110	0.070	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.111	0.0227	0.0295	0.0044	0.0044	-	<0.010
Sulphate (SO_4)	mg/L	6.76	7.72	5.66	8.92	9.17	-	19.3
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	<0.0010	<0.0010	-	<0.002
Cyanide, Total	mg/L	0.0044	0.0034	0.0025	0.0015	0.0014	-	<0.01
Organic Carbon								
Total Organic Carbon	mg/L	3.28	3.00	1.69	1.28	0.84	-	1.00
Total Metals								
Aluminum (Al)	mg/L	2.48	0.641	0.649	0.0588	0.0487	0.3670	0.2350
Antimony (Sb)	mg/L	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010
Arsenic (As)	mg/L	0.00096	0.00027	<0.00030	0.00015	0.00013	<0.0005	<0.0050
Barium (Ba)	mg/L	0.0904	0.0569	0.0420	0.0368	0.0368	0.0386	0.0798
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.011	0.011	<0.010	0.012	0.011	0.02	<0.040
Cadmium (Cd)	mg/L	0.000122	0.000034	0.000035	0.000012	<0.000010	0.000	<0.00010
Calcium (Ca)	mg/L	33.6	32.2	27.6	27.3	25.7	30.2	51.700
Chromium (Cr)	mg/L	0.00356	0.00117	0.00116	<0.00050	0.00010	00.0	<0.0050
Cobalt (Co)	mg/L	0.00121	0.00029	0.00034	<0.00010	<0.00010	0.00024	<0.00050
Copper (Cu)	mg/L	0.00309	0.00092	0.00104	<0.00070	<0.00030	0.0009	0.00120
Iron (Fe)	mg/L	2.88	0.631	0.716	0.109	0.092	0.49	0.26
Lead (Pb)	mg/L	0.00151	0.000322	0.000414	0.000114	0.000075	0.000	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.002600	0.007
Magnesium (Mg)	mg/L	9.78	7.93	7.33	6.58	7.04	8.13	14.3
Manganese (Mn)	mg/L	0.0624	0.0146	0.0212	0.0130	0.00824	0.01	0.01
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2010						
Month Sampled		May	May	June	July	August	October	December
Date Sampled		20-May-10	31-May-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10
Lab Sample ID	Units	L889661-7	L892473-3	L897909-6	L915316-3	L921658-2	R010261-06	R012173-05
Total Metals (*cont'd*)								
Molybdenum (Mo)	mg/L	0.000659	0.000591	0.000465	0.000529	0.000551	0.0005	<0.0010
Nickel (Ni)	mg/L	0.00422	0.00125	0.00129	<0.00050	<0.00050	0.001400	0.0025
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	1.13	0.522	0.483	0.313	0.319	-	-
Selenium (Se)	mg/L	0.00022	0.00025	<0.00020	0.00010	0.00010	0.0004	<0.0030
Silicon (Si)	mg/L	4.72	2.59	1.79	0.951	1.02	-	-
Silver (Ag)	mg/L	0.000028	0.000016	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	1.120	2.69
Strontium (Sr)	mg/L	0.0817	0.0705	0.0541	0.0751	0.0834	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	0.041	0.021	0.011	<0.010	<0.010	0.022	<0.050
Uranium (U)	mg/L	0.000267	0.000217	0.000171	0.000159	0.000160	0.00018	0.00036
Vanadium (V)	mg/L	0.0085	0.0025	0.0022	<0.0010	<0.0010	<0.001	<0.0100
Zinc (Zn)	mg/L	0.0143	0.0033	0.0031	0.0013	<0.0010	0.0030	<0.010
Dissolved Metals								
Aluminum (Al)	mg/L	0.0172	0.0181	0.0106	0.0031	0.0033	0.017	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.001
Arsenic (As)	mg/L	0.00011	0.00010	<0.00010	0.00012	<0.00010	0.0005	<0.005
Barium (Ba)	mg/L	0.0401	0.0451	0.0322	0.0367	0.0347	0.0328	0.0725
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.005	<0.04
Cadmium (Cd)	mg/L	0.000011	0.000012	<0.000010	<0.000010	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	26.8	30.1	24.2	27.9	24.0	27.5	44.2
Chromium (Cr)	mg/L	<0.00020	<0.00020	<0.00020	<0.00050	<0.00010	<0.0005	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00005	<0.0005
Copper (Cu)	mg/L	0.00045	0.00039	0.00031	0.00026	0.00014	0.0005	<0.001
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.054	<0.1
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0023	0.0077
Magnesium (Mg)	mg/L	7.40	7.21	5.95	6.25	6.77	7.51	14.1
Manganese (Mn)	mg/L	0.000404	0.00274	0.000987	0.000193	0.000271	0.0032	0.0074
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Molybdenum (Mo)	mg/L	0.000464	0.000557	0.000447	0.000560	0.000556	0.0005	<0.001
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0008	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.302	0.271	0.225	0.306	0.307	-	-
Selenium (Se)	mg/L	<0.00020	0.00025	<0.00020	0.00013	0.00011	0.0005	0.0031
Silicon (Si)	mg/L	1.08	1.14	0.926	0.856	0.943	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	1.41	2.68
Strontium (Sr)	mg/L	0.0575	0.0682	0.0505	0.0757	0.0813	0.0721	0.157
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000154	0.000176	0.000132	0.000155	0.000155	0.00017	0.00035
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0046	<0.01

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2010						
Month Sampled		May	May	June	July	August	October	December
Date Sampled		20-May-10	31-May-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10
Lab Sample ID	Units	L889661-7	L892473-3	L897909-6	L915316-3	L921658-2	R010261-06	R012173-05
Hydrocarbons								
EPH10-19	mg/L	-	-	<0.25	-	<0.25	<0.1	-
EPH19-32	mg/L	-	-	<0.25	-	<0.25	<0.1	-
LEPH	mg/L	-	-	<0.25	-	<0.25	<0.1	-
HEPH	mg/L	-	-	<0.25	-	<0.25	<0.1	-
PAH	mg/L	-	-	-	-	-	<0.3	-
Polycyclic Aromatic Hydrocarbons								-
Acenaphthene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Acenaphthylene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Acridine	mg/L	-	-	<0.000050	-	<0.000010	<0.0001	-
Anthracene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Benz(a)anthracene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Benzo(a)pyrene	mg/L	-	-	<0.000010	-	<0.000010	<0.00001	-
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Chrysene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Fluoranthene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Fluorene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	-	<0.000010	<0.00005	-
Naphthalene	mg/L	-	-	<0.000050	-	0.000043	<0.0003	-
Phenanthrene	mg/L	-	-	<0.000050	-	<0.000020	<0.0001	-
Pyrene	mg/L	-	-	<0.000050	-	<0.000010	<0.0001	-
Quinoline	mg/L	-	-	<0.000050	-	<0.000010	<0.0001	-
Surrogate: d10-Acenaphthene (SS)	mg/L	-	-	99	-	76	-	-
Surrogate: d9-Acridine (SS)	mg/L	-	-	92	-	77	-	-
Surrogate: d12-Chrysene (SS)	mg/L	-	-	93	-	72	-	-
Surrogate: d8-Naphthalene (SS)	mg/L	-	-	93	-	81	-	-
Surrogate: d10-Phenanthrene (SS)	mg/L	-	-	94	-	79	-	-

Notes:
All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2011													
Month Sampled		January	February	March	April	May	May	May	June	June	July	August	September	October	November
Date Sampled		5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	8-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-07	L981301-4	L990825-5	L999009-2	L1004821-3	L1006884-5	L1009390-3	L1012487-4	L1015493-3	L1034422-11	L1049771-7	L1064458-11	L1073725-9	L1091894-8
Physical Tests															
Colour, True	CU	5	<5.0	<5.0	<5.0	16.8	24.8	23.3	12.0	<5.0	6.0	9.2	8.2	<5.0	9.5
Conductivity	µS/cm	307	317	331	350	258	199	201	183	182	210	145	176	252	233
Hardness (as $CaCO_3$)	mg/L	144.0	162	166	181	136	98.3	99.1	95.8	94.6	106	69.6	87.6	123	128
pH	pH	8.06	8.18	7.39	8.27	8.23	8.12	8.22	8.20	8.17	8.22	8.17	8.24	8.32	8.30
Total Suspended Solids	mg/L	4.0	<3.0	<3.0	9.3	128	312	188	69.5	74.0	18.5	147	25.3	<1.0	<1.0
Total Dissolved Solids	mg/L	193	-	191	-	154	-	140	-	121	-	-	-	<3.0	8.7
Turbidity	NTU	4.1	1.45	2.05	7.44	81.8	172	167	61.7	87.6	14.1	72.9	14.2	3.77	7.16
Anions and Nutrients															
Acidity (as $CaCO_3$)	mg/L	<2	<1.0	11.9	1.4	<1.0	2.5	1.9	1.5	<1.0	<1.0	2.6	2.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	151	153	154	166	121	102	98.3	90.9	90.3	107	72.6	85.5	121	118
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	151	153	154	166	121	102	98.3	90.9	90.3	107	72.6	85.5	121	118
Ammonia (as N)	mg/L	<0.02	<0.0050	<0.0050	0.0086	<0.0050	0.0092	0.0098	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.59	1.63	1.99	1.95	0.51	0.64	0.55	<0.50	<0.50	<0.50	<0.50	<0.50	0.71	0.66
Fluoride (F)	mg/L	<0.10	0.047	0.049	0.055	0.048	0.042	0.055	0.037	0.024	0.041	0.021	0.028	0.042	0.042
Nitrate (as N)	mg/L	0.08	0.0878	0.0903	0.0706	0.116	0.0985	0.0681	0.0565	0.0483	0.0205	0.0170	0.0195	0.0216	0.0558
Nitrite (as N)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.2	<0.050	0.080	0.129	0.344	0.522	0.372	0.203	0.262	0.149	0.323	<0.050	0.098	<0.050
Total Nitrogen	mg/L	-	0.120	0.170	0.200	0.460	0.620	0.440	0.260	0.310	0.170	0.340	<0.050	0.120	0.080
Orthophosphate (as P)-Dissolved	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	-	<0.0020	<0.0020	<0.0020	0.0029	0.0053	0.0066	<0.0020	0.0026	<0.0020	<0.0020	<0.0020	<0.0020	0.0025
Phosphorus-Total	mg/L	<0.01	0.0023	0.0023	0.0094	0.120	0.197	0.203	0.104	0.0693	0.0243	0.133	0.0335	0.0047	0.0104
Sulphate (SO_4)	mg/L	20.9	20.0	23.5	30.2	10.6	9.59	12.0	7.38	9.47	9.46	5.17	6.45	12.0	10.8
Cyanides															
Cyanide, Weak Acid Dissociable	mg/L	<0.002	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0020	<0.0021	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.01	0.0015	<0.0010	0.0020	<0.0020	0.0102	0.0071	0.0044	0.0044	0.0034	0.0043	<0.0020	<0.0020	0.0031
Organic Carbon															
Total Organic Carbon	mg/L	1.00	1.63	1.13	1.59	7.17	10.7	9.89	4.23	5.44	2.46	4.52	2.07	1.55	2.63
Total Metals															
Aluminum (Al)	mg/L	0.093	0.0253	0.0410	0.193	2.54	5.08	3.23	1.81	1.82	0.617	2.34	0.571	0.125	0.217
Antimony (Sb)	mg/L	<0.0010	<0.00010	<0.00010	<0.00010	0.00014	0.00022	0.00017	0.00011	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.0050	0.00031	0.00012	0.00020	0.00106	0.00221	0.00152	0.00073	0.00071	0.00029	0.00108	0.00028	0.00014	0.00019
Barium (Ba)	mg/L	0.0901	0.0732	0.0764	0.0796	0.124	0.218	0.138	0.0825	0.0799	0.0584	0.0518	0.0339	0.0469	0.0458
Beryllium (Be)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.040	0.016	0.015	0.014	0.016	0.016	0.015	<0.010	0.012	0.012	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.00010	0.000013	<0.000010	0.000023	0.000130	0.000279	0.000196	0.000091	0.000109	0.000034	0.000094	0.000026	0.000012	0.000021
Calcium (Ca)	mg/L	35.3	50.8	46.0	48.2	44.4	37.5	35.9	31.1	30.8	31.8	26.0	26.9	34.5	35.6
Chromium (Cr)	mg/L	<0.0050	0.00022	0.00018	0.00034	0.00381	0.00769	0.00524	0.00291	0.00275	0.00118	0.00345	0.00095	0.00037	0.00246
Cobalt (Co)	mg/L	<0.00050	<0.00010	<0.00010	0.00013	0.00118	0.00265	0.00177	0.00079	0.00077	0.00026	0.00143	0.00028	<0.00010	0.00015
Copper (Cu)	mg/L	<0.0020	<0.00050	<0.00050	<0.00050	0.00319	0.00734	0.00595	0.00264	0.00422	0.00088	0.00334	0.00091	<0.00050	0.00057
Iron (Fe)	mg/L	0.17	0.132	0.165	0.332	2.98	6.70	4.27	1.95	1.82	0.619	3.40	0.626	0.183	0.307
Lead (Pb)	mg/L	<0.0010	<0.000050	<0.000050	0.000130	0.00158	0.00358	0.00241	0.000993	0.000906	0.000338	0.00179	0.000409	0.000084	0.000158
Lithium (Li)	mg/L	0.007	0.0070	0.0081	0.0085	0.0065	0.0073	0.0052	<0.0050	<0.0050	0.00302	0.00421	0.00179	0.00368	0.00349
Magnesium (Mg)	mg/L	13.5	13.5	13.7	13.6	11.3	11.6	9.48	8.11	8.19	8.26	7.46	6.79	9.65	9.72
Manganese (Mn)	mg/L	0.0098	0.00944	0.0117	0.0171	0.0642	0.120	0.0744	0.0357	0.0347	0.0155	0.0807	0.0170	0.00856	0.0117
Mercury (Hg)	mg/L	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2011													
Month Sampled		January	February	March	April	May	May	May	June	June	July	August	September	October	November
Date Sampled		5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	8-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-07	L981301-4	L990825-5	L999009-2	L1004821-3	L1006884-5	L1009390-3	L1012487-4	L1015493-3	L1034422-11	L1049771-7	L1064458-11	L1073725-9	L1091894-8
Total Metals (*cont'd*)															
Molybdenum (Mo)	mg/L	<0.0010	0.000880	0.000922	0.000881	0.000806	0.000829	0.000675	0.000591	0.000532	0.000644	0.000454	0.000453	0.000651	0.000646
Nickel (Ni)	mg/L	<0.0020	0.00054	<0.00050	0.00078	0.00434	0.00974	0.00763	0.00338	0.00320	0.00120	0.00409	0.00096	<0.00050	0.00073
Phosphorus (P)	mg/L	<0.20	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.38	0.516	0.533	0.593	1.23	2.15	1.63	0.957	0.898	0.488	0.991	0.457	0.384	0.399
Selenium (Se)	mg/L	<0.0050	0.00027	0.00029	0.00046	0.00036	0.00048	0.00050	0.00029	0.00038	0.00028	0.00014	0.00012	0.00017	0.00016
Silicon (Si)	mg/L	<5.0	1.77	1.72	1.95	6.13	10.7	11.0	4.97	5.89	2.04	4.28	1.85	1.37	1.65
Silver (Ag)	mg/L	<0.00050	<0.000010	<0.000010	<0.000010	0.000030	0.000089	0.000055	0.000023	0.000020	<0.000010	0.000016	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.84	2.8	3.5	3.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.2	0.169	0.180	0.181	0.113	0.0924	0.0813	0.0664	0.0708	0.0792	0.0562	0.0607	0.0970	0.104
Thallium (Tl)	mg/L	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	0.000017	0.000054	0.000015	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.050	<0.010	<0.010	0.014	0.061	0.121	0.146	0.052	0.072	0.015	0.044	0.013	<0.010	<0.010
Uranium (U)	mg/L	0.00038	0.000313	0.000330	0.000354	0.000350	0.000491	0.000376	0.000232	0.000241	0.000207	0.000223	0.000150	0.000216	0.000225
Vanadium (V)	mg/L	<0.010	<0.0010	<0.0010	<0.0010	0.0086	0.0181	0.0122	0.0068	0.0063	0.0022	0.0066	0.0017	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.040	<0.0030	<0.0030	<0.0030	0.0145	0.0322	0.0213	0.0092	0.0117	0.0044	0.0117	0.0034	<0.0030	<0.0030
Dissolved Metals															
Aluminum (Al)	mg/L	<0.05	<0.0030	<0.0030	0.0037	0.0364	0.0847	0.0652	0.0469	0.0494	0.0120	0.0267	0.0147	0.0041	0.0071
Antimony (Sb)	mg/L	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.005	0.00014	<0.00010	0.00012	0.00016	0.00017	0.00016	0.00013	0.00011	0.00013	0.00015	0.00012	0.00011	0.00010
Barium (Ba)	mg/L	0.0837	0.0633	0.0728	0.0761	0.0640	0.0498	0.0556	0.0424	0.0429	0.0457	0.0238	0.0263	0.0430	0.0454
Beryllium (Be)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.04	<0.010	0.014	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0001	<0.000010	<0.000010	0.000012	0.000015	0.000016	0.000018	0.000014	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	23.9	45.0	44.3	49.6	38.5	26.3	27.5	26.9	26.3	29.7	19.5	24.6	34.0	35.5
Chromium (Cr)	mg/L	<0.005	<0.00010	0.00011	<0.00010	0.00014	0.00024	0.00021	0.00017	0.00017	<0.00010	0.00011	<0.00010	0.00011	<0.00010
Cobalt (Co)	mg/L	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.0054	<0.00050	<0.00050	<0.00050	0.00149	0.00122	0.00123	0.00087	0.00097	0.00092	0.00101	<0.00050	0.00082	<0.00050
Iron (Fe)	mg/L	<0.1	<0.030	<0.030	<0.030	0.060	0.083	0.078	0.048	0.050	<0.030	0.039	<0.030	<0.030	0.040
Lead (Pb)	mg/L	<0.001	<0.000050	<0.000050	<0.000050	0.000100	0.000066	0.000087	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0051	0.0068	0.0080	0.0086	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00254	0.00130	0.00135	0.00358	0.00348
Magnesium (Mg)	mg/L	13	12.1	13.4	13.8	9.68	7.91	7.38	6.99	7.01	7.76	5.07	6.36	9.35	9.53
Manganese (Mn)	mg/L	0.0082	0.00764	0.00966	0.0121	0.00672	0.00739	0.00610	0.00410	0.00402	0.00412	0.00431	0.00218	0.00552	0.00564
Mercury (Hg)	mg/L	0.00033	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0011	0.000822	0.000876	0.000871	0.000609	0.000440	0.000413	0.000447	0.000403	0.000565	0.000290	0.000444	0.000663	0.000620
Nickel (Ni)	mg/L	<0.002	<0.00050	<0.00050	0.00056	0.00071	0.00102	0.00135	0.00064	0.00065	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.465	0.468	0.508	0.551	0.410	0.414	0.425	0.306	0.288	0.262	0.248	0.270	0.360	0.332
Selenium (Se)	mg/L	<0.005	0.00030	0.00032	0.00046	0.00034	0.00036	0.00047	0.00032	0.00041	0.00027	0.00011	0.00012	0.00018	0.00021
Silicon (Si)	mg/L	<5	1.71	1.61	1.61	1.55	1.44	1.57	1.25	1.28	1.12	0.793	1.04	1.19	1.30
Silver (Ag)	mg/L	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	3.07	3.0	3.5	3.7	2.7	3.0	3.2	2.5	3.5	2.5	<2.0	<2.0	2.8	<2.0
Strontium (Sr)	mg/L	0.159	0.162	0.172	0.182	0.104	0.0719	0.0712	0.0593	0.0657	0.0777	0.0501	0.0605	0.0990	0.102
Thallium (Tl)	mg/L	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00044	0.000296	0.000321	0.000352	0.000225	0.000174	0.000179	0.000132	0.000136	0.000174	0.000093	0.000124	0.000203	0.000216
Vanadium (V)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.04	<0.0030	<0.0030	<0.0030	0.0047	0.0031	0.0034	0.0033	0.0037	0.0034	0.0037	<0.0030	0.0033	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-9	L1117841-16	L1127031-7	L1137305-7	L1148502-7	L1154387-3	L1157872-3	L1162268-3	L1166580-4	L1166580-9	L1169751-7	L1174000-4	L1184612-7	L1197851-9	L1228768-9	L1243937-7	L1251738-8
Physical Tests																		
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	13.0	12.6	8.6	12.8	8.8	8.6	6.6	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	333	328	333	320	229	192	195	168	164	162	161	167	162	174	208	259	289
Hardness (as $CaCO_3$)	mg/L	167	163	159	168	123	98.9	98.4	89.1	88.8	90.5	80.5	85.5	74.5	92.1	111	140	164
pH	pH	8.12	8.32	8.25	8.31	8.31	8.28	8.28	8.22	8.27	8.19	8.27	8.26	8.24	8.26	8.21	8.16	8.22
Total Suspended Solids	mg/L	8.7	<3.0	20.7	<3.0	97.2	107	24.0	52.3	41.3	40.7	40.6	37.7	11.8	4.7	<3.0	<3.0	3.3
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	9.51	2.66	11.8	2.60	62.2	62.1	27.7	42.3	36.7	35.2	21.8	39.2	6.32	5.07	1.53	2.38	2.57
Anions and Nutrients																		
Acidity (as $CaCO_3$)	mg/L	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	1.9	1.2	1.3	2.5	1.3	<1.0	1.2	<1.0	<1.0	<1.0	1.4
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	166	159	164	158	126	101	97.4	88.2	89.4	88.1	82.9	85.7	83.5	92.1	104	133	142
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	5.0	<2.0	1.6	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	166	164	164	160	126	101	97.4	88.2	89.4	88.1	82.9	85.7	83.5	92.1	104	133	142
Ammonia (as N)	mg/L	0.0110	<0.0050	0.0321	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0052
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	3.92	1.79	3.77	1.46	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.72	0.67	1.19	1.54
Fluoride (F)	mg/L	0.052	0.059	0.048	0.062	0.043	0.035	0.036	0.035	0.034	0.034	0.030	0.030	0.031	0.035	0.037	0.046	0.051
Nitrate (as N)	mg/L	0.135	0.104	0.0724	0.0582	0.0872	0.0758	0.0630	0.0527	0.0506	0.0494	0.0400	0.0316	0.0137	0.0187	0.0378	0.0718	0.0963
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0077	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	0.398	<0.050	0.073	0.124	0.067	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	0.070	0.074
Total Nitrogen	mg/L	0.120	0.100	0.470	0.070	0.160	0.200	0.130	0.080	0.080	0.070	0.070	<0.050	<0.050	<0.050	0.100	-	0.154
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	0.0014	<0.0010	<0.0010	0.0011	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	0.0022	<0.0020	0.0023	0.0026	<0.0020	<0.0020	0.0028	0.0029	0.0022	<0.0020	0.0030	<0.0020	<0.0020	0.0026	<0.0020
Phosphorus-Total	mg/L	0.0117	0.0043	0.0326	0.0050	0.0968	0.104	0.0364	0.0779	0.0421	0.0447	0.0385	0.0494	0.0041	0.0052	0.0028	0.0027	<0.0020
Sulphate (SO_4)	mg/L	17.3	17.8	19.1	18.2	6.89	5.53	6.37	6.29	7.02	6.85	6.82	6.96	7.85	8.73	11.6	16.2	18.4
Cyanides																		
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0022	0.0015	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																		
Total Organic Carbon	mg/L	2.18	1.65	3.19	1.90	4.20	5.44	3.84	3.36	2.87	2.91	2.12	1.64	1.27	0.94	1.49	1.19	1.27
Total Metals																		
Aluminum (Al)	mg/L	0.115	0.0448	0.288	0.0729	1.52	1.75	0.765	1.19	0.437	0.991	0.678	1.13	0.269	0.164	0.0572	0.0540	0.0851
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00021	<0.00010	0.00014	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00018	0.00013	0.00026	0.00016	0.00069	0.00090	0.00038	0.00057	0.00031	0.00044	0.00037	0.00052	0.00022	0.00018	0.00014	0.00019	0.00021
Barium (Ba)	mg/L	0.0654	0.0674	0.0702	0.0771	0.0802	0.0796	0.0534	0.0570	0.0492	0.0570	0.0430	0.0567	0.0368	0.0393	0.0417	0.0591	0.0608
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.015	<0.010	0.014	0.014	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	0.011
Cadmium (Cd)	mg/L	0.000039	0.000013	0.000063	0.000016	0.000091	0.000122	0.000042	0.000076	0.000053	0.000064	0.000049	0.000065	0.000025	0.000015	0.000011	0.000011	0.000014
Calcium (Ca)	mg/L	45.6	46.2	49.0	48.8	36.0	32.3	25.2	28.3	27.7	24.2	24.1	27.8	22.8	26.6	33.0	40.5	44.1
Chromium (Cr)	mg/L	0.00055	0.00014	0.00106	0.00024	0.00208	0.00272	0.00119	0.00196	0.00079	0.00177	0.00108	0.00171	0.00050	0.00028	0.00015	0.00015	0.00024
Cobalt (Co)	mg/L	0.00010	<0.00010	0.00022	<0.00010	0.00079	0.00107	0.00033	0.00060	0.00034	0.00047	0.00036	0.00058	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00115	<0.00050	0.00246	<0.00050	0.00250	0.00286	0.00114	0.00171	0.00104	0.00131	0.00115	0.0131	0.00117	0.00055	<0.00050	<0.00050	0.00064
Iron (Fe)	mg/L	0.188	0.151	0.617	0.216	1.89	2.57	0.872	1.37	0.627	1.10	0.863	1.26	0.335	0.239	0.130	0.115	0.206
Lead (Pb)	mg/L	0.000140	<0.000050	0.000394	<0.000050	0.00101	0.00131	0.000368	0.000786	0.000540	0.000541	0.000480	0.00115	0.000222	0.000140	0.000058	0.000058	0.000074
Lithium (Li)	mg/L	0.00517	0.00635	0.00689	0.00704	0.00326	0.00324	0.00181	0.00284	0.00181	0.00212	0.00193	0.00251	0.00197	0.00301	0.00325	0.00533	0.00644
Magnesium (Mg)	mg/L	11.5	11.8	13.0	13.0	9.23	8.63	7.38	7.08	6.48	7.04	6.07	6.63	5.39	7.08	8.29	10.7	11.1
Manganese (Mn)	mg/L	0.00902	0.00895	0.0242	0.0119	0.0386	0.0500	0.0171	0.0290	0.0207	0.0235	0.0209	0.0254	0.00986	0.00915	0.00721	0.00600	0.00898
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR4 - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-9	L1117841-16	L1127031-7	L1137305-7	L1148502-7	L1154387-3	L1157872-3	L1162268-3	L1166580-4	L1166580-9	L1169751-7	L1174000-4	L1184612-7	L1197851-9	L1228768-9	L1243937-7	L1251738-8
Total Metals (*cont'd*)																		
Molybdenum (Mo)	mg/L	0.000831	0.000840	0.000929	0.000867	0.000617	0.000613	0.000432	0.000513	0.000449	0.000451	0.000417	0.000550	0.000490	0.000557	0.000624	0.000767	0.000792
Nickel (Ni)	mg/L	0.00081	<0.00050	0.00139	0.00050	0.00303	0.00377	0.00160	0.00236	0.00142	0.00230	0.00142	0.00208	0.00104	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.562	0.464	0.830	0.526	0.748	0.845	0.517	0.656	0.392	0.595	0.445	0.651	0.338	0.325	0.329	0.413	0.475
Selenium (Se)	mg/L	0.00028	0.00025	0.00024	0.00026	0.00028	0.00030	0.00026	0.00031	0.00028	0.00032	0.00031	0.00028	0.00019	0.00012	0.00019	0.00025	0.00023
Silicon (Si)	mg/L	1.76	1.63	2.18	1.62	4.44	4.49	2.66	3.67	1.77	3.52	2.06	4.84	1.41	1.31	1.26	1.47	1.74
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000021	0.000029	<0.000010	0.000017	<0.000010	0.000012	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.8	2.8	4.0	2.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	2.4
Strontium (Sr)	mg/L	0.142	0.147	0.163	0.164	0.0828	0.0673	0.0538	0.0581	0.0619	0.0541	0.0504	0.0621	0.0617	0.0761	0.0917	0.137	0.149
Thallium (Tl)	mg/L	<0.000010	<0.000010	0.000013	<0.000010	0.000043	0.000053	0.000018	0.000036	0.000017	0.000023	0.000020	0.000028	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	0.021	<0.010	0.050	0.044	0.027	0.035	0.011	0.045	0.024	0.074	0.012	0.014	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000307	0.000313	0.000337	0.000321	0.000269	0.000249	0.000159	0.000212	0.000197	0.000189	0.000164	0.000205	0.000154	0.000162	0.000208	0.000283	0.000277
Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0045	0.0066	0.0027	0.0045	0.0018	0.0038	0.0026	0.0041	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0119	0.0058	0.0320	<0.0030	0.0105	0.0125	0.0054	0.0074	0.0044	0.0061	0.0047	0.0145	0.0047	<0.0030	<0.0030	<0.0030	0.0032
Dissolved Metals																		
Aluminum (Al)	mg/L	0.0057	<0.0030	0.0053	0.0035	0.0107	0.0408	0.0286	0.0352	0.0341	0.0331	0.0253	0.0338	0.0078	0.0043	0.0049	0.0033	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00015	<0.00010	0.00013	0.00012	0.00012	0.00013	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00010	0.00010	0.00011	0.00010	0.00011	0.00010
Barium (Ba)	mg/L	0.0672	0.0673	0.0628	0.0727	0.0531	0.0414	0.0413	0.0384	0.0390	0.0388	0.0324	0.0341	0.0291	0.0374	0.0401	0.0549	0.0592
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011
Cadmium (Cd)	mg/L	0.000051	0.000014	0.000039	<0.000010	0.000015	0.000011	<0.000010	0.000013	0.000016	0.000010	<0.000010	0.000012	0.000029	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	46.5	45.6	43.6	46.6	34.9	28.2	27.8	25.4	25.5	26.2	22.7	24.2	21.0	25.6	31.7	39.0	46.2
Chromium (Cr)	mg/L	0.00023	<0.00010	0.00017	<0.00010	<0.00010	0.00011	0.00013	0.00013	0.00016	0.00014	0.00013	0.00011	0.00011	<0.00010	<0.00010	<0.00010	0.00011
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00249	0.00058	0.00271	0.00091	0.00058	0.00088	<0.00050	<0.00050	<0.00050	<0.00050	0.00086	0.00076	0.00062	<0.00050	<0.00050	0.00077	0.00090
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.032	0.048	0.038	0.031	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.000089	<0.000050	<0.000050	<0.000050	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00559	0.00660	0.00695	0.00734	0.00223	0.00163	0.00152	0.00141	0.00151	0.00162	0.00133	0.00162	0.00180	0.00280	0.00320	0.00532	0.00681
Magnesium (Mg)	mg/L	12.3	11.9	12.2	12.4	8.73	6.92	7.03	6.22	6.09	6.06	5.79	6.07	5.36	6.85	7.84	10.3	11.7
Manganese (Mn)	mg/L	0.00724	0.00791	0.0168	0.00929	0.00457	0.00632	0.00225	0.00244	0.00250	0.00248	0.00314	0.00349	0.00364	0.00420	0.00472	0.00537	0.00740
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000795	0.000816	0.000821	0.000808	0.000534	0.000433	0.000427	0.000419	0.000465	0.000453	0.000399	0.000446	0.000427	0.000541	0.000598	0.000730	0.000841
Nickel (Ni)	mg/L	0.00101	<0.00050	0.00068	<0.00050	0.00054	0.00062	<0.00050	0.00053	0.00052	0.00057	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.02	0.485	0.751	0.500	0.331	0.309	0.259	0.244	0.246	0.238	0.240	0.241	0.224	0.278	0.282	0.407	0.504
Selenium (Se)	mg/L	0.00033	0.00027	0.00028	0.00032	0.00025	0.00023	0.00024	0.00029	0.00031	0.00031	0.00029	0.00023	0.00014	0.00013	0.00020	0.00027	0.00026
Silicon (Si)	mg/L	1.66	1.57	1.61	1.49	1.23	1.21	1.14	1.08	1.04	1.06	0.939	0.965	0.877	0.931	1.10	1.37	1.65
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	5.5	3.5	5.0	3.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.4	4.0
Strontium (Sr)	mg/L	0.149	0.147	0.147	0.154	0.0826	0.0608	0.0589	0.0540	0.0589	0.0598	0.0490	0.0554	0.0554	0.0741	0.0890	0.130	0.153
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000320	0.000291	0.000296	0.000281	0.000209	0.000145	0.000139	0.000134	0.000149	0.000151	0.000119	0.000130	0.000114	0.000131	0.000191	0.000244	0.000261
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0313	0.0073	0.0167	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0035

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR7 - 2011										
Month Sampled		February	March	April	May	June	July	August	September	October	November	November
Date Sampled		23-Feb-11	29-Mar-11	26-Apr-11	18-May-11	8-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11	29-Nov-11
Lab Sample ID	Units	L981301-5	L990825-4	L999009-1	L1006884-4	L1015493-12	L1034422-10	L1049771-10	L1064458-10	L1073725-8	L1091894-6	L1091894-11
Physical Tests												
Colour, True	CU	<5.0	<5.0	<5.0	20.3	11.3	9.3	8.7	7.6	<5.0	10.2	9.6
Conductivity	µS/cm	321	336	339	203	173	207	146	176	267	238	244
Hardness (as $CaCO_3$)	mg/L	166	168	174	98.9	90.4	104	70.5	87.8	129	129	133
pH	pH	8.17	8.13	8.20	8.10	8.15	8.18	8.18	8.24	8.30	8.29	8.29
Total Suspended Solids	mg/L	<3.0	<3.0	8.8	247	34.7	19.8	151	16.7	<1.0	<1.0	<1.0
Total Dissolved Solids	mg/L	-	194	-	-	103	-	-	-	4.0	8.7	3.3
Turbidity	NTU	1.12	1.68	8.72	109	23.7	15.1	61.6	12.9	3.15	8.16	4.45
Anions and Nutrients												
Acidity (as $CaCO_3$)	mg/L	1.2	4.5	2.1	1.6	3.5	1.3	2.3	2.2	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	157	155	157	106	89.5	106	72.0	86.9	129	120	135
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	157	155	157	106	89.5	106	72.0	86.9	129	120	135
Ammonia (as N)	mg/L	<0.0050	<0.0050	0.0074	0.0068	0.0095	0.0073	<0.0050	0.0214	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.60	2.06	1.88	<0.50	<0.50	<0.50	<0.50	<0.50	0.80	0.78	0.97
Fluoride (F)	mg/L	0.046	0.049	0.052	0.035	0.021	0.041	0.021	0.028	0.047	0.043	0.044
Nitrate (as N)	mg/L	0.0889	0.0932	0.0689	0.103	0.0406	0.0205	0.0188	0.0192	0.0192	0.0614	0.0532
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	0.067	0.151	0.407	0.189	0.149	0.211	<0.050	0.091	<0.050	<0.050
Total Nitrogen	mg/L	0.109	0.160	0.220	0.510	0.230	0.170	0.230	<0.050	0.110	0.060	<0.050
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	0.0051	0.0025	<0.0020	<0.0020	<0.0020	<0.0020	0.0036	<0.0020
Phosphorus-Total	mg/L	0.0022	0.0031	0.0104	0.0386	0.0303	0.0227	0.143	0.0205	0.0032	0.0135	0.0068
Sulphate (SO_4)	mg/L	21.2	25.3	29.6	7.85	6.00	8.89	5.42	6.46	12.1	11.6	9.51
Cyanides												
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	-	<0.0020	<0.0011	<0.0011
Cyanide, Total	mg/L	0.0014	0.0013	0.0020	0.0100	0.0040	0.0036	0.0032	0.0024	<0.0020	0.0038	0.0029
Organic Carbon												
Total Organic Carbon	mg/L	1.45	2.98	1.73	8.06	4.32	2.73	4.06	2.08	1.68	2.57	2.67
Total Metals												
Aluminum (Al)	mg/L	0.0168	0.0380	0.233	3.34	0.922	0.731	2.24	0.495	0.0670	0.262	0.115
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00018	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00016	0.00010	0.00022	0.00164	0.00038	0.00030	0.00115	0.00027	0.00016	0.00020	0.00014
Barium (Ba)	mg/L	0.0680	0.0767	0.0804	0.124	0.0532	0.0626	0.0605	0.0324	0.0657	0.0494	0.0537
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.015	0.016	0.014	0.014	0.011	0.012	<0.010	<0.010	0.012	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000011	0.000013	0.000023	0.000230	0.000041	0.000034	0.000112	0.000020	0.000013	0.000025	0.000014
Calcium (Ca)	mg/L	46.7	47.8	46.9	37.5	26.2	31.0	27.6	26.1	36.6	36.3	35.7
Chromium (Cr)	mg/L	0.00017	0.00048	0.00035	0.00513	0.00151	0.00135	0.00320	0.00091	0.00036	0.00048	0.00026
Cobalt (Co)	mg/L	<0.00010	<0.00010	0.00014	0.00190	0.00036	0.00027	0.00146	0.00024	<0.00010	0.00015	<0.00010
Copper (Cu)	mg/L	0.00085	<0.00050	<0.00050	0.00503	0.00151	0.00092	0.00344	0.00080	<0.00050	0.00069	<0.00050
Iron (Fe)	mg/L	0.125	0.142	0.351	4.70	0.916	0.645	3.29	0.546	0.134	0.387	0.182
Lead (Pb)	mg/L	0.000099	<0.000050	0.000142	0.00260	0.000473	0.000396	0.00190	0.000308	0.000060	0.000191	0.000084
Lithium (Li)	mg/L	0.0068	0.0083	0.0084	0.0057	<0.0050	0.00336	0.00422	0.00149	0.00478	0.00354	0.00338
Magnesium (Mg)	mg/L	12.4	14.3	13.3	11.5	6.79	8.04	7.78	6.51	9.99	9.95	9.99
Manganese (Mn)	mg/L	0.00633	0.00724	0.0161	0.103	0.0175	0.0158	0.0840	0.0150	0.0155	0.0133	0.00826
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR7 - 2011										
Month Sampled		February	March	April	May	June	July	August	September	October	November	November
Date Sampled		23-Feb-11	29-Mar-11	26-Apr-11	18-May-11	8-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11	29-Nov-11
Lab Sample ID	Units	L981301-5	L990825-4	L999009-1	L1006884-4	L1015493-12	L1034422-10	L1049771-10	L1064458-10	L1073725-8	L1091894-6	L1091894-11
Total Metals (*cont'd*)												
Molybdenum (Mo)	mg/L	0.000896	0.000957	0.000882	0.000702	0.000455	0.000611	0.000466	0.000436	0.000702	0.000665	0.000608
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00076	0.00687	0.00201	0.00146	0.00421	0.00086	<0.00050	0.00078	0.00052
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.458	0.514	0.597	1.46	0.545	0.516	0.969	0.429	0.387	0.478	0.410
Selenium (Se)	mg/L	0.00025	0.00029	0.00044	0.00035	0.00019	0.00021	0.00015	0.00012	0.00017	0.00018	0.00015
Silicon (Si)	mg/L	1.77	1.72	2.00	6.77	2.69	2.31	4.26	1.75	1.45	1.78	1.63
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	0.000055	0.000013	<0.000010	0.000018	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.6	3.2	3.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.168	0.184	0.177	0.0860	0.0538	0.0751	0.0600	0.0588	0.100	0.108	0.101
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	0.000018	0.000057	0.000012	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	0.019	0.070	0.020	0.017	0.049	0.013	<0.010	0.011	<0.010
Uranium (U)	mg/L	0.000309	0.000342	0.000360	0.000385	0.000157	0.000199	0.000238	0.000143	0.000220	0.000234	0.000211
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0123	0.0034	0.0024	0.0068	0.0015	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0231	0.0071	0.0055	0.0124	0.0035	<0.0030	0.0031	<0.0030
Dissolved Metals												
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	0.0508	0.0682	0.0336	0.0241	0.0131	0.0035	0.0069	0.0069
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00013	<0.00010	0.00012	0.00015	0.00011	0.00012	0.00014	0.00011	0.00013	0.00010	0.00012
Barium (Ba)	mg/L	0.0657	0.0734	0.0751	0.0454	0.0385	0.0476	0.0251	0.0266	0.0613	0.0462	0.0541
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	0.014	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	0.000017	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	0.000012	0.000010
Calcium (Ca)	mg/L	46.4	44.8	47.3	26.4	25.3	29.1	19.7	24.7	35.6	35.6	36.9
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	0.00016	0.00019	0.00013	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	0.00099	0.00091	0.00095	0.00145	<0.00050	0.00083	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	0.082	0.057	0.039	0.037	<0.030	<0.030	0.068	0.039
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000074	<0.000050	<0.000050	0.000087	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0068	0.0077	0.0081	<0.0050	<0.0050	0.00271	0.00132	0.00127	0.00458	0.00354	0.00349
Magnesium (Mg)	mg/L	12.3	13.8	13.6	8.01	6.58	7.52	5.15	6.36	9.79	9.67	10.0
Manganese (Mn)	mg/L	0.00571	0.00505	0.00995	0.00700	0.00325	0.00442	0.00550	0.00211	0.0134	0.00611	0.00550
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000849	0.000850	0.000812	0.000476	0.000394	0.000534	0.000321	0.000450	0.000699	0.000658	0.000594
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00050	0.00073	0.00084	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.460	0.498	0.544	0.372	0.275	0.274	0.253	0.266	0.377	0.393	0.383
Selenium (Se)	mg/L	0.00028	0.00029	0.00043	0.00023	0.00018	0.00023	<0.00010	0.00011	0.00019	0.00021	0.00019
Silicon (Si)	mg/L	1.72	1.60	1.53	1.30	1.37	1.29	0.784	1.02	1.32	1.32	1.53
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.8	3.1	3.4	2.1	<2.0	2.4	<2.0	<2.0	3.2	<2.0	<2.0
Strontium (Sr)	mg/L	0.165	0.168	0.172	0.0712	0.0544	0.0757	0.0518	0.0601	0.0992	0.104	0.102
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000298	0.000323	0.000341	0.000158	0.000118	0.000163	0.000095	0.000124	0.000206	0.000217	0.000211
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0031	0.0038	0.0038	0.0043	<0.0030	0.0031	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR7 - 2012												MR7B - 2012
Month Sampled		January	February	March	April	May	June	July	August	October	October	November	December	August
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	26-Jun-12	24-Jul-12	21-Aug-12	22-Oct-12	22-Oct-12	28-Nov-12	18-Dec-12	21-Aug-12
Lab Sample ID	Units	L1108712-8	L1117841-15	L1127031-6	L1137305-6	L1148502-6	L1169751-6	L1184612-6	L1197851-14	L1228768-10	L1228768-14	L1243937-6	L1251738-9	L1197851-14
Physical Tests														
Colour, True	CU	<5.0	<5.0	<5.0	5.1	13.5	5.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	318	386	345	319	227	152	157	176	207	210	259	289	176
Hardness (as $CaCO_3$)	mg/L	160	195	187	168	123	76.3	76.1	93.9	111	111	143	163	93.9
pH	pH	8.26	8.22	8.24	8.30	8.29	8.29	8.23	8.29	8.20	8.10	8.17	8.17	8.29
Total Suspended Solids	mg/L	4.7	<3.0	<3.0	4.7	75.2	30.6	28.4	6.0	<3.0	<3.0	<3.0	<3.0	6.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	4.09	1.12	0.93	3.58	43.7	17.8	9.21	3.64	1.13	1.35	1.41	1.79	3.64
Anions and Nutrients														
Acidity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	1.5	<1.0	2.1	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	159	174	167	162	120	75.1	80.3	93.4	106	105	133	143	93.4
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	159	174	167	162	120	75.1	80.3	93.4	106	105	133	143	93.4
Ammonia (as N)	mg/L	0.0081	<0.0050	0.0068	0.0203	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.24	1.44	1.61	1.59	<0.50	<0.50	<0.50	0.61	0.68	0.68	1.17	1.59	0.61
Fluoride (F)	mg/L	0.054	0.060	0.058	0.061	0.043	0.025	0.028	0.035	0.037	0.037	0.045	0.051	0.035
Nitrate (as N)	mg/L	0.0993	0.0625	0.0666	0.0566	0.0847	0.0398	0.0137	0.0106	0.0364	0.0371	0.0747	0.101	0.0106
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	0.113	<0.050	0.065	<0.050	<0.050	<0.050	<0.050	<0.050	0.060	0.062	<0.050
Total Nitrogen	mg/L	0.070	0.100	0.180	0.080	0.150	0.060	<0.050	<0.050	0.070	0.070	-	0.135	<0.050
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	0.0021	<0.0020	0.0022	0.0022	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.0039	<0.0020	0.0021	0.0084	0.0724	0.0352	0.0188	0.0034	0.0040	0.0021	0.0029	<0.0020	0.0034
Sulphate (SO_4)	mg/L	16.5	33.4	28.3	18.2	6.67	4.49	5.76	8.62	11.5	11.5	17.2	20.1	8.62
Cyanides														
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0013	0.0018	0.0027	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon														
Total Organic Carbon	mg/L	1.83	1.88	2.00	2.33	4.20	1.97	1.04	1.06	1.46	1.45	1.16	1.01	1.06
Total Metals														
Aluminum (Al)	mg/L	0.0785	0.0096	0.0139	0.129	1.31	0.440	0.357	0.109	0.0454	0.0524	0.0306	0.0216	0.109
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00013	0.00010	0.00011	0.00017	0.00069	0.00030	0.00026	0.00017	0.00014	0.00013	0.00011	0.00015	0.00017
Barium (Ba)	mg/L	0.0647	0.110	0.0784	0.0795	0.0788	0.0317	0.0378	0.0420	0.0408	0.0418	0.0559	0.0596	0.0420
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.014	0.010	0.011	0.014	0.011	<0.010	0.012	<0.010	<0.010	<0.010	0.011	0.011	<0.010
Cadmium (Cd)	mg/L	0.000018	0.000017	<0.000020	0.000017	0.000087	0.000038	0.000032	0.000010	0.000011	0.000010	0.000012	0.000010	0.000010
Calcium (Ca)	mg/L	47.6	53.9	50.0	48.0	37.5	23.5	23.6	26.9	32.1	32.1	41.5	44.4	26.9
Chromium (Cr)	mg/L	0.00043	<0.00010	0.00016	0.00027	0.00191	0.00073	0.00064	0.00022	0.00013	0.00013	0.00017	0.00011	0.00022
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00072	0.00029	0.00024	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00063	<0.00050	<0.00050	<0.00050	0.00224	0.00095	0.00079	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050
Iron (Fe)	mg/L	0.139	0.097	0.125	0.277	1.74	0.645	0.553	0.173	0.112	0.120	0.093	0.088	0.173
Lead (Pb)	mg/L	0.000077	<0.000050	<0.000050	0.000079	0.000934	0.00240	0.000324	0.000121	<0.000050	0.000053	<0.000050	<0.000050	0.000121
Lithium (Li)	mg/L	0.00501	0.00599	0.00638	0.00692	0.00333	0.00157	0.00203	0.00261	0.00311	0.00309	0.00513	0.00631	0.00261
Magnesium (Mg)	mg/L	12.1	14.3	14.3	12.6	9.77	5.44	5.51	6.38	8.09	8.31	10.9	11.1	6.38
Manganese (Mn)	mg/L	0.00747	0.0259	0.0101	0.0143	0.0379	0.0177	0.0177	0.00703	0.00628	0.00614	0.00545	0.00558	0.00703
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR7 - 2012												MR7B - 2012
Month Sampled		January	February	March	April	May	June	July	August	October	October	November	December	August
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	26-Jun-12	24-Jul-12	21-Aug-12	22-Oct-12	22-Oct-12	28-Nov-12	18-Dec-12	21-Aug-12
Lab Sample ID	Units	L1108712-8	L1117841-15	L1127031-6	L1137305-6	L1148502-6	L1169751-6	L1184612-6	L1197851-14	L1228768-10	L1228768-14	L1243937-6	L1251738-9	L1197851-14
Total Metals (*cont'd*)														
Molybdenum (Mo)	mg/L	0.000866	0.000814	0.000847	0.000837	0.000631	0.000422	0.000462	0.000558	0.000606	0.000586	0.000795	0.000816	0.000558
Nickel (Ni)	mg/L	0.00060	0.00056	<0.00050	0.00062	0.00288	0.00104	0.00086	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.425	0.480	0.468	0.533	0.729	0.347	0.330	0.308	0.306	0.315	0.418	0.442	0.308
Selenium (Se)	mg/L	0.00027	0.00024	0.00027	0.00028	0.00027	0.00017	0.00011	0.00011	0.00016	0.00017	0.00023	0.00023	0.00011
Silicon (Si)	mg/L	1.67	1.77	1.63	1.72	3.63	1.50	1.39	1.12	1.18	1.17	1.38	1.52	1.12
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000019	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.1	2.8	2.7	2.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0
Strontium (Sr)	mg/L	0.148	0.154	0.166	0.159	0.0877	0.0451	0.0565	0.0760	0.0916	0.0893	0.139	0.149	0.0760
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000041	0.000016	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00033	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	0.036	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000317	0.000375	0.000362	0.000319	0.000275	0.000136	0.000151	0.000174	0.000203	0.000198	0.000282	0.000286	0.000174
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0044	0.0018	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0088	<0.0030	<0.0030	<0.0030	0.0099	0.0040	0.0034	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals														
Aluminum (Al)	mg/L	0.0060	<0.0030	<0.0030	0.0115	0.0105	0.0168	0.0076	0.0039	0.0047	0.0050	<0.0030	<0.0030	0.0039
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00011	0.00010	0.00010	0.00013	0.00011	0.00010	0.00011	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	0.00012
Barium (Ba)	mg/L	0.0582	0.110	0.0789	0.0754	0.0531	0.0254	0.0317	0.0385	0.0404	0.0410	0.0530	0.0595	0.0385
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010
Cadmium (Cd)	mg/L	0.000011	0.000013	<0.000010	0.000010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	<0.000010
Calcium (Ca)	mg/L	44.8	54.7	51.7	46.6	34.6	21.7	21.3	26.8	31.4	31.2	39.6	46.1	26.8
Chromium (Cr)	mg/L	0.00044	<0.00010	<0.00010	0.00043	<0.00010	0.00013	<0.00010	<0.00010	0.00012	0.00012	<0.00010	0.00023	<0.00010
Cobalt (Co)	mg/L	0.00019	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00052	0.00052	0.00066	0.00072	<0.00050	0.00089	0.00079	<0.00050	<0.00050	<0.00050	0.00080	0.00092	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	0.047	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000068	<0.000050
Lithium (Li)	mg/L	0.00484	0.00613	0.00662	0.00724	0.00214	0.00107	0.00159	0.00273	0.00315	0.00307	0.00480	0.00682	0.00273
Magnesium (Mg)	mg/L	11.7	14.1	14.0	12.5	8.80	5.35	5.55	6.52	7.90	8.09	10.6	11.7	6.52
Manganese (Mn)	mg/L	0.00581	0.0263	0.0115	0.0104	0.00495	0.00322	0.00650	0.00290	0.00404	0.00401	0.00515	0.00644	0.00290
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.00104	0.000787	0.000802	0.000836	0.000523	0.000399	0.000432	0.000526	0.000583	0.000579	0.000702	0.000865	0.000526
Nickel (Ni)	mg/L	<0.00050	0.00055	<0.00050	0.00071	0.00054	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.428	0.476	0.479	0.508	0.329	0.216	0.225	0.291	0.278	0.293	0.417	0.496	0.291
Selenium (Se)	mg/L	0.00025	0.00027	0.00032	0.00030	0.00025	0.00013	0.00011	0.00013	0.00016	0.00017	0.00024	0.00029	0.00013
Silicon (Si)	mg/L	1.65	1.78	1.61	1.52	1.23	0.853	0.883	0.909	1.08	1.07	1.38	1.63	0.909
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.9	3.5	3.6	3.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.3	3.9	<2.0
Strontium (Sr)	mg/L	0.143	0.153	0.169	0.152	0.0812	0.0446	0.0555	0.0765	0.0867	0.0845	0.136	0.154	0.0765
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000306	0.000347	0.000352	0.000284	0.000201	0.000097	0.000108	0.000147	0.000183	0.000180	0.000239	0.000283	0.000147
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0047	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0045	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR8 - 2011									MR8 - 2012						
Month Sampled		February	March	June	July	August	September	October	October	November	January	January	February	March	April	May	June
Date Sampled		24-Feb-11	30-Mar-11	8-Jun-11	19-Jul-11	23-Aug-11	27-Sep-11	18-Oct-11	18-Oct-11	30-Nov-11	23-Jan-12	24-Jan-12	20-Feb-12	19-Mar-12	17-Apr-12	15-May-12	24-Jul-12
Lab Sample ID	Units	L981301-6	L990825-12	L1015493-11	L1034422-1	L1049771-5	L1064458-15	L1073725-13	L1073725-14	L1091304-1	L1108712-1	L1108712-11	L1117841-19	L1127031-14	L1137305-15	L1148502-16	L1184612-16
Physical Tests																	
Colour, True	CU	<5.0	<5.0	6.6	7.7	7.3	7.1	<5.0	<5.0	6.7	<5.0	<5.0	<5.0	<5.0	<5.0	12.8	<5.0
Conductivity	µS/cm	332	341	181	207	152	183	264	255	254	319	312	333	344	321	234	152
Hardness (as $CaCO_3$)	mg/L	187	171	94.3	108	73.2	92.1	122	127	125	169	157	165	183	168	125	74.7
pH	pH	8.02	8.13	8.16	8.22	8.18	8.08	8.32	8.32	8.36	8.13	8.15	8.28	8.24	8.29	8.33	8.25
Total Suspended Solids	mg/L	4.2	<3.0	55.3	17.1	102	18.7	<1.0	<1.0	<1.0	6.7	<3.0	<3.0	<3.0	<3.0	17.9	14.4
Total Dissolved Solids	mg/L	-	196	102	-	-	-	<3.0	<3.0	<3.0	-	-	-	-	-	-	-
Turbidity	NTU	6.57	1.20	19.8	10.9	38.5	10.3	2.76	2.76	2.48	3.10	62.8	1.37	1.86	3.13	13.5	6.99
Anions and Nutrients																	
Acidity (as $CaCO_3$)	mg/L	2.4	4.3	3.3	1.5	2.5	2.2	<1.0	<1.0	<1.0	1.4	1.2	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	168	159	92.7	106	75.6	89.8	122	123	121	167	158	154	159	162	129	77.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	168	159	92.7	106	75.6	89.8	122	123	121	167	158	154	159	162	129	77.0
Ammonia (as N)	mg/L	<0.0050	<0.0050	0.0094	0.0078	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0060	0.0071	<0.0050	0.0206	0.0167	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.75	2.09	<0.50	<0.50	<0.50	<0.50	0.73	0.73	0.78	1.23	1.16	1.41	4.85	1.66	<0.50	<0.50
Fluoride (F)	mg/L	0.039	0.047	<0.020	0.040	0.024	0.029	0.042	0.042	0.042	0.056	0.053	0.056	0.047	0.059	0.044	0.028
Nitrate (as N)	mg/L	0.0901	0.0950	0.0487	0.0223	0.0175	0.0194	0.0209	0.0210	0.0574	0.157	0.0736	0.0966	0.0730	0.0498	0.0817	0.0109
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	0.075	0.191	0.148	0.202	<0.050	<0.050	0.059	<0.050	<0.050	<0.050	<0.050	0.207	<0.050	0.078	<0.050
Total Nitrogen	mg/L	0.139	0.170	0.240	0.170	0.220	<0.050	0.070	0.080	0.090	0.140	0.070	0.090	0.280	0.050	0.160	<0.050
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	<0.0020	0.0025	0.0021
Phosphorus-Total	mg/L	0.0070	<0.0020	0.0675	0.0159	0.0873	0.0143	0.0036	0.0035	0.0036	0.0054	0.0031	<0.0020	0.0073	0.0049	0.0145	0.0056
Sulphate (SO_4)	mg/L	20.6	24.7	5.53	8.99	6.01	6.73	12.4	12.3	11.2	17.3	13.3	18.8	20.6	18.5	6.82	5.59
Cyanides																	
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0019	0.0013	<0.0010	0.0035	0.0022	0.0030	0.0028	<0.0020	0.0028	0.0012	0.0019	0.0016	0.0019	0.0014	<0.0010	<0.0010
Organic Carbon																	
Total Organic Carbon	mg/L	1.85	1.18	2.66	2.77	3.04	2.04	1.64	1.57	2.07	1.92	1.81	1.63	2.52	2.09	4.04	1.41
Total Metals																	
Aluminum (Al)	mg/L	0.229	0.0153	0.658	0.431	1.31	0.424	0.139	0.0816	0.0556	0.0416	0.0606	0.0129	0.0237	0.0747	0.556	0.403
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00031	0.00010	0.00033	0.00024	0.00067	0.00025	0.00015	0.00013	0.00013	0.00015	0.00013	0.00013	0.00014	0.00016	0.00027	0.00024
Barium (Ba)	mg/L	0.0749	0.0758	0.0430	0.0546	0.0469	0.0334	0.0488	0.0477	0.0448	0.0696	0.0638	0.0700	0.0734	0.0803	0.0618	0.0347
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.015	0.014	0.010	0.013	<0.010	<0.010	0.012	<0.010	<0.010	0.015	0.014	0.011	0.012	0.013	0.010	<0.010
Cadmium (Cd)	mg/L	0.000028	<0.000010	0.000044	0.000026	0.000080	0.000021	0.000013	0.000012	0.000013	0.000016	0.000018	0.000017	<0.000030	0.000018	0.000036	0.000018
Calcium (Ca)	mg/L	48.9	46.0	28.4	31.2	25.2	27.1	35.6	34.4	34.0	47.8	46.4	47.4	49.8	48.9	37.1	21.4
Chromium (Cr)	mg/L	0.00044	0.00010	0.00108	0.00097	0.00183	0.00084	0.00039	0.00028	0.00019	0.00037	0.00041	<0.00010	0.00020	0.00025	0.00073	0.00061
Cobalt (Co)	mg/L	0.00013	<0.00010	0.00034	0.00021	0.00081	0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	0.00017
Copper (Cu)	mg/L	0.00061	<0.00050	0.00144	0.00070	0.00197	0.00072	0.00071	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00119	<0.00050	0.00089	0.00062
Iron (Fe)	mg/L	0.378	0.121	0.796	0.483	1.80	0.438	0.200	0.132	0.117	0.123	0.138	0.118	0.134	0.220	0.521	0.404
Lead (Pb)	mg/L	0.000174	<0.000050	0.000408	0.000256	0.00110	0.000260	0.000127	0.000065	0.000054	0.000070	0.000078	<0.000050	0.000056	0.000061	0.000276	0.000227
Lithium (Li)	mg/L	0.0066	0.0078	<0.0050	0.00257	0.00300	0.00175	0.00377	0.00360	0.00323	0.00500	0.00475	0.00641	0.00626	0.00661	0.00261	0.00159
Magnesium (Mg)	mg/L	13.2	13.9	7.27	7.93	6.80	6.85	9.81	9.58	8.96	12.6	11.5	12.6	13.8	12.9	9.35	5.38
Manganese (Mn)	mg/L	0.0153	0.00431	0.0183	0.0129	0.0525	0.0127	0.00905	0.00644	0.00601	0.00759	0.00777	0.00620	0.00614	0.0109	0.0144	0.0117
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR8 - 2011									MR8 - 2012						
Month Sampled		February	March	June	July	August	September	October	October	November	January	January	February	March	April	May	June
Date Sampled		24-Feb-11	30-Mar-11	8-Jun-11	19-Jul-11	23-Aug-11	27-Sep-11	18-Oct-11	18-Oct-11	30-Nov-11	23-Jan-12	24-Jan-12	20-Feb-12	19-Mar-12	17-Apr-12	15-May-12	24-Jul-12
Lab Sample ID	Units	L981301-6	L990825-12	L1015493-11	L1034422-1	L1049771-5	L1064458-15	L1073725-13	L1073725-14	L1091304-1	L1108712-1	L1108712-11	L1117841-19	L1127031-14	L1137305-15	L1148502-16	L1184612-16
Total Metals (*cont'd*)																	
Molybdenum (Mo)	mg/L	0.000956	0.000907	0.000483	0.000587	0.000438	0.000487	0.000688	0.000653	0.000607	0.000905	0.000862	0.000881	0.000847	0.000876	0.000669	0.000472
Nickel (Ni)	mg/L	0.00070	<0.00050	0.00129	0.00096	0.00234	0.00078	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.00050	0.00051	<0.00050	0.00115	0.00064
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.541	0.494	0.454	0.413	0.713	0.402	0.395	0.363	0.339	0.444	0.415	0.471	0.606	0.518	0.487	0.315
Selenium (Se)	mg/L	0.00027	0.00027	0.00017	0.00022	0.00013	0.00013	0.00018	0.00016	0.00017	0.00027	0.00023	0.00022	0.00026	0.00025	0.00025	0.00012
Silicon (Si)	mg/L	2.42	1.67	2.03	2.03	2.75	1.66	1.37	1.28	1.31	1.68	1.71	1.64	1.62	1.59	2.64	1.55
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.7	3.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	2.4	3.1	2.6	<2.0	<2.0
Strontium (Sr)	mg/L	0.175	0.179	0.0556	0.0744	0.0593	0.0622	0.100	0.0985	0.0964	0.150	0.143	0.153	0.165	0.162	0.0892	0.0545
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	0.000012	0.000034	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.014	<0.010	0.015	0.017	0.029	0.011	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.025	0.016
Uranium (U)	mg/L	0.000343	0.000344	0.000158	0.000199	0.000198	0.000153	0.000228	0.000221	0.000211	0.000352	0.000303	0.000330	0.000333	0.000335	0.000241	0.000138
Vanadium (V)	mg/L	<0.0010	<0.0010	0.0025	0.0015	0.0040	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	0.0012
Zinc (Zn)	mg/L	<0.0030	<0.0030	0.0046	0.0038	0.0073	<0.0030	<0.0030	<0.0030	<0.0030	0.0056	0.0040	<0.0030	0.0073	<0.0030	0.0041	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0154	0.0101	0.0121	0.0108	0.0037	0.0038	0.0049	<0.0030	0.0035	<0.0030	0.0043	<0.0030	0.0083	0.0073
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00019	<0.00010	0.00011	0.00011	0.00011	0.00012	0.00012	0.00010	0.00010	0.00014	0.00011	<0.00010	0.00013	0.00011	0.00014	0.00010
Barium (Ba)	mg/L	0.0735	0.0746	0.0330	0.0455	0.0271	0.0285	0.0443	0.0459	0.0452	0.0642	0.0594	0.0676	0.0699	0.0756	0.0544	0.0321
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000015	<0.000010	0.000011	<0.000010	0.000010	0.000011	<0.000010	<0.000010	<0.000010	0.000011	0.000011	<0.000010	0.000062	0.000011	0.000015	<0.000010
Calcium (Ca)	mg/L	51.7	45.4	26.3	30.3	20.5	25.9	33.0	35.1	34.8	47.1	44.5	45.9	51.7	46.7	35.2	21.4
Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00012	0.00015	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00010	0.00013	<0.00010	0.00018	<0.00010	<0.00010	0.00011
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	0.00070	0.00096	0.00091	0.00053	0.00094	<0.00050	<0.00050	0.00094	<0.00050	<0.00050	0.00302	0.00067	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000087	<0.000050	<0.000050	0.000059	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0069	0.0077	<0.0050	0.00220	0.00171	0.00157	0.00351	0.00354	0.00335	0.00507	0.00464	0.00641	0.00689	0.00691	0.00231	0.00164
Magnesium (Mg)	mg/L	14.0	14.0	6.97	7.82	5.36	6.68	9.61	9.68	9.23	12.5	11.1	12.3	13.1	12.5	9.07	5.17
Manganese (Mn)	mg/L	0.0130	0.00362	0.00290	0.00374	0.00418	0.00206	0.00433	0.00454	0.00442	0.00603	0.00590	0.00566	0.00699	0.00731	0.00592	0.00453
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000993	0.000887	0.000412	0.000557	0.000358	0.000439	0.000639	0.000656	0.000589	0.000845	0.000795	0.000817	0.000858	0.000790	0.000595	0.000433
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.00050	0.00096	<0.00050	0.00056	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.517	0.506	0.248	0.264	0.248	0.281	0.367	0.374	0.325	0.453	0.415	0.471	1.04	0.503	0.353	0.198
Selenium (Se)	mg/L	0.00027	0.00027	0.00016	0.00022	0.00011	0.00012	0.00018	0.00018	0.00017	0.00028	0.00024	0.00022	0.00030	0.00031	0.00024	0.00010
Silicon (Si)	mg/L	1.99	1.64	1.03	1.13	0.795	1.05	1.18	1.24	1.28	1.59	1.60	1.58	1.59	1.47	1.24	0.798
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	3.0	3.1	2.4	2.7	<2.0	<2.0	3.2	<2.0	<2.0	3.6	2.0	3.0	4.9	3.6	<2.0	<2.0
Strontium (Sr)	mg/L	0.180	0.172	0.0549	0.0759	0.0548	0.0651	0.0980	0.104	0.0981	0.148	0.140	0.148	0.172	0.151	0.0855	0.0529
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000344	0.000342	0.000113	0.000166	0.000104	0.000133	0.000195	0.000228	0.000223	0.000306	0.000292	0.000301	0.000315	0.000293	0.000217	0.000119
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	0.0034	0.0040	0.0039	<0.0030	0.0040	<0.0030	<0.0030	0.0074	0.0056	0.0039	0.0250	<0.0030	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2010								
Month Sampled		May	May	June	June	July	August	October	December	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10	8-Dec-10
Lab Sample ID	Units	L889661-8	L892473-7	L894624-2	L897909-11	L915316-4	L921658-3	R010261-07	R012173-06	R012173-07
Physical Tests										
Colour, True	CU	13.1	41.1	6.7	5.6	<5.0	<5.0	-	327	326
Conductivity	µS/cm	186	180	210	159	194	192	121.0	190	185.0
Hardness (as $CaCO_3$)	mg/L	98.2	91.2	106	85.7	99.7	93.4	110	171	177.0
pH	pH	8.14	7.83	8.29	8.18	8.20	8.14	7.69	8.09	8.05
Total Suspended Solids	mg/L	163	39.1	51.2	36.4	5.0	3.8	7.0	<1	<1
Total Dissolved Solids	mg/L	106	129	123	97	99	111	130	178	177
Turbidity	NTU	57.0	41.3	8.85	18.8	1.86	1.59	-	0.8	0.8
Anions and Nutrients										
Acidity (as $CaCO_3$)	mg/L	2.1	3.6	<1.0	2.4	2.2	2.5	-	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	91.2	87.7	111	86.8	89.5	87.6	-	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	-	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	-	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	91.2	87.7	111	86.8	89.5	87.6	-	151	151
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0054	0.0125	<0.0050	-	<0.02	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10	<0.10
Chloride (Cl)	mg/L	<0.50	0.66	<0.50	<0.50	0.55	0.63	-	1.24	1.28
Fluoride (F)	mg/L	0.028	0.052	0.028	0.022	0.029	0.026	-	<0.10	<0.10
Nitrate (as N)	mg/L	0.0915	0.578	0.0675	0.0371	0.0205	0.0125	-	0.01	0.02
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.01	<0.01
Total Kjeldahl Nitrogen	mg/L	<0.050	0.388	0.073	0.094	0.120	<0.050	-	0.07	0.07
Total Nitrogen	mg/L	0.140	0.966	0.140	0.131	0.140	0.050	-	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.114	0.0499	0.0660	0.0351	0.0055	0.0034	-	<0.010	0.025
Sulphate (SO_4)	mg/L	6.80	9.74	6.09	4.69	8.61	9.51	-	17.6	18.2
Cyanides										
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	<0.0010	<0.0010	-	<0.002	<0.002
Cyanide, Total	mg/L	0.0038	0.0102	0.0032	0.0023	0.0015	0.0016	-	<0.01	<0.01
Organic Carbon										
Total Organic Carbon	mg/L	3.89	8.48	2.08	1.62	1.58	0.85	-	1.00	1.00
Total Metals										
Aluminum (Al)	mg/L	2.39	1.06	0.515	0.810	0.160	0.0363	0.25	<0.050	0.074
Antimony (Sb)	mg/L	0.00012	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0010	<0.0010
Arsenic (As)	mg/L	0.00105	0.00056	0.00034	<0.00040	0.00016	0.00013	<0.0005	<0.0050	<0.0050
Barium (Ba)	mg/L	0.0926	0.119	0.0620	0.0434	0.0725	0.0391	0.0428	0.0755	0.083
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-
Boron (B)	mg/L	0.012	0.013	<0.010	<0.010	0.012	0.011	0.018	<0.040	<0.040
Cadmium (Cd)	mg/L	0.000153	0.000051	0.000045	0.000044	0.000020	<0.000010	0.00002	<0.00010	<0.00010
Calcium (Ca)	mg/L	37.0	26.7	34.4	28.4	34.8	25.9	32.1	51.9	49.1
Chromium (Cr)	mg/L	0.00351	0.00197	0.00108	0.00131	<0.00050	0.00021	0.0017	<0.0050	<0.0050
Cobalt (Co)	mg/L	0.00130	0.00062	0.00037	0.00043	0.00011	<0.00010	0.0002	<0.00050	<0.00050
Copper (Cu)	mg/L	0.00348	0.00381	0.00114	0.00112	<0.00060	<0.00030	0.0008	<0.0010	<0.0010
Iron (Fe)	mg/L	3.06	1.31	0.751	0.911	0.223	0.072	0.38	0.13	<0.10
Lead (Pb)	mg/L	0.00173	0.000726	0.000492	0.000538	0.000153	0.000057	0.0002	<0.0010	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0029	0.0067	0.0072
Magnesium (Mg)	mg/L	10.6	7.00	8.14	7.67	8.61	7.07	9.96	14.7	15.2
Manganese (Mn)	mg/L	0.0741	0.0196	0.0211	0.0259	0.0107	0.00647	0.0102	0.0053	0.0051
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2010								
Month Sampled		May	May	June	June	July	August	October	December	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10	8-Dec-10
Lab Sample ID	Units	L889661-8	L892473-7	L894624-2	L897909-11	L915316-4	L921658-3	R010261-07	R012173-06	R012173-07
Total Metals (*cont'd*)										
Molybdenum (Mo)	mg/L	0.000658	0.000421	0.000560	0.000479	0.000619	0.000600	0.0005	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.00457	0.00353	0.00148	0.00153	0.00055	<0.00050	0.0018	0.0023	<0.0020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-	-
Potassium (K)	mg/L	1.11	0.879	0.518	0.522	0.493	0.325	-	-	-
Selenium (Se)	mg/L	0.00030	0.00072	0.00020	<0.00020	0.00019	0.00011	0.0004	<0.0030	<0.0030
Silicon (Si)	mg/L	4.43	3.45	1.98	1.98	1.52	1.01			
Silver (Ag)	mg/L	0.000030	0.000019	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.35	2.1	2.19
Strontium (Sr)	mg/L	0.0882	0.0518	0.0657	0.0531	0.0887	0.0835	-	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.00020	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010			
Titanium (Ti)	mg/L	0.036	0.022	0.011	0.011	<0.010	<0.010	0.017	<0.050	<0.050
Uranium (U)	mg/L	0.000288	0.000213	0.000241	0.000178	0.000288	0.000156	0.00018	0.00033	0.00032
Vanadium (V)	mg/L	0.0089	0.0040	0.0024	0.0028	<0.0010	<0.0010	<0.001	<0.0100	<0.0100
Zinc (Zn)	mg/L	0.0149	0.0073	0.0041	0.0041	0.0016	<0.0010	0.004	<0.010	<0.010
Dissolved Metals										
Aluminum (Al)	mg/L	0.0158	0.0618	0.0078	0.0115	0.0038	0.0024	0.009	<0.05	<0.05
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.001	<0.001
Arsenic (As)	mg/L	<0.00010	0.00016	<0.00010	<0.00010	0.00013	0.00012	<0.0005	<0.005	<0.005
Barium (Ba)	mg/L	0.0395	0.0889	0.0468	0.0313	0.0454	0.0384	0.0389	0.0747	0.0829
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-
Boron (B)	mg/L	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	0.006	<0.04	<0.04
Cadmium (Cd)	mg/L	<0.000010	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.00001	<0.0001	<0.0001
Calcium (Ca)	mg/L	26.9	25.9	30.6	24.2	29.0	25.9	30.6	45	46.8
Chromium (Cr)	mg/L	<0.00020	<0.00050	<0.00020	<0.00020	<0.00050	<0.00010	<0.0005	<0.005	<0.005
Cobalt (Co)	mg/L	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00005	<0.0005	<0.0005
Copper (Cu)	mg/L	0.00044	0.00098	0.00034	0.00027	0.00024	0.00029	0.0005	<0.001	<0.001
Iron (Fe)	mg/L	0.035	0.094	<0.030	<0.030	<0.030	<0.030	0.048	<0.1	<0.1
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0028	0.0063	0.0068
Magnesium (Mg)	mg/L	7.52	6.41	7.14	6.16	6.61	6.97	8.27	14.2	14.5
Manganese (Mn)	mg/L	0.000408	0.00316	0.000796	0.000550	0.000096	0.000362	0.0029	0.0049	0.0047
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005	<0.0005
Molybdenum (Mo)	mg/L	0.000501	0.000384	0.000563	0.000443	0.000543	0.000566	0.0005	<0.001	<0.001
Nickel (Ni)	mg/L	<0.00050	0.00176	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	<0.002	<0.002
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-	-
Potassium (K)	mg/L	0.309	0.419	0.290	0.220	0.331	0.318	-	-	-
Selenium (Se)	mg/L	0.00022	0.00077	<0.00020	<0.00020	0.00011	<0.00010	0.0005	<0.003	0.0033
Silicon (Si)	mg/L	1.03	1.55	1.10	0.901	0.916	0.912	-	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005	<0.0005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.48	2.06	2.12
Strontium (Sr)	mg/L	0.0575	0.0500	0.0618	0.0483	0.0773	0.0832	0.081	0.154	0.157
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05	<0.05
Uranium (U)	mg/L	0.000159	0.000156	0.000197	0.000128	0.000172	0.000157	0.00018	0.00037	0.00037
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01	<0.01
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.01	<0.01

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2010								
Month Sampled		May	May	June	June	July	August	October	December	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	8-Dec-10	8-Dec-10
Lab Sample ID	Units	L889661-8	L892473-7	L894624-2	L897909-11	L915316-4	L921658-3	R010261-07	R012173-06	R012173-07
Hydrocarbons										
EPH10-19	mg/L	-	-	-	-	-	<0.25	-	-	-
EPH19-32	mg/L	-	-	-	-	-	<0.25	-	-	-
LEPH	mg/L	-	-	-	-	-	<0.25	-	-	-
HEPH	mg/L	-	-	-	-	-	<0.25	-	-	-
PAH	mg/L	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Acenaphthylene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Acridine	mg/L	-	-	-	-	-	<0.000010	-	-	-
Anthracene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Benz(a)anthracene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Benzo(a)pyrene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Benzo(b)fluoranthene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Benzo(g,h,i)perylene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Benzo(k)fluoranthene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Chrysene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Dibenz(a,h)anthracene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Fluoranthene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Fluorene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Naphthalene	mg/L	-	-	-	-	-	<0.000020	-	-	-
Phenanthrene	mg/L	-	-	-	-	-	<0.000020	-	-	-
Pyrene	mg/L	-	-	-	-	-	<0.000010	-	-	-
Quinoline	mg/L	-	-	-	-	-	<0.000010	-	-	-
Surrogate: d10-Acenaphthene (SS)	mg/L	-	-	-	-	-	78	-	-	-
Surrogate: d9-Acridine (SS)	mg/L	-	-	-	-	-	84	-	-	-
Surrogate: d12-Chrysene (SS)	mg/L	-	-	-	-	-	74	-	-	-
Surrogate: d8-Naphthalene (SS)	mg/L	-	-	-	-	-	82	-	-	-
Surrogate: d10-Phenanthrene (SS)	mg/L	-	-	-	-	-	82	-	-	-

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2011										
Month Sampled		January	March	April	May	May	June	July	August	September	October	November
Date Sampled		5-Jan-11	30-Mar-11	27-Apr-11	17-May-11	17-May-11	7-Jun-11	19-Jul-11	23-Aug-11	27-Sep-11	18-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-08	L990825-11	L999009-6	L1007262-3	L1007262-4	L1015493-17	L1034422-2	L1049771-1	L1064458-16	L1073725-12	L1091894-10
Physical Tests												
Colour, True	CU	5	<5.0	<5.0	20.3	20.3	6.8	7.1	8.6	7.2	<5.0	9.3
Conductivity	µS/cm	308	342	353	208	209	182	206	142	184	265	235
Hardness (as $CaCO_3$)	mg/L	151	167	164	108	108	94.4	110	71.4	91.9	126	127
pH	pH	8.04	8.16	8.19	8.05	8.20	8.18	8.24	8.05	8.22	8.32	8.29
Total Suspended Solids	mg/L	<1	<3.0	20.4	213	206	33.3	17.8	150	18.0	<1.0	<1.0
Total Dissolved Solids	mg/L	194	197	-	-	-	105	-	-	-	<3.0	3.3
Turbidity	NTU	1.1	1.13	21.9	89.8	90.1	18.6	12.1	68.5	10.4	2.98	6.16
Anions and Nutrients												
Acidity (as $CaCO_3$)	mg/L	<2	4.2	2.1	2.5	1.7	2.9	2.0	2.3	1.7	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	155	160	163	114	112	94.0	105	73.0	81.5	123	128
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	155	160	163	114	112	94.0	105	73.0	81.5	123	128
Ammonia (as N)	mg/L	<0.02	0.0271	0.0062	0.0103	0.0070	<0.0050	0.0070	<0.0050	0.0110	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.55	2.00	1.90	3.24	<0.50	<0.50	<0.50	<0.50	<0.50	0.72	0.68
Fluoride (F)	mg/L	<0.10	0.045	0.054	0.038	0.037	0.020	0.039	0.021	0.029	0.043	0.041
Nitrate (as N)	mg/L	0.09	0.0945	0.0704	0.109	0.111	0.0448	0.0255	0.0197	0.0175	0.0199	0.0596
Nitrite (as N)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.13	0.086	0.190	0.292	0.259	0.135	0.184	0.180	0.082	0.050	<0.050
Total Nitrogen	mg/L	-	0.180	0.260	0.400	0.370	0.180	0.210	0.200	0.100	0.070	0.050
Orthophosphate (as P)-Dissolved	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	-	<0.0020	0.0021	0.0034	0.0040	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	0.0033
Phosphorus-Total	mg/L	<0.01	<0.0020	0.0237	0.359	0.163	0.0328	0.0137	0.111	0.0226	0.0040	0.0064
Sulphate (SO_4)	mg/L	21.1	24.5	32.5	6.46	6.45	5.52	8.68	5.34	6.72	12.3	11.2
Cyanides												
Cyanide, Weak Acid Dissociable	mg/L	<0.002	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0020	<0.0020	<0.0030	<0.0011
Cyanide, Total	mg/L	<0.01	0.0013	0.0027	0.0074	0.0076	<0.0010	0.0029	0.0038	0.0033	<0.0020	0.0032
Organic Carbon												
Total Organic Carbon	mg/L	1	1.09	2.82	9.98	9.52	2.97	3.22	2.48	2.34	1.54	2.61
Total Metals												
Aluminum (Al)	mg/L	0.063	0.0312	0.755	2.89	3.08	0.739	0.473	2.12	0.456	0.0851	0.116
Antimony (Sb)	mg/L	<0.0010	<0.00010	<0.00010	0.00017	0.00017	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.0050	<0.00010	0.00037	0.00158	0.00157	0.00034	0.00027	0.00101	0.00024	0.00012	0.00014
Barium (Ba)	mg/L	0.0962	0.0755	0.0934	0.125	0.127	0.0447	0.0564	0.0522	0.0351	0.0485	0.0458
Beryllium (Be)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.040	0.013	0.013	0.014	0.015	0.010	0.011	<0.010	<0.010	0.011	<0.010
Cadmium (Cd)	mg/L	<0.00010	<0.000010	0.000043	0.000242	0.000206	0.000044	0.000030	0.000091	0.000024	0.000013	0.000015
Calcium (Ca)	mg/L	36.9	45.5	45.7	40.3	40.3	28.6	31.6	25.2	28.0	34.9	34.4
Chromium (Cr)	mg/L	<0.0050	0.00014	0.00119	0.00476	0.00498	0.00121	0.00087	0.00306	0.00083	0.00027	0.00026
Cobalt (Co)	mg/L	<0.00050	<0.00010	0.00035	0.00181	0.00176	0.00031	0.00023	0.00127	0.00022	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.0020	<0.00050	0.00098	0.00457	0.00460	0.00122	0.00075	0.00295	0.00073	<0.00050	0.00052
Iron (Fe)	mg/L	0.11	0.167	0.924	4.11	4.17	0.770	0.533	3.01	0.475	0.129	0.178
Lead (Pb)	mg/L	<0.0010	<0.000050	0.000388	0.00240	0.00235	0.000395	0.000272	0.00164	0.000266	0.000063	0.000098
Lithium (Li)	mg/L	0.0074	0.0076	0.0078	0.0054	0.0055	<0.0050	0.00263	0.00382	0.00195	0.00368	0.00335
Magnesium (Mg)	mg/L	14.2	13.8	13.1	11.0	11.0	7.14	7.94	6.98	7.00	9.65	9.66
Manganese (Mn)	mg/L	0.0046	0.00645	0.0252	0.0993	0.0971	0.0167	0.0150	0.0715	0.0136	0.00653	0.00806
Mercury (Hg)	mg/L	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2011										
Month Sampled		January	March	April	May	May	June	July	August	September	October	November
Date Sampled		5-Jan-11	30-Mar-11	27-Apr-11	17-May-11	17-May-11	7-Jun-11	19-Jul-11	23-Aug-11	27-Sep-11	18-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-08	L990825-11	L999009-6	L1007262-3	L1007262-4	L1015493-17	L1034422-2	L1049771-1	L1064458-16	L1073725-12	L1091894-10
Total Metals (*cont'd*)												
Molybdenum (Mo)	mg/L	<0.0010	0.000857	0.000880	0.000771	0.000763	0.000501	0.000601	0.000454	0.000504	0.000648	0.000621
Nickel (Ni)	mg/L	<0.0020	<0.00050	0.00150	0.00655	0.00657	0.00130	0.00105	0.00355	0.00079	<0.00050	0.00053
Phosphorus (P)	mg/L	<0.20	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.39	0.499	0.837	1.40	1.47	0.492	0.434	0.952	0.420	0.364	0.366
Selenium (Se)	mg/L	<0.0050	0.00024	0.00045	0.00034	0.00038	0.00017	0.00022	0.00014	0.00013	0.00016	0.00017
Silicon (Si)	mg/L	<5.0	1.68	3.49	6.32	6.82	2.22	2.15	4.29	1.69	1.28	1.43
Silver (Ag)	mg/L	<0.00050	<0.000010	<0.000010	0.000050	0.000050	<0.000010	<0.000010	0.000015	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.67	3.1	3.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.2	0.174	0.163	0.0829	0.0834	0.0574	0.0725	0.0571	0.0634	0.100	0.102
Thallium (Tl)	mg/L	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000013	0.000049	0.000013	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.050	<0.010	0.044	0.064	0.076	0.017	0.019	0.050	0.013	<0.010	<0.010
Uranium (U)	mg/L	0.00031	0.000335	0.000410	0.000379	0.000359	0.000164	0.000203	0.000208	0.000153	0.000223	0.000223
Vanadium (V)	mg/L	<0.010	<0.0010	0.0025	0.0110	0.0117	0.0027	0.0017	0.0059	0.0015	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.040	<0.0030	0.0042	0.0210	0.0209	0.0048	0.0044	0.0105	<0.0030	<0.0030	<0.0030
Dissolved Metals												
Aluminum (Al)	mg/L	<0.05	<0.0030	0.0053	0.0339	0.0348	0.0251	0.0099	0.0223	0.0116	0.0051	0.0068
Antimony (Sb)	mg/L	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.005	<0.00010	0.00010	0.00013	0.00014	0.00012	0.00013	0.00011	0.00011	0.00011	0.00012
Barium (Ba)	mg/L	0.0834	0.0744	0.0790	0.0491	0.0493	0.0347	0.0471	0.0256	0.0288	0.0461	0.0458
Beryllium (Be)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.04	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0001	<0.000010	<0.000010	0.000014	0.000012	0.000013	<0.000010	<0.000010	0.000011	<0.000010	0.000010
Calcium (Ca)	mg/L	24.1	44.0	44.8	30.3	30.2	26.5	31.0	20.2	25.9	34.5	34.9
Chromium (Cr)	mg/L	<0.005	<0.00010	<0.00010	0.00017	0.00017	0.00014	0.00011	0.00011	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.002	<0.00050	<0.00050	0.00084	0.00094	0.00076	0.00098	0.00106	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.1	<0.030	<0.030	0.056	0.056	0.037	<0.030	0.036	<0.030	<0.030	0.042
Lead (Pb)	mg/L	<0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000063	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0055	0.0079	0.0073	<0.0050	<0.0050	<0.0050	0.00242	0.00120	0.00167	0.00357	0.00346
Magnesium (Mg)	mg/L	13.2	13.8	12.8	7.92	7.82	6.87	7.92	5.07	6.61	9.74	9.57
Manganese (Mn)	mg/L	0.0043	0.00384	0.00711	0.00571	0.00550	0.00318	0.00539	0.00522	0.00187	0.00433	0.00512
Mercury (Hg)	mg/L	<0.0002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	<0.001	0.000877	0.000641	0.000479	0.000482	0.000432	0.000587	0.000322	0.000427	0.000646	0.000622
Nickel (Ni)	mg/L	<0.002	<0.00050	0.00054	0.00070	0.00072	<0.00050	0.00053	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.461	0.499	0.560	0.367	0.374	0.252	0.273	0.257	0.273	0.370	0.340
Selenium (Se)	mg/L	<0.005	0.00025	0.00048	0.00028	0.00025	0.00018	0.00022	0.00012	0.00012	0.00017	0.00021
Silicon (Si)	mg/L	<5	1.65	1.65	1.33	1.28	1.10	1.13	0.784	1.02	1.21	1.31
Silver (Ag)	mg/L	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	2.78	3.1	3.7	2.2	<2.0	2.1	2.7	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.157	0.174	0.155	0.0696	0.0702	0.0554	0.0771	0.0535	0.0640	0.103	0.101
Thallium (Tl)	mg/L	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0004	0.000331	0.000362	0.000165	0.000167	0.000123	0.000178	0.000097	0.000130	0.000225	0.000222
Vanadium (V)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.04	<0.0030	<0.0030	<0.0030	0.0039	0.0031	0.0039	0.0050	0.0031	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 sample which was analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2012												
Month Sampled		January	February	March	April	April	May	June	July	August	August	October	November	December
Date Sampled		23-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	17-Apr-12	15-May-12	27-Jun-12	24-Jul-12	21-Aug-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-2	L1117841-14	L1127031-15	L1137305-12	L1137305-16	L1148502-12	L1169751-12	L1184612-11	L1197851-17	L1197851-18	L1228768-13	L1243937-11	L1251738-12
Physical Tests														
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	12.6	5.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	356	344	346	326	326	238	157	163	187	186	210	264	301
Hardness (as $CaCO_3$)	mg/L	184	172	190	172	172	128	78.3	83.4	91.3	95.0	115	144	154
pH	pH	7.99	8.19	8.26	8.24	8.27	8.28	8.28	8.22	8.29	8.24	8.18	8.16	8.23
Total Suspended Solids	mg/L	3.3	<3.0	4.0	4.7	<3.0	51.9	24.6	15.8	6.7	4.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	2.80	1.01	1.42	3.87	3.55	22.0	13.8	7.44	3.87	3.63	1.62	1.73	0.98
Anions and Nutrients														
Acidity (as $CaCO_3$)	mg/L	2.6	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	1.3	1.0	1.2	1.7	<1.0	1.3
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	182	167	171	167	161	121	82.3	84.3	94.5	95.2	107	135	149
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	182	167	171	167	161	121	82.3	84.3	94.5	95.2	107	135	149
Ammonia (as N)	mg/L	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0079	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.10	1.40	1.57	1.50	1.50	<0.50	<0.50	<0.50	0.63	0.63	0.70	1.22	1.56
Fluoride (F)	mg/L	0.057	0.058	0.056	0.058	0.058	0.044	0.026	0.029	0.036	0.036	0.037	0.046	0.051
Nitrate (as N)	mg/L	0.0761	0.0698	0.0688	0.0517	0.0521	0.0811	0.0400	0.0114	0.0098	0.0096	0.0365	0.0747	0.0857
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	0.069	<0.050	<0.050	<0.050	<0.050	0.054	0.215	<0.050
Total Nitrogen	mg/L	0.090	0.050	<0.050	0.070	0.050	0.150	0.070	<0.050	<0.050	<0.050	0.090	-	0.128
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	0.0020	<0.0020	<0.0020	0.0024	<0.0020	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	0.0049	0.0022	0.0037	0.0056	0.0071	0.0553	0.0270	0.0074	0.0052	0.0037	<0.0020	0.0031	0.0023
Sulphate (SO_4)	mg/L	22.0	20.6	22.5	20.1	19.9	7.42	4.36	7.09	9.61	9.61	12.3	17.0	20.6
Cyanides														
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0020	0.0017	<0.0010	0.0019	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon														
Total Organic Carbon	mg/L	1.80	1.68	1.37	2.00	1.84	3.79	1.81	1.32	1.00	0.94	1.60	1.75	1.23
Total Metals														
Aluminum (Al)	mg/L	0.0485	0.0107	0.0183	0.0896	0.0760	0.736	0.469	0.415	0.0985	0.0982	0.0472	0.0327	0.0125
Antimony (Sb)	mg/L	0.00033	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00020	0.00011	0.00013	0.00018	0.00016	0.00044	0.00028	0.00028	0.00018	0.00019	0.00013	0.00018	0.00013
Barium (Ba)	mg/L	0.0742	0.0708	0.0759	0.0781	0.0801	0.0668	0.0331	0.0366	0.0422	0.0402	0.0415	0.0587	0.0640
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.014	0.012	0.014	0.011	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Cadmium (Cd)	mg/L	0.000016	0.000012	<0.000020	0.000018	0.000019	0.000062	0.000032	0.000026	0.000012	0.000010	<0.000010	0.000018	<0.000010
Calcium (Ca)	mg/L	52.2	48.3	57.5	49.8	50.9	35.4	25.0	23.2	26.9	28.6	32.1	40.0	46.1
Chromium (Cr)	mg/L	0.00039	0.00010	0.00017	0.00023	0.00027	0.00124	0.00072	0.00066	0.00023	0.00023	0.00015	0.00132	0.00011
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00045	0.00024	0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00141	0.00076	0.00064	<0.00050	<0.00050	<0.00050	0.00148	0.00056
Iron (Fe)	mg/L	0.293	0.145	0.184	0.318	0.286	1.09	0.587	0.493	0.210	0.202	0.107	0.093	0.090
Lead (Pb)	mg/L	0.000069	<0.000050	<0.000050	0.000072	0.000071	0.000566	0.000317	0.000251	0.000107	0.000101	0.000118	0.000058	<0.000050
Lithium (Li)	mg/L	0.00509	0.00640	0.00695	0.00682	0.00686	0.00265	0.00167	0.00170	0.00289	0.00308	0.00307	0.00492	0.00654
Magnesium (Mg)	mg/L	13.9	12.6	14.4	13.2	13.5	9.68	5.83	5.67	6.64	6.69	8.27	10.8	11.9
Manganese (Mn)	mg/L	0.0131	0.00753	0.00886	0.0134	0.0134	0.0271	0.0144	0.0133	0.00856	0.00812	0.00629	0.00413	0.00400
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6 - 2012												
Month Sampled		January	February	March	April	April	May	June	July	August	August	October	November	December
Date Sampled		23-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	17-Apr-12	15-May-12	27-Jun-12	24-Jul-12	21-Aug-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-2	L1117841-14	L1127031-15	L1137305-12	L1137305-16	L1148502-12	L1169751-12	L1184612-11	L1197851-17	L1197851-18	L1228768-13	L1243937-11	L1251738-12
Total Metals (*cont'd*)														
Molybdenum (Mo)	mg/L	0.000905	0.000829	0.000932	0.000805	0.000848	0.000594	0.000465	0.000490	0.000582	0.000565	0.000583	0.000760	0.000838
Nickel (Ni)	mg/L	0.00054	<0.00050	<0.00050	0.00055	0.00053	0.00192	0.00093	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.476	0.453	0.500	0.533	0.536	0.574	0.350	0.361	0.326	0.316	0.312	0.488	0.447
Selenium (Se)	mg/L	0.00027	0.00025	0.00026	0.00047	0.00027	0.00026	0.00013	0.00010	0.00013	0.00011	0.00018	0.00022	0.00024
Silicon (Si)	mg/L	1.82	1.63	1.70	1.65	1.66	2.43	1.53	1.66	1.13	1.13	1.19	1.39	1.55
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000034	<0.000010
Sodium (Na)	mg/L	2.2	2.4	2.6	2.6	2.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	2.5
Strontium (Sr)	mg/L	0.157	0.151	0.183	0.159	0.162	0.0844	0.0476	0.0594	0.0781	0.0782	0.0887	0.133	0.154
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000024	0.000013	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.018	0.014	0.012	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000366	0.000331	0.000361	0.000335	0.000344	0.000247	0.000138	0.000156	0.000176	0.000181	0.000201	0.000279	0.000302
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0027	0.0016	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0035	<0.0030	<0.0030	<0.0030	<0.0030	0.0067	0.0036	0.0039	<0.0030	<0.0030	<0.0030	0.0036	<0.0030
Dissolved Metals														
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0086	0.0130	0.0074	0.0040	0.0035	0.0056	0.0037	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00016	0.00011	0.00011	0.00012	0.00013	0.00012	<0.00010	0.00011	0.00014	0.00012	<0.00010	0.00011	0.00015
Barium (Ba)	mg/L	0.0706	0.0690	0.0722	0.0757	0.0759	0.0544	0.0273	0.0311	0.0390	0.0400	0.0414	0.0545	0.0595
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.010	0.011	0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000014	0.000012	<0.000010	0.000011	0.000014	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	0.000013	<0.000010
Calcium (Ca)	mg/L	50.7	48.0	53.5	47.5	47.9	35.9	22.9	24.4	25.8	27.1	32.3	39.9	43.0
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	0.00401	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00097	0.00063	0.00066	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00111	0.00072
Iron (Fe)	mg/L	0.181	0.049	0.063	0.044	0.044	0.050	<0.030	<0.030	<0.030	<0.030	<0.030	0.138	<0.030
Lead (Pb)	mg/L	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00523	0.00655	0.00675	0.00675	0.00703	0.00236	0.00110	0.00181	0.00304	0.00309	0.00313	0.00505	0.00634
Magnesium (Mg)	mg/L	13.9	12.6	13.8	12.9	12.9	9.25	5.11	5.49	6.54	6.67	8.23	10.8	11.4
Manganese (Mn)	mg/L	0.0118	0.00773	0.00820	0.00957	0.00973	0.00507	0.00192	0.00501	0.00373	0.00379	0.00400	0.00433	0.00439
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000836	0.000834	0.000813	0.000786	0.000768	0.000568	0.000419	0.000453	0.000556	0.000549	0.000579	0.00210	0.000764
Nickel (Ni)	mg/L	0.00053	<0.00050	<0.00050	<0.00050	0.00050	0.00052	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00065	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.487	0.485	0.491	0.502	0.502	0.343	0.189	0.212	0.304	0.306	0.290	0.477	0.446
Selenium (Se)	mg/L	0.00027	0.00028	0.00028	0.00033	0.00031	0.00024	0.00013	<0.00010	0.00013	0.00011	0.00016	0.00023	0.00024
Silicon (Si)	mg/L	1.77	1.62	1.66	1.49	1.50	1.25	0.824	0.840	0.965	0.965	1.10	1.41	1.54
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	3.7	3.2	3.3	3.3	3.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.5	3.7
Strontium (Sr)	mg/L	0.153	0.150	0.168	0.152	0.151	0.0863	0.0449	0.0591	0.0759	0.0780	0.0865	0.129	0.141
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000345	0.000315	0.000336	0.000306	0.000306	0.000215	0.000105	0.000129	0.000162	0.000163	0.000182	0.000246	0.000263
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0049	0.0030	<0.0030	<0.0030	<0.0030	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0034	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR10 - 2011				MR10 - 2012		
Month Sampled		March	June	June	September	March	June	December
Date Sampled		30-Mar-11	8-Jun-11	8-Jun-11	27-Sep-11	19-Mar-12	27-Jun-12	17-Dec-12
Lab Sample ID	Units	L990825-13	L1015493-10	L1015493-6	L1064458-14	L1127031-13	L1169751-17	L1251738-19
Physical Tests								
Colour, True	CU	<5.0	9.5	9.6	7.6	<5.0	6.7	<5.0
Conductivity	µS/cm	373	191	190	203	363	169	382
Hardness (as $CaCO_3$)	mg/L	182	99.5	99.8	100	196	84.3	207
pH	pH	8.14	8.16	8.17	8.31	8.27	8.32	8.28
Total Suspended Solids	mg/L	<3.0	56.7	60.0	24.7	<3.0	37.3	<3.0
Total Dissolved Solids	mg/L	219	115	111	12.6	1.33	18.3	1.21
Turbidity	NTU	2.50	28.3	27.6	-	-	-	-
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	4.8	3.4	3.3	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	167	92.1	91.5	95.1	169	86.5	184
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	167	92.1	91.5	95.1	169	86.5	184
Ammonia (as N)	mg/L	0.0257	<0.0050	0.0058	<0.0050	0.0176	<0.0050	0.0216
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	2.21	<0.50	<0.50	<0.50	1.90	<0.50	1.99
Fluoride (F)	mg/L	0.050	0.023	0.022	0.034	0.063	0.031	0.064
Nitrate (as N)	mg/L	0.210	0.0929	0.0966	0.0706	0.247	0.0717	0.239
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	0.0013	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.090	0.157	0.173	0.108	<0.052	<0.050	0.080
Total Nitrogen	mg/L	0.300	0.250	0.270	0.180	0.260	0.120	0.286
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	0.0014	0.0013	<0.0010	<0.0010	0.0012	0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	0.0027	0.0026	<0.0020	0.0022	0.0024	0.0026
Phosphorus-Total	mg/L	0.0057	0.0395	0.0629	0.0210	0.0064	0.0417	0.0037
Sulphate (SO_4)	mg/L	35.5	9.25	9.32	10.7	30.8	7.19	35.9
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	0.0020	<0.0010	0.0037	<0.0010	<0.0010	<0.0010
Organic Carbon								
Total Organic Carbon	mg/L	1.21	3.44	3.50	2.14	1.71	2.19	2.03
Total Metals								
Aluminum (Al)	mg/L	0.0413	0.983	0.984	0.483	0.0578	0.618	0.0141
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00012	0.00050	0.00051	0.00026	0.00012	0.00034	0.00016
Barium (Ba)	mg/L	0.100	0.0682	0.0649	0.0467	0.0932	0.0483	0.107
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.013	0.011	<0.010	<0.010	0.013	<0.010	0.012
Cadmium (Cd)	mg/L	0.000012	0.000067	0.000065	0.000024	<0.000020	0.000041	0.000011
Calcium (Ca)	mg/L	49.5	30.3	28.7	29.8	56.0	25.3	58.3
Chromium (Cr)	mg/L	0.00014	0.00173	0.00162	0.00085	0.00025	0.00105	0.00011
Cobalt (Co)	mg/L	<0.00010	0.00049	0.00048	0.00023	<0.00010	0.00034	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00168	0.00221	0.00085	0.00074	0.00105	0.00059
Iron (Fe)	mg/L	0.112	1.16	1.20	0.540	0.151	0.881	0.059
Lead (Pb)	mg/L	<0.000050	0.000598	0.000627	0.000300	0.000076	0.000454	<0.000050
Lithium (Li)	mg/L	0.0079	<0.0050	<0.0050	0.00218	0.00730	0.00208	0.00803
Magnesium (Mg)	mg/L	15.1	8.15	7.69	7.51	14.7	6.19	15.7
Manganese (Mn)	mg/L	0.00247	0.0243	0.0234	0.0144	0.00594	0.0185	0.00222
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR10 - 2011				MR10 - 2012		
Month Sampled		March	June	June	September	March	June	December
Date Sampled		30-Mar-11	8-Jun-11	8-Jun-11	27-Sep-11	19-Mar-12	27-Jun-12	17-Dec-12
Lab Sample ID	Units	L990825-13	L1015493-10	L1015493-6	L1064458-14	L1127031-13	L1169751-17	L1251738-19
Total Metals (cont'd)								
Molybdenum (Mo)	mg/L	0.000920	0.000640	0.000603	0.000699	0.000996	0.000639	0.00112
Nickel (Ni)	mg/L	<0.00050	0.00217	0.00210	0.00097	0.00054	0.00142	0.00052
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.564	0.624	0.634	0.460	0.603	0.441	1.01
Selenium (Se)	mg/L	0.00054	0.00044	0.00045	0.00029	0.00054	0.00033	0.00068
Silicon (Si)	mg/L	1.81	2.69	2.71	1.81	1.68	1.93	2.00
Silver (Ag)	mg/L	<0.000010	0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	4.7	<2.0	<2.0	<2.0	4.1	<2.0	4.5
Strontium (Sr)	mg/L	0.182	0.0670	0.0639	0.0755	0.185	0.0542	0.191
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	0.000013	<0.000010	0.000020	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.020	0.023	0.013	<0.010	0.018	<0.010
Uranium (U)	mg/L	0.000402	0.000220	0.000205	0.000188	0.000430	0.000185	0.000437
Vanadium (V)	mg/L	<0.0010	0.0039	0.0040	0.0017	<0.0010	0.0027	<0.0010
Zinc (Zn)	mg/L	<0.0030	0.0071	0.0070	0.0039	0.0073	0.0046	<0.0030
Dissolved Metals								
Aluminum (Al)	mg/L	<0.0030	0.0243	0.0249	0.0116	0.0032	0.0154	0.0134
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	0.00011	0.00011	0.00012	0.00011	0.00011	0.00012
Barium (Ba)	mg/L	0.0970	0.0448	0.0451	0.0392	0.0881	0.0375	0.108
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.013	<0.010	<0.010	<0.010	0.011	<0.010	0.011
Cadmium (Cd)	mg/L	0.000014	0.000014	0.000014	<0.000010	0.000015	<0.000010	0.000012
Calcium (Ca)	mg/L	48.4	27.8	27.8	28.3	54.9	24.2	58.4
Chromium (Cr)	mg/L	<0.00010	0.00017	0.00015	<0.00010	<0.00010	0.00012	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00075	0.00092	<0.00050	0.00110	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.030	0.035	0.038	<0.030	<0.030	<0.030	0.050
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0081	<0.0050	<0.0050	0.00197	0.00729	0.00151	0.00808
Magnesium (Mg)	mg/L	14.8	7.31	7.38	7.21	14.3	5.79	14.8
Manganese (Mn)	mg/L	0.00138	0.00287	0.00300	0.00204	0.00394	0.00211	0.00181
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000897	0.000548	0.000561	0.000640	0.000903	0.000596	0.00105
Nickel (Ni)	mg/L	<0.00050	0.00061	0.00064	<0.00050	0.00051	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.530	0.281	0.291	0.302	0.617	0.220	0.975
Selenium (Se)	mg/L	0.00059	0.00045	0.00044	0.00033	0.00066	0.00033	0.00079
Silicon (Si)	mg/L	1.67	1.15	1.16	1.11	1.65	0.929	1.94
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	4.5	2.2	2.3	<2.0	5.4	<2.0	4.2
Strontium (Sr)	mg/L	0.178	0.0638	0.0645	0.0761	0.180	0.0538	0.184
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000395	0.000160	0.000156	0.000169	0.000373	0.000137	0.000421
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	0.0031	0.0050	<0.0030	0.0105	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC-01 - 2011							TC-01 - 2012			
Month Sampled		May	June	July	August	September	October	November	April	May	June	July
Date Sampled		18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	18-Apr-12	16-May-12	26-Jun-12	24-Jul-12
Lab Sample ID	Units	L1006884-3	L1015493-15	L1034422-9	L1049152-7	L1064458-9	L1073725-7	L1091894-13	L1137305-10	L1148502-10	L1169751-10	L1184612-10
Physical Tests												
Colour, True	CU	68.1	40.5	39.8	18.6	19.7	12.0	19.0	16.4	58.4	33.5	20.8
Conductivity	µS/cm	64.1	69.0	91.1	143	156	175	158	193	73.5	93.6	142
Hardness (as $CaCO_3$)	mg/L	31.6	36.5	48.1	67.8	73.4	82.5	81.5	95.9	40.1	47.6	69.4
pH	pH	7.76	8.02	7.30	8.15	8.21	8.21	8.21	8.21	8.03	8.25	8.22
Total Suspended Solids	mg/L	22.8	6.0	<3.0	<3.0	<3.0	<1.0	<1.0	<3.0	22.5	<3.0	<3.0
Total Dissolved Solids	mg/L	-	61	-	-	-	-	3.3	-	-	-	-
Turbidity	NTU	15.2	6.76	3.89	1.34	1.83	1.15	3.18	2.47	11.9	1.47	2.40
Anions and Nutrients												
Acidity (as $CaCO_3$)	mg/L	3.5	4.0	3.6	1.9	2.6	2.3	<1.0	<1.0	2.5	2.1	1.3
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	29.6	33.2	46.7	73.4	76.5	93.5	86.9	104	35.0	47.8	77.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	29.6	33.2	46.7	73.4	76.5	93.5	86.9	104	35.0	47.8	77.6
Ammonia (as N)	mg/L	0.0061	0.0088	0.0127	<0.0050	0.0088	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.039	0.029	0.059	0.083	0.094	0.090	0.091	0.098	0.053	0.059	0.077
Nitrate (as N)	mg/L	0.0904	0.0124	0.0054	0.0835	0.0537	0.0849	0.144	0.260	0.115	0.0091	0.0603
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.370	0.268	0.265	0.187	0.116	0.155	<0.050	0.140	0.245	0.151	<0.050
Total Nitrogen	mg/L	0.460	0.280	0.270	0.270	0.170	0.240	0.140	0.400	0.360	0.160	0.100
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	0.0019	0.0016	0.0032	0.0039	0.0030	0.0033	0.0046	0.0030	0.0021	0.0031
Phosphorus-Total Dissolved	mg/L	0.0103	0.0053	0.0051	0.0056	0.0053	0.0043	0.0054	0.0061	0.0089	0.0057	0.0070
Phosphorus-Total	mg/L	0.0615	0.0148	0.0107	0.0077	0.0090	0.0076	0.0079	0.0080	0.0283	0.0077	0.0070
Sulphate (SO_4)	mg/L	2.27	2.15	2.47	3.80	4.47	4.87	3.76	3.50	2.18	2.51	3.24
Cyanides												
Cyanide, Weak Acid Dissociable	mg/L	0.0012	0.0013	0.0010	0.0013	-	<0.0025	<0.0011	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0126	0.0082	0.0073	0.0033	0.0054	0.0045	0.0055	0.0045	<0.0010	<0.0010	<0.0010
Organic Carbon												
Total Organic Carbon	mg/L	13.0	10.3	8.68	4.87	5.31	3.85	5.16	4.40	12.3	7.63	5.21
Total Metals												
Aluminum (Al)	mg/L	0.737	0.370	0.217	0.0665	0.0745	0.0488	0.0804	0.0811	0.892	0.0937	0.120
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00032	0.00019	0.00018	0.00017	0.00018	0.00013	0.00015	0.00014	0.00036	0.00016	0.00020
Barium (Ba)	mg/L	0.0869	0.0789	0.105	0.131	0.136	0.143	0.122	0.148	0.0882	0.105	0.142
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	0.010	<0.010	<0.010	0.010	0.011	<0.010	0.012	<0.010	<0.010	0.012
Cadmium (Cd)	mg/L	0.000052	0.000024	0.000054	0.000013	0.000012	<0.000010	0.000014	0.000015	0.000042	0.000014	0.000017
Calcium (Ca)	mg/L	8.93	10.5	13.5	18.9	20.6	22.2	21.4	27.2	11.6	13.2	19.2
Chromium (Cr)	mg/L	0.00129	0.00076	0.00051	0.00024	0.00035	0.00026	0.00023	0.00031	0.00163	0.00031	0.00032
Cobalt (Co)	mg/L	0.00034	0.00015	0.00011	0.00027	<0.00010	<0.00010	<0.00010	<0.00010	0.00030	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00148	0.00089	0.00082	0.00058	0.00067	<0.00050	0.00067	0.00063	0.00147	0.00066	0.00081
Iron (Fe)	mg/L	0.856	0.325	0.183	0.054	0.071	0.039	0.080	0.063	0.749	0.105	0.087
Lead (Pb)	mg/L	0.000392	0.000137	0.000076	<0.000050	<0.000050	<0.000050	0.000051	<0.000050	0.000359	<0.000050	0.000052

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC-01 - 2011							TC-01 - 2012			
Month Sampled		May	June	July	August	September	October	November	April	May	June	July
Date Sampled		18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	18-Apr-12	16-May-12	26-Jun-12	24-Jul-12
Lab Sample ID	Units	L1006884-3	L1015493-15	L1034422-9	L1049152-7	L1064458-9	L1073725-7	L1091894-13	L1137305-10	L1148502-10	L1169751-10	L1184612-10
Total Metals (*cont'd*)												
Lithium (Li)	mg/L	<0.0050	<0.0050	0.00160	0.00210	0.00152	0.00218	0.00194	0.00248	0.00125	0.00124	0.00188
Magnesium (Mg)	mg/L	2.62	2.80	3.81	5.33	5.84	6.85	6.10	7.55	3.23	3.82	4.97
Manganese (Mn)	mg/L	0.0168	0.00439	0.00194	0.00135	0.00132	0.00118	0.00131	0.000762	0.0102	0.00121	0.00107
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000114	0.000109	0.000146	0.000259	0.000310	0.000307	0.000292	0.000332	0.000134	0.000125	0.000220
Nickel (Ni)	mg/L	0.00245	0.00157	0.00135	0.00081	0.00092	0.00067	0.00082	0.00074	0.00226	0.00110	0.00085
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.527	0.310	0.252	0.355	0.353	0.342	0.318	0.385	0.418	0.262	0.369
Selenium (Se)	mg/L	0.00015	0.00012	0.00014	0.00019	0.00014	<0.00010	0.00015	0.00014	0.00015	0.00014	0.00014
Silicon (Si)	mg/L	2.49	2.08	1.91	1.85	1.83	1.65	1.65	2.04	3.05	1.70	2.17
Silver (Ag)	mg/L	0.000036	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000027	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	2.1	2.7	3.2	2.5	3.8	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.0353	0.0394	0.0533	0.0760	0.0810	0.0816	0.0758	0.0872	0.0385	0.0514	0.0786
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000021	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00047	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.025	<0.010	<0.010
Uranium (U)	mg/L	0.000071	0.000039	0.000044	0.000075	0.000105	0.000163	0.000140	0.000240	0.000077	0.000035	0.000083
Vanadium (V)	mg/L	0.0022	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0022	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0059	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0052	<0.0030	<0.0030
Dissolved Metals												
Aluminum (Al)	mg/L	0.262	0.104	0.0697	0.0184	0.0162	0.0117	0.0937	0.0160	0.0964	0.0479	0.0223
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00017	0.00013	0.00014	0.00015	0.00015	0.00012	0.00019	0.00014	0.00015	0.00015	0.00015
Barium (Ba)	mg/L	0.0631	0.0645	0.0823	0.115	0.116	0.129	0.129	0.139	0.0715	0.0895	0.134
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000032	0.000014	0.000015	<0.000010	0.000011	<0.000010	0.000013	0.000011	0.000017	0.000013	0.000013
Calcium (Ca)	mg/L	8.41	10.0	13.1	18.4	19.8	22.1	22.2	26.2	11.1	12.9	19.2
Chromium (Cr)	mg/L	0.00055	0.00032	0.00026	0.00012	<0.00010	<0.00010	0.00019	<0.00010	0.00030	0.00020	0.00014
Cobalt (Co)	mg/L	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00136	0.00117	0.00139	0.00119	0.00077	0.00056	0.00056	0.00068	0.00080	0.00143	0.00069
Iron (Fe)	mg/L	0.288	0.108	0.089	<0.030	<0.030	<0.030	0.079	<0.030	0.158	0.063	<0.030
Lead (Pb)	mg/L	0.000123	0.000052	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	<0.0050	0.00145	0.00217	0.00178	0.00213	0.00226	0.00273	0.00088	0.00120	0.00195
Magnesium (Mg)	mg/L	2.57	2.78	3.76	5.31	5.81	6.63	6.33	7.41	3.01	3.71	5.21
Manganese (Mn)	mg/L	0.00416	0.00182	0.00103	0.000559	0.000525	0.000439	0.000573	0.000485	0.00146	0.00126	0.000477
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000072	0.000090	0.000118	0.000236	0.000276	0.000296	0.000324	0.000288	0.000085	0.000114	0.000202
Nickel (Ni)	mg/L	0.00158	0.00131	0.00126	0.00081	0.00083	0.00062	0.00076	0.00069	0.00141	0.00116	0.00083
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.401	0.234	0.222	0.363	0.347	0.344	0.336	0.374	0.264	0.262	0.336
Selenium (Se)	mg/L	0.00014	0.00012	0.00014	0.00014	0.00012	<0.00010	0.00016	0.00015	0.00013	0.00011	0.00012
Silicon (Si)	mg/L	1.90	1.66	1.74	1.84	1.79	1.65	1.91	1.94	1.63	1.61	1.93
Silver (Ag)	mg/L	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC-01 - 2011							TC-01 - 2012			
Month Sampled		May	June	July	August	September	October	November	April	May	June	July
Date Sampled		18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	18-Apr-12	16-May-12	26-Jun-12	24-Jul-12
Lab Sample ID	Units	L1006884-3	L1015493-15	L1034422-9	L1049152-7	L1064458-9	L1073725-7	L1091894-13	L1137305-10	L1148502-10	L1169751-10	L1184612-10
Dissolved Metals (*cont'd*)												
Sodium (Na)	mg/L	<2.0	<2.0	2.3	3.7	3.3	3.6	2.7	4.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.0336	0.0376	0.0527	0.0745	0.0804	0.0837	0.0766	0.0845	0.0361	0.0502	0.0746
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000045	0.000028	0.000033	0.000059	0.000096	0.000155	0.000139	0.000229	0.000043	0.000024	0.000064
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0035	0.0051	0.0041	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	0.0034	<0.0030	0.0034

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC -02 - 2010	TC-02 - 2011								TC-02 - 2012		
Month Sampled		May	April	May	June	July	August	September	October	November	April	May	June
Date Sampled		30-May-10	27-Apr-11	17-May-11	7-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	17-Apr-12	15-May-12	26-Jun-12
Lab Sample ID	Units	L892473-5	L999009-10	L1007262-6	L1015493-16	L1034422-6	L1049771-9	L1064458-6	L1073725-4	L1091894-14	L1137305-11	L1148502-11	L1169751-11
Physical Tests													
Colour, True	CU	40.5	20.1	54.4	38.3	36.2	15.2	15.4	16.4	14.7	9.4	49.4	28.6
Conductivity	µS/cm	147	301	131	119	173	357	375	383	351	301	125	174
Hardness (as $CaCO_3$)	mg/L	72.3	146	53.5	60.1	88.6	182	201	194	197	155	67.6	84.5
pH	pH	8.10	8.18	8.02	8.04	8.12	8.20	8.25	8.07	8.28	7.96	8.09	8.20
Total Suspended Solids	mg/L	31.6	139	2070	55.3	5.8	<3.0	10.0	<1.0	<1.0	<3.0	418	5.3
Total Dissolved Solids	mg/L	103	-	-	89	-	-	-	4.0	4.0	-	-	-
Turbidity	NTU	24.0	54.6	1310	34.4	6.95	1.15	6.44	4.37	1.65	0.40	155	7.40
Anions and Nutrients													
Acidity (as $CaCO_3$)	mg/L	2.6	2.3	1.5	4.2	1.5	2.3	1.2	4.3	<1.0	3.2	2.4	2.8
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	69.0	143	64.3	60.7	88.8	184	197	203	206	150	60.5	90.1
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	69.0	143	64.3	60.7	88.8	184	197	203	206	150	60.5	90.1
Ammonia (as N)	mg/L	<0.0050	0.0087	0.0431	0.0153	0.0115	0.0057	0.0185	0.0112	<0.0050	<0.0050	0.0066	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	1.02	<0.50	<0.50	<0.50	<0.50	<0.50	0.53	0.87	1.13	<0.50	<0.50
Fluoride (F)	mg/L	0.069	0.083	0.066	0.039	0.077	0.083	0.088	0.086	0.079	0.086	0.063	0.075
Nitrate (as N)	mg/L	0.0620	0.141	0.171	0.0221	<0.0050	0.0053	<0.0050	<0.0050	0.0080	0.0147	0.111	<0.0050
Nitrite (as N)	mg/L	<0.0010	0.0034	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.188	0.436	3.56	0.278	0.260	0.265	0.130	0.230	<0.050	0.065	0.549	0.170
Total Nitrogen	mg/L	0.250	0.580	3.73	0.300	0.260	0.270	0.130	0.230	0.050	0.080	0.660	0.170
Orthophosphate (as P)-Dissolved	mg/L	-	0.0030	0.0093	0.0032	0.0025	0.0041	0.0033	0.0022	0.0019	0.0049	0.0027	0.0029
Phosphorus-Total Dissolved	mg/L	-	0.0061	0.0159	0.0061	0.0054	0.0062	0.0056	0.0035	0.0054	0.0066	0.0088	0.0054
Phosphorus-Total	mg/L	0.0328	0.190	1.31	0.0438	0.0123	0.0077	0.0284	0.0205	0.0159	0.0082	0.369	0.0170
Sulphate (SO_4)	mg/L	6.61	19.1	5.01	4.64	6.11	11.7	11.8	10.2	16.6	14.6	4.33	5.91
Cyanides													
Cyanide, Weak Acid Dissociable	mg/L	-	<0.0010	0.0011	0.0021	<0.0010	<0.0020	<0.0020	<0.0020	<0.0011	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0106	0.0303	0.0268	0.0076	0.0097	0.0029	0.0050	0.0065	0.0047	0.0031	<0.0010	<0.0010
Organic Carbon													
Total Organic Carbon	mg/L	8.42	10.2	60.3	11.9	8.51	5.01	4.71	5.15	5.60	4.21	17.8	7.37
Total Metals													
Aluminum (Al)	mg/L	0.761	1.38	22.1	1.57	0.286	0.0112	0.0252	0.0199	0.0149	0.0074	4.48	0.248
Antimony (Sb)	mg/L	0.00010	0.00015	0.00058	0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00024	<0.00010
Arsenic (As)	mg/L	0.00045	0.00103	0.0192	0.00060	0.00023	0.00025	0.00032	0.00027	0.00018	0.00011	0.00279	0.00027
Barium (Ba)	mg/L	0.111	0.286	1.74	0.124	0.114	0.215	0.239	0.239	0.201	0.178	0.248	0.118
Beryllium (Be)	mg/L	<0.00050	<0.00050	0.00158	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00028	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.011	0.011	0.035	0.011	0.011	<0.010	0.011	0.011	<0.010	0.010	0.011	<0.010
Cadmium (Cd)	mg/L	0.000042	0.000112	0.00158	0.000059	0.000029	0.000023	0.000022	0.000031	0.000025	0.000022	0.000320	0.000026
Calcium (Ca)	mg/L	21.8	40.1	54.9	18.0	26.9	52.6	58.9	57.2	53.2	45.7	22.4	24.1
Chromium (Cr)	mg/L	0.00151	0.00199	0.0351	0.00265	0.00100	0.00016	0.00026	0.00021	0.00013	0.00012	0.00659	0.00057
Cobalt (Co)	mg/L	0.00047	0.00112	0.0202	0.00062	0.00020	0.00021	0.00027	0.00034	0.00022	<0.00010	0.00337	0.00018

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC -02 - 2010	TC-02 - 2011								TC-02 - 2012		
Month Sampled		May	April	May	June	July	August	September	October	November	April	May	June
Date Sampled		30-May-10	27-Apr-11	17-May-11	7-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	17-Apr-12	15-May-12	26-Jun-12
Lab Sample ID	Units	L892473-5	L999009-10	L1007262-6	L1015493-16	L1034422-6	L1049771-9	L1064458-6	L1073725-4	L1091894-14	L1137305-11	L1148502-11	L1169751-11
Total Metals (*cont'd*)													
Copper (Cu)	mg/L	0.00201	0.00400	0.0501	0.00256	0.00131	0.00078	0.00075	0.00061	0.00077	0.00077	0.00923	0.00133
Iron (Fe)	mg/L	0.817	2.42	43.4	1.35	0.430	0.204	0.884	0.627	0.235	<0.030	7.25	0.297
Lead (Pb)	mg/L	0.000519	0.00174	0.0284	0.000754	0.000160	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00422	0.000225
Lithium (Li)	mg/L	<0.0050	0.0055	0.0267	<0.0050	0.00256	0.00266	0.00296	0.00309	0.00226	0.00335	0.00484	0.00227
Magnesium (Mg)	mg/L	5.26	10.2	18.8	4.73	7.44	13.1	15.3	15.2	14.1	11.0	6.89	6.12
Manganese (Mn)	mg/L	0.0116	0.0628	0.660	0.0207	0.0156	0.0451	0.0511	0.0636	0.0390	0.000239	0.129	0.00673
Mercury (Hg)	mg/L	<0.000010	<0.000010	0.000096	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000048	<0.000010
Molybdenum (Mo)	mg/L	0.000240	0.000624	0.00221	0.000239	0.000241	0.000346	0.000404	0.000331	0.000290	0.000305	0.000492	0.000237
Nickel (Ni)	mg/L	0.00302	0.00425	0.0618	0.00332	0.00180	0.00193	0.00204	0.00213	0.00194	0.00127	0.0125	0.00170
Phosphorus (P)	mg/L	<0.30	<0.30	2.12	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	0.36	<0.30
Potassium (K)	mg/L	0.642	1.06	6.68	0.783	0.417	0.561	0.626	0.696	0.563	0.570	1.39	0.450
Selenium (Se)	mg/L	0.00024	0.00039	0.00160	0.00017	0.00018	0.00019	0.00012	0.00010	0.00012	0.00017	0.00036	0.00018
Silicon (Si)	mg/L	3.22	4.73	38.8	4.48	2.36	2.54	2.80	2.76	2.37	1.85	8.72	2.21
Silver (Ag)	mg/L	0.000024	0.000028	0.000675	0.000025	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000133	<0.000010
Sodium (Na)	mg/L	<2.0	5.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.9	<2.0	<2.0
Strontium (Sr)	mg/L	0.0590	0.105	0.136	0.0482	0.0672	0.116	0.118	0.118	0.108	0.102	0.0543	0.0627
Thallium (Tl)	mg/L	<0.00010	<0.00010	0.00058	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000120	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.021	0.032	0.295	0.041	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.064	0.011
Uranium (U)	mg/L	0.000133	0.000614	0.00234	0.000138	0.000114	0.000195	0.000209	0.000201	0.000186	0.000319	0.000362	0.000108
Vanadium (V)	mg/L	0.0030	0.0045	0.0753	0.0055	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0147	<0.0010
Zinc (Zn)	mg/L	0.0064	0.0133	0.227	0.0088	0.0041	<0.0030	0.0032	0.0033	0.0035	<0.0030	0.0419	0.0037
Dissolved Metals													
Aluminum (Al)	mg/L	0.0925	0.439	0.173	0.0750	0.0459	0.0054	0.0039	0.0043	0.0069	0.0046	0.0465	0.0363
Antimony (Sb)	mg/L	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00016	0.00026	0.00033	0.00015	0.00015	0.00028	0.00030	0.00030	0.00020	0.00011	0.00016	0.00016
Barium (Ba)	mg/L	0.0806	0.213	0.0559	0.0678	0.0960	0.204	0.221	0.229	0.214	0.172	0.0719	0.108
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000019	0.000012	0.000022	0.000020	0.000018	0.000065	0.000023	0.000027	0.000013	0.000023	0.000022	0.000014
Calcium (Ca)	mg/L	21.0	41.8	14.3	16.8	25.0	51.5	56.2	53.9	54.7	44.1	19.4	23.6
Chromium (Cr)	mg/L	<0.00050	0.00056	0.00045	0.00028	0.00022	0.00014	0.00011	<0.00010	<0.00010	<0.00010	0.00014	0.00018
Cobalt (Co)	mg/L	0.00014	0.00013	0.00018	<0.00010	<0.00010	0.00019	0.00023	0.00041	0.00012	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00111	0.00112	0.00227	0.00139	0.00160	0.00142	0.00084	0.00112	0.00063	0.00130	0.00101	0.00150
Iron (Fe)	mg/L	0.090	<0.030	0.202	0.097	0.077	0.151	0.542	0.595	0.139	<0.030	0.102	0.061
Lead (Pb)	mg/L	<0.000050	0.000109	0.000128	0.000063	0.000057	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.00254	0.00294	0.00297	0.00270	0.00247	0.00359	0.00133	0.00210
Magnesium (Mg)	mg/L	4.84	10.2	4.33	4.41	6.37	13.1	14.7	14.4	14.7	10.8	4.64	6.21
Manganese (Mn)	mg/L	0.00221	0.00431	0.00920	0.00327	0.00325	0.0421	0.0437	0.0732	0.0256	0.00105	0.00170	0.00423
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000184	0.000536	0.000184	0.000158	0.000204	0.000345	0.000392	0.000314	0.000310	0.000280	0.000167	0.000206

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		TC -02 - 2010	TC-02 - 2011								TC-02 - 2012		
Month Sampled		May	April	May	June	July	August	September	October	November	April	May	June
Date Sampled		30-May-10	27-Apr-11	17-May-11	7-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11	17-Apr-12	15-May-12	26-Jun-12
Lab Sample ID	Units	L892473-5	L999009-10	L1007262-6	L1015493-16	L1034422-6	L1049771-9	L1064458-6	L1073725-4	L1091894-14	L1137305-11	L1148502-11	L1169751-11
Dissolved Metals (*cont'd*)													
Nickel (Ni)	mg/L	0.00173	0.00180	0.00187	0.00147	0.00152	0.00204	0.00185	0.00219	0.00180	0.00127	0.00139	0.00139
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.355	0.838	0.557	0.303	0.342	0.575	0.620	0.692	0.583	0.559	0.323	0.390
Selenium (Se)	mg/L	<0.00020	0.00039	0.00019	0.00016	0.00015	0.00019	0.00012	0.00010	0.00017	0.00020	0.00016	0.00016
Silicon (Si)	mg/L	1.84	1.99	1.95	1.73	2.03	2.54	2.78	2.72	2.55	1.86	1.68	1.92
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	5.0	2.8	2.2	2.8	3.4	2.5	3.2	<2.0	4.0	<2.0	2.3
Strontium (Sr)	mg/L	0.0564	0.0974	0.0340	0.0462	0.0715	0.116	0.119	0.115	0.110	0.0984	0.0470	0.0630
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000094	0.000394	0.000114	0.000059	0.000092	0.000191	0.000205	0.000182	0.000195	0.000240	0.000085	0.000091
Vanadium (V)	mg/L	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0020	<0.0030	0.0054	0.0048	0.0049	0.0050	0.0072	0.0057	<0.0030	0.0034	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-03 - 2011												
Month Sampled		February	February	March	March	April	May	June	July	August	August	September	October	November
Date Sampled		23-Feb-11	23-Feb-11	29-Mar-11	29-Mar-11	27-Apr-11	18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L981301-7	L981301-11	L990825-7	L990825-8	L999009-12	L1006884-1	L1015493-14	L1034422-7	L1049152-4	L1049152-5	L1064458-7	L1073725-5	L1091894-4
Physical Tests														
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	5.8	43.8	22.8	20.0	8.6	8.5	7.5	6.1	7.2
Conductivity	µS/cm	414	413	415	417	383	173	190	304	408	405	434	432	375
Hardness (as $CaCO_3$)	mg/L	196	195	190	187	162	75.8	87.8	137	188	189	210	199	186
pH	pH	8.21	8.23	8.11	8.14	8.23	7.98	8.06	8.22	8.32	8.31	8.41	8.36	8.26
Total Suspended Solids	mg/L	<3.0	<3.0	4.0	4.0	<3.0	60.2	30.7	4.5	<3.0	<3.0	<3.0	<1.0	<1.0
Total Dissolved Solids	mg/L	-	-	257	257	-	-	111	-	-	-	-	8.0	<3.0
Turbidity	NTU	0.51	0.52	12.9	12.3	2.20	32.3	17.3	3.37	0.70	0.72	0.66	2.84	0.46
Anions and Nutrients														
Acidity (as $CaCO_3$)	mg/L	1.0	<1.0	4.7	4.6	1.8	3.1	4.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	170	167	173	166	161	72.7	69.4	105	153	152	161	159	153
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	4.6	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	170	167	173	166	161	72.7	69.4	105	153	152	161	163	153
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0074	<0.0050	<0.0050	0.0088	0.0052	0.0054	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.69	0.67	0.81	0.81	0.91	0.52	<0.50	<0.50	<0.50	<0.50	0.64	0.64	0.70
Fluoride (F)	mg/L	0.068	0.069	0.066	0.064	0.061	0.059	0.045	0.081	0.091	0.091	0.090	0.084	0.079
Nitrate (as N)	mg/L	0.134	0.134	0.133	0.135	0.0923	0.0942	0.0710	0.0856	0.0166	0.0207	0.0066	0.0135	0.0775
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	0.077	0.076	0.168	0.376	0.209	0.214	0.163	0.109	0.053	0.107	<0.050
Total Nitrogen	mg/L	0.167	0.172	0.210	0.210	0.260	0.470	0.280	0.300	0.180	0.130	0.060	0.120	0.090
Orthophosphate (as P)-Dissolved	mg/L	0.0028	0.0024	0.0020	0.0022	0.0027	0.0021	0.0023	0.0012	<0.0010	<0.0010	0.0013	<0.0010	0.0015
Phosphorus-Total Dissolved	mg/L	0.0037	0.0027	0.0024	0.0027	0.0040	0.0091	0.0050	0.0027	0.0032	<0.0020	0.0033	<0.0020	0.0044
Phosphorus-Total	mg/L	0.0039	0.0035	0.0109	0.0104	0.0080	0.0613	0.0358	0.0090	0.0044	0.0047	0.0044	0.0121	0.0053
Sulphate (SO_4)	mg/L	59.7	59.8	58.6	58.5	47.5	22.3	29.8	55.6	64.4	64.5	70.5	67.7	53.9
Cyanides														
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0011	<0.0010	0.0024	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0020	<0.0011
Cyanide, Total	mg/L	0.0016	0.0019	0.0021	0.0014	0.0087	0.0144	0.0068	0.0063	0.0034	0.0029	0.0031	<0.0020	0.0033
Organic Carbon														
Total Organic Carbon	mg/L	2.08	2.50	1.83	1.95	2.40	10.6	6.55	5.11	2.95	2.57	2.73	2.26	2.78
Total Metals														
Aluminum (Al)	mg/L	0.0086	0.0047	0.670	0.706	0.105	1.18	0.849	0.154	0.0188	0.0225	0.0112	0.0183	0.0094
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00014	0.00011	0.00020	0.00025	0.00016	0.00062	0.00039	0.00017	0.00016	0.00014	0.00014	0.00011	<0.00010
Barium (Ba)	mg/L	0.222	0.218	0.234	0.233	0.188	0.119	0.119	0.140	0.216	0.209	0.217	0.218	0.184
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.011	0.011	0.011	0.011	<0.010	0.011	0.012	0.013	0.012	0.012	0.011	0.010	<0.010
Cadmium (Cd)	mg/L	0.000011	<0.000010	0.000015	0.000011	0.000014	0.000086	0.000044	0.000023	0.000013	0.000015	0.000012	0.000012	0.000013
Calcium (Ca)	mg/L	54.9	53.3	50.3	51.2	43.6	19.1	23.4	35.0	51.0	49.9	56.8	53.7	48.1
Chromium (Cr)	mg/L	0.00015	0.00019	0.00108	0.00114	0.00030	0.00208	0.00156	0.00045	0.00025	0.00013	0.00020	0.00023	0.00012
Cobalt (Co)	mg/L	<0.00010	<0.00010	0.00013	0.00014	<0.00010	0.00063	0.00032	<0.00010	0.00101	0.00071	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00072	<0.00050	0.00060	0.00062	<0.00050	0.00222	0.00135	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.060	0.055	0.373	0.384	0.180	1.55	0.762	0.200	0.114	0.113	0.106	0.114	0.074
Lead (Pb)	mg/L	<0.000050	<0.000050	0.000196	0.000210	<0.000050	0.000758	0.000463	0.000074	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0052	0.0051	0.0055	0.0055	<0.0050	<0.0050	<0.0050	0.00597	0.00653	0.00637	0.00602	0.00544	0.00469
Magnesium (Mg)	mg/L	15.9	15.4	16.8	16.9	12.0	6.84	8.00	13.1	16.3	15.7	17.6	17.0	15.0
Manganese (Mn)	mg/L	0.00791	0.00719	0.0103	0.0108	0.0199	0.0448	0.0183	0.0118	0.0185	0.0177	0.0162	0.0146	0.0199
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-03 - 2011												
Month Sampled		February	February	March	March	April	May	June	July	August	August	September	October	November
Date Sampled		23-Feb-11	23-Feb-11	29-Mar-11	29-Mar-11	27-Apr-11	18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L981301-7	L981301-11	L990825-7	L990825-8	L999009-12	L1006884-1	L1015493-14	L1034422-7	L1049152-4	L1049152-5	L1064458-7	L1073725-5	L1091894-4
Total Metals (*cont'd*)														
Molybdenum (Mo)	mg/L	0.000467	0.000471	0.000471	0.000473	0.000396	0.000364	0.000385	0.000483	0.000553	0.000509	0.000509	0.000446	0.000385
Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00086	0.00088	0.00059	0.00319	0.00207	0.00118	0.00061	0.00058	0.00055	0.00050	0.00051
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.530	0.506	0.772	0.792	0.518	0.819	0.646	0.552	0.675	0.651	0.629	0.614	0.519
Selenium (Se)	mg/L	0.00188	0.00138	0.00130	0.00131	0.00100	0.00092	0.00146	0.00245	0.00163	0.00157	0.00125	0.00125	0.00109
Silicon (Si)	mg/L	2.08	2.04	3.56	3.66	1.96	3.27	3.22	2.05	1.90	1.85	1.95	1.89	1.85
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000034	0.000026	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	12.2	11.9	12.4	12.4	10.1	3.0	4.6	7.9	10.2	10.0	11.6	11.4	10.3
Strontium (Sr)	mg/L	0.190	0.193	0.189	0.191	0.148	0.0809	0.110	0.182	0.212	0.207	0.211	0.196	0.173
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	0.030	0.035	<0.010	0.022	0.023	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000601	0.000595	0.000642	0.000640	0.000511	0.000207	0.000286	0.000453	0.000529	0.000518	0.000534	0.000555	0.000466
Vanadium (V)	mg/L	<0.0010	<0.0010	0.0022	0.0022	<0.0010	0.0041	0.0030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	0.0030	<0.0030	<0.0030	0.0094	0.0063	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals														
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0122	0.0113	0.0097	0.110	0.0471	0.0149	0.0038	0.0032	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00012	0.00011	<0.00010	<0.00010	<0.00010	0.00017	0.00012	0.00013	0.00012	0.00014	0.00012	0.00010	0.00011
Barium (Ba)	mg/L	0.212	0.217	0.212	0.206	0.183	0.0803	0.0802	0.122	0.205	0.202	0.208	0.201	0.191
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000020	0.000020	0.000012	0.000011	0.000012	<0.000010	<0.000010	0.000012
Calcium (Ca)	mg/L	52.6	52.6	49.2	48.1	44.4	19.2	22.3	34.4	49.4	49.4	55.6	52.5	49.6
Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00010	0.00011	<0.00010	0.00030	0.00019	0.00013	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00123	0.00100	0.00105	0.00085	0.00101	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.032	0.148	0.074	0.054	0.034	0.034	0.048	0.034	0.048
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000066	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0052	0.0051	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00566	0.00644	0.00660	0.00594	0.00517	0.00486
Magnesium (Mg)	mg/L	15.6	15.4	16.3	16.3	12.5	6.79	7.80	12.5	15.7	16.0	17.2	16.5	15.0
Manganese (Mn)	mg/L	0.00666	0.00669	0.00644	0.00632	0.0139	0.00796	0.00621	0.00848	0.0154	0.0151	0.0141	0.0114	0.0186
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000425	0.000444	0.000442	0.000428	0.000301	0.000282	0.000318	0.000457	0.000473	0.000496	0.000460	0.000431	0.000400
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00131	0.00112	0.00097	0.00054	0.00061	0.00055	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.542	0.512	0.528	0.532	0.521	0.494	0.395	0.501	0.666	0.676	0.636	0.597	0.528
Selenium (Se)	mg/L	0.00142	0.00157	0.00127	0.00127	0.00104	0.00093	0.00154	0.00240	0.00179	0.00175	0.00139	0.00141	0.00131
Silicon (Si)	mg/L	2.05	2.05	1.92	1.91	1.88	1.73	1.67	1.84	1.88	1.87	2.01	1.92	1.88
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	12.1	11.9	12.0	12.0	10.5	4.9	5.9	9.1	11.5	11.5	11.9	11.7	10.1
Strontium (Sr)	mg/L	0.185	0.183	0.180	0.182	0.147	0.0800	0.103	0.177	0.204	0.204	0.209	0.199	0.173
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000563	0.000553	0.000595	0.000599	0.000503	0.000130	0.000202	0.000420	0.000500	0.000507	0.000521	0.000552	0.000469
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0048	0.0039	0.0037	0.0033	0.0041	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-03 - 2012												
Month Sampled		January	February	February	March	April	May	June	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	26-Jun-12	26-Jun-12	24-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-6	L1117841-4	L1117841-10	L1127031-4	L1137305-4	L1148502-4	L1169751-4	L1169751-20	L1184612-4	L1197851-4	L1228768-11	L1243937-4	L1251738-10
Physical Tests														
Colour, True	CU	5.4	<5.0	<5.0	<5.0	5.1	32.7	17.2	17.4	9.4	7.0	6.5	<5.0	<5.0
Conductivity	µS/cm	378	384	383	386	381	189	278	279	382	398	427	422	440
Hardness (as $CaCO_3$)	mg/L	177	180	188	195	185	92.1	127	122	178	200	205	214	210
pH	pH	8.17	8.28	8.29	8.27	8.23	8.11	8.23	8.25	8.32	8.44	8.26	8.17	8.27
Total Suspended Solids	mg/L	3.3	<3.0	<3.0	<3.0	<3.0	28.5	6.6	9.3	5.8	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.68	0.62	0.50	0.49	0.71	18.7	4.73	4.64	5.07	0.92	0.49	0.50	1.16
Anions and Nutrients														
Acidity (as $CaCO_3$)	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	2.5	2.6	1.8	<1.0	<1.0	2.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	166	163	165	173	171	77.7	97.5	102	151	160	158	164	166
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	4.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	166	163	165	173	171	77.7	97.5	102	151	164	158	164	166
Ammonia (as N)	mg/L	0.0078	0.0050	<0.0050	0.0089	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0051	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.64	0.70	0.67	0.77	0.82	<0.50	<0.50	<0.50	<0.50	<0.50	0.73	0.56	0.57
Fluoride (F)	mg/L	0.080	0.081	0.081	0.082	0.082	0.072	0.086	0.086	0.094	0.095	0.087	0.081	0.081
Nitrate (as N)	mg/L	0.0836	0.0881	0.0882	0.0846	0.0663	0.0576	0.111	0.109	0.111	0.0411	0.0755	0.118	0.127
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	0.125	<0.050	0.122	0.088	0.051	<0.050	0.119	0.064	0.079	0.082
Total Nitrogen	mg/L	0.090	0.070	0.060	0.210	0.100	0.180	0.200	0.160	0.140	0.160	0.140	-	0.192
Orthophosphate (as P)-Dissolved	mg/L	0.0019	0.0032	0.0023	<0.0010	0.0018	0.0024	0.0030	0.0019	0.0013	0.0021	0.0015	0.0024	0.0015
Phosphorus-Total Dissolved	mg/L	0.0023	0.0029	0.0030	0.0053	0.0023	0.0074	0.0038	0.0041	0.0035	0.0025	<0.0020	0.0033	0.0024
Phosphorus-Total	mg/L	0.0037	0.0038	0.0035	0.0041	0.0052	0.0391	0.0115	0.0112	0.0052	0.0045	0.0027	0.0043	0.0041
Sulphate (SO_4)	mg/L	46.1	46.0	46.0	45.1	44.4	21.9	51.1	51.1	73.0	70.2	86.9	81.6	79.3
Cyanides														
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0024	0.0019	0.0020	0.0019	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon														
Total Organic Carbon	mg/L	2.23	2.24	2.25	2.55	2.34	8.18	4.62	4.52	3.15	2.74	2.51	1.93	1.99
Total Metals														
Aluminum (Al)	mg/L	0.0153	0.0083	0.0068	0.0290	0.0165	1.08	0.135	0.149	0.150	0.0211	0.0087	0.0054	0.0074
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	0.00045	0.00018	0.00019	0.00022	0.00016	0.00012	0.00017	0.00012
Barium (Ba)	mg/L	0.180	0.190	0.189	0.200	0.196	0.119	0.122	0.130	0.190	0.253	0.208	0.220	0.225
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.012	<0.010	<0.010	<0.010	0.011	0.010	<0.010	<0.010	0.016	0.011	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000020	<0.000010	0.000057	0.000022	0.000037	0.000025	0.000013	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	49.5	48.5	47.8	53.3	51.1	26.1	29.4	30.2	43.9	53.9	55.2	57.1	57.7
Chromium (Cr)	mg/L	0.00024	<0.00010	<0.00010	0.00013	0.00015	0.00122	0.00032	0.00038	0.00032	0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00039	0.00011	0.00011	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	0.00067	<0.00050	0.00165	0.00065	0.00068	0.00059	<0.00050	<0.00050	<0.00050	0.00052
Iron (Fe)	mg/L	0.088	0.070	0.073	0.118	0.098	1.00	0.232	0.254	0.222	0.100	0.092	0.081	0.082
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000059	<0.000050	0.000547	0.000113	0.000118	0.000106	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00465	0.00426	0.00427	0.00454	0.00444	0.00286	0.00582	0.00591	0.00815	0.00705	0.00630	0.00606	0.00609
Magnesium (Mg)	mg/L	13.9	13.5	13.5	15.2	14.5	7.72	10.7	10.9	15.4	18.0	17.5	18.5	17.8
Manganese (Mn)	mg/L	0.0187	0.0115	0.0117	0.0154	0.0122	0.0295	0.0118	0.0120	0.0144	0.0105	0.0120	0.0116	0.0119
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-03 - 2012												
Month Sampled		January	February	February	March	April	May	June	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	26-Jun-12	26-Jun-12	24-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-6	L1117841-4	L1117841-10	L1127031-4	L1137305-4	L1148502-4	L1169751-4	L1169751-20	L1184612-4	L1197851-4	L1228768-11	L1243937-4	L1251738-10
Total Metals (*cont'd*)														
Molybdenum (Mo)	mg/L	0.000440	0.000390	0.000407	0.000418	0.000436	0.000384	0.000493	0.000515	0.000576	0.000518	0.000472	0.000456	0.000463
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00242	0.00121	0.00115	0.00082	0.00080	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.483	0.494	0.496	0.524	0.515	0.615	0.548	0.538	0.674	0.742	0.569	0.567	0.573
Selenium (Se)	mg/L	0.00102	0.00097	0.00090	0.00093	0.00083	0.00080	0.00303	0.00309	0.00340	0.00208	0.00263	0.00226	0.00206
Silicon (Si)	mg/L	1.92	1.90	1.89	1.95	1.84	3.84	1.88	1.91	2.29	2.16	1.95	1.87	1.90
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	9.4	9.4	9.4	9.7	9.6	3.6	7.7	7.9	12.0	12.5	14.1	12.7	13.0
Strontium (Sr)	mg/L	0.166	0.153	0.152	0.173	0.164	0.0913	0.167	0.168	0.234	0.227	0.230	0.229	0.215
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.037	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000481	0.000493	0.000496	0.000507	0.000532	0.000217	0.000475	0.000485	0.000651	0.000612	0.000626	0.000642	0.000621
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0034	<0.0030	0.0073	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals														
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	0.0034	0.0034	0.0277	0.0180	0.0185	0.0070	0.0038	<0.0030	<0.0030	0.0033
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	0.00011	0.00010	<0.00010	0.00011	0.00012	0.00011	0.00011	0.00013	0.00013	0.00012	<0.00010	<0.00010
Barium (Ba)	mg/L	0.169	0.193	0.190	0.188	0.191	0.0952	0.120	0.124	0.189	0.243	0.205	0.204	0.211
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000014	0.000013	<0.000010	0.000011	0.000012	0.000013	0.000019	0.000012	0.000010	<0.000010	<0.000010	0.000010
Calcium (Ca)	mg/L	48.0	49.7	52.8	53.0	50.1	24.7	32.3	30.9	45.3	52.3	53.4	55.8	55.9
Chromium (Cr)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	0.00012	<0.00010	<0.00010	0.00012	0.00010	0.00011	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	0.00066	0.00095	0.00077	0.00063	0.00105	0.00117	0.00091	<0.00050	<0.00050	0.00082	0.00073
Iron (Fe)	mg/L	0.041	0.032	<0.030	<0.030	0.032	0.075	0.049	0.048	0.043	<0.030	0.040	0.039	0.032
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00444	0.00452	0.00487	0.00466	0.00479	0.00234	0.00664	0.00598	0.00893	0.00726	0.00625	0.00605	0.00625
Magnesium (Mg)	mg/L	13.9	13.6	13.7	15.2	14.6	7.41	11.2	10.9	15.7	16.9	17.4	18.0	17.1
Manganese (Mn)	mg/L	0.0156	0.0110	0.0109	0.00972	0.00948	0.00570	0.00809	0.00802	0.0115	0.00814	0.0109	0.0109	0.0113
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000384	0.000394	0.000403	0.000395	0.000399	0.000299	0.000524	0.000493	0.000570	0.000534	0.000444	0.000427	0.000431
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	0.00055	0.00110	0.00101	0.00098	0.00073	0.00071	<0.00050	0.00056	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.503	0.525	0.524	0.517	0.533	0.399	0.535	0.551	0.666	0.711	0.559	0.581	0.583
Selenium (Se)	mg/L	0.00105	0.00101	0.00108	0.00107	0.00092	0.00078	0.00327	0.00322	0.00345	0.00206	0.00259	0.00232	0.00229
Silicon (Si)	mg/L	1.97	1.90	1.94	1.94	1.86	1.59	1.78	1.74	1.96	2.10	1.95	1.91	1.95
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	9.8	9.7	10.3	10.7	10.6	3.4	9.0	9.2	12.9	13.1	14.3	14.1	14.6
Strontium (Sr)	mg/L	0.162	0.156	0.168	0.171	0.157	0.0860	0.182	0.171	0.237	0.220	0.219	0.224	0.210
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000465	0.000493	0.000508	0.000495	0.000496	0.000167	0.000460	0.000437	0.000611	0.000536	0.000586	0.000616	0.000583
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-05 - 2010				M20-05 - 2011									
Month Sampled		June	July	October	December	February	March	April	May	June	July	August	September	October	November
Date Sampled		14-Jun-10	27-Jul-10	16-Oct-10	8-Dec-10	23-Feb-11	30-Mar-11	27-Apr-11	18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L897909-9	L915316-5	R010261-09	R012173-09	L981301-9	L990825-10	L999009-11	L1006884-2	L1015493-13	L1034422-8	L1049152-6	L1064458-8	L1073725-6	L1091894-5
Physical Tests															
Colour, True	CU	25.1	6.9	-	-	<5.0	<5.0	12.4	44.6	21.7	20.5	7.7	6.3	5.3	6.1
Conductivity	µS/cm	272	404	-	419	414	417	349	180	199	301	390	422	423	379
Hardness (as $CaCO_3$)	mg/L	150	183	217	207	199	186	152	83.3	92.4	138	183	206	198	190
pH	pH	8.08	8.45	8.30	8.22	8.31	8.24	8.23	7.80	8.14	8.32	8.38	8.20	8.43	8.34
Total Suspended Solids	mg/L	<3.0	18.0	6	<1	<3.0	<3.0	176	424	98.0	24.5	10.0	<3.0	<1.0	<1.0
Total Dissolved Solids	mg/L	177	250	270	234	-	249	-	-	149	-	-	-	4.0	8.7
Turbidity	NTU	0.55	14.5	-	2.3	1.95	3.38	270	207	72.2	27.7	6.43	2.91	5.84	10.9
Anions and Nutrients															
Acidity (as $CaCO_3$)	mg/L	3.9	<1.0	-	-	<1.0	2.5	1.9	3.7	3.5	<1.0	<1.0	2.4	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	163	159	-	-	172	173	146	72.8	75.6	106	152	168	162	157
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	4.1	-	-	1.6	<2.0	<2.0	<2.0	<2.0	<1.0	4.7	<2.0	7.6	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	-	-	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	163	163	-	162	174	173	146	72.8	75.6	106	156	168	170	158
Ammonia (as N)	mg/L	0.0063	<0.0050	-	<0.02	<0.0050	<0.0050	0.0109	0.0095	0.0118	0.0140	0.0058	0.0137	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	-	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	-	0.7	0.70	0.67	1.43	0.58	<0.50	<0.50	<0.50	0.62	0.63	0.69
Fluoride (F)	mg/L	0.045	0.081	-	<0.10	0.067	0.064	0.063	0.059	0.044	0.082	0.086	0.088	0.082	0.079
Nitrate (as N)	mg/L	<0.0050	0.0520	-	0.02	0.132	0.118	0.105	0.0979	0.0644	0.0178	0.0210	<0.0050	<0.0050	0.0768
Nitrite (as N)	mg/L	<0.0010	<0.0010	-	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.195	0.108	-	0.08	0.073	0.082	0.625	0.752	0.336	0.232	0.169	<0.050	0.120	<0.050
Total Nitrogen	mg/L	0.195	0.160	-	-	0.206	0.200	0.730	0.850	0.400	0.250	0.190	<0.050	0.120	0.090
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	0.0031	0.0018	0.0127	0.0016	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	0.0013
Phosphorus-Total Dissolved	mg/L	-	-	-	-	0.0023	0.0026	0.0147	0.0085	0.0044	<0.0020	<0.0020	<0.0020	<0.0020	0.0044
Phosphorus-Total	mg/L	0.0079	0.0202	-	<0.010	0.0052	0.0055	0.348	0.169	0.0977	0.0370	0.0146	0.0062	0.0098	0.0146
Sulphate (SO_4)	mg/L	0.94	56.7	-	56.8	53.1	52.1	36.5	21.1	28.9	50.5	52.2	61.2	57.0	50.9
Cyanides															
Cyanide, Weak Acid Dissociable	mg/L	-	0.0012	-	<0.002	<0.0010	<0.0010	<0.0011	0.0013	0.0011	<0.0010	<0.0010	-	<0.0020	<0.0011
Cyanide, Total	mg/L	0.0064	0.0026	-	<0.01	0.0015	0.0018	0.0026	0.0179	0.0071	0.0090	0.0026	0.0029	0.0027	0.0023
Organic Carbon															
Total Organic Carbon	mg/L	7.78	2.77	-	2.2	2.30	1.94	11.9	18.1	9.69	5.58	3.10	2.56	2.45	2.64
Total Metals															
Aluminum (Al)	mg/L	0.0331	0.415	0.268	0.127	0.0480	0.135	4.98	5.36	2.36	0.892	0.263	0.103	0.178	0.234
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.0001	<0.0010	<0.00010	<0.00010	0.00019	0.00026	0.00014	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00030	0.00026	<0.0005	<0.0050	0.00014	0.00013	0.00240	0.00241	0.00103	0.00039	0.00018	0.00013	0.00016	0.00018
Barium (Ba)	mg/L	0.182	0.211	0.202	0.225	0.216	0.222	0.322	0.280	0.166	0.157	0.210	0.213	0.212	0.202
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.0001	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	0.014	0.018	<0.040	0.011	<0.010	0.013	0.016	0.014	0.014	0.012	0.011	0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000038	0.00002	<0.00010	0.000014	0.000018	0.000292	0.000365	0.000118	0.000048	0.000027	0.000019	0.000020	0.000024
Calcium (Ca)	mg/L	47.0	50.8	55	52.6	52.7	53.5	46.4	31.6	27.2	37.0	49.6	57.1	53.5	52.9
Chromium (Cr)	mg/L	0.00022	0.00069	0.0008	<0.0050	0.00020	0.00029	0.00856	0.00863	0.00412	0.00172	0.00052	0.00050	0.00043	0.00046
Cobalt (Co)	mg/L	<0.00010	0.00022	0.00021	<0.00050	<0.00010	<0.00010	0.00240	0.00300	0.00110	0.00037	0.00047	<0.00010	<0.00010	0.00012
Copper (Cu)	mg/L	<0.00040	0.00125	0.0013	<0.0010	<0.00050	<0.00050	0.00785	0.00886	0.00399	0.00164	0.00083	0.00056	0.00054	0.00064
Iron (Fe)	mg/L	0.300	0.458	0.36	<0.10	0.042	0.089	7.98	7.14	2.65	0.859	0.220	0.091	0.145	0.236
Lead (Pb)	mg/L	<0.000050	0.000303	0.0001	<0.0010	<0.000050	0.000147	0.00384	0.00393	0.00136	0.000440	0.000136	0.000059	0.000096	0.000133
Lithium (Li)	mg/L	<0.0050	0.0064	0.0067	0.0064	<0.0050	<0.0050	0.0073	0.0069	0.0051	0.00605	0.00565	0.00509	0.00480	0.00450
Magnesium (Mg)	mg/L	11.1	13.7	19.4	18.3	14.5	16.4	12.6	10.4	9.02	12.9	14.6	16.6	16.0	15.2
Manganese (Mn)	mg/L	0.0307	0.0103	0.0058	<0.0020	0.00105	0.00180	0.107	0.155	0.0471	0.0189	0.00759	0.00294	0.00368	0.00527
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.00005	<0.00050	<0.000010	<0.000010	0.000020	0.000021	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-05 - 2010				M20-05 - 2011									
Month Sampled		June	July	October	December	February	March	April	May	June	July	August	September	October	November
Date Sampled		14-Jun-10	27-Jul-10	16-Oct-10	8-Dec-10	23-Feb-11	30-Mar-11	27-Apr-11	18-May-11	7-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L897909-9	L915316-5	R010261-09	R012173-09	L981301-9	L990825-10	L999009-11	L1006884-2	L1015493-13	L1034422-8	L1049152-6	L1064458-8	L1073725-6	L1091894-5
Total Metals (*cont'd*)															
Molybdenum (Mo)	mg/L	0.000253	0.000517	0.0006	<0.0010	0.000481	0.000510	0.000795	0.000653	0.000500	0.000513	0.000471	0.000532	0.000471	0.000444
Nickel (Ni)	mg/L	0.00074	0.00124	0.0022	<0.0020	<0.00050	<0.00050	0.00929	0.0122	0.00499	0.00219	0.00085	0.00060	0.00064	0.00081
Phosphorus (P)	mg/L	<0.30	<0.30	-	-	<0.30	<0.30	0.36	0.38	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.278	0.830	-	-	0.523	0.587	2.07	2.16	1.23	0.831	0.728	0.638	0.650	0.626
Selenium (Se)	mg/L	<0.00020	0.00114	0.0024	0.0045	0.00116	0.00117	0.00094	0.00102	0.00135	0.00219	0.00128	0.00108	0.00106	0.00104
Silicon (Si)	mg/L	1.80	2.85	-	-	2.15	2.22	21.5	11.2	5.64	3.24	2.51	2.14	2.25	2.46
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.00005	<0.00050	<0.000010	<0.000010	0.000109	0.000113	0.000042	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	10.4	15.4	11.1	10.2	10.6	8.3	3.1	4.4	7.2	8.2	10.0	9.7	9.5
Strontium (Sr)	mg/L	0.0670	0.167	-	-	0.163	0.171	0.133	0.103	0.109	0.174	0.181	0.187	0.171	0.166
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00002	<0.00020	<0.00010	<0.00010	0.00014	0.00014	<0.00010	0.000023	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	0.00013	0.00036	-	-	<0.00010	<0.00010	0.00027	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.015	0.018	<0.050	<0.010	<0.010	0.322	0.119	0.048	0.023	0.012	<0.010	<0.010	0.015
Uranium (U)	mg/L	0.000097	0.000564	0.00054	0.00054	0.000534	0.000602	0.000724	0.000542	0.000358	0.000466	0.000485	0.000516	0.000530	0.000491
Vanadium (V)	mg/L	<0.0010	0.0015	<0.001	<0.0100	<0.0010	<0.0010	0.0199	0.0192	0.0090	0.0032	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0010	0.0032	0.004	<0.010	<0.0030	<0.0030	0.0368	0.0377	0.0142	0.0063	<0.0030	0.0033	<0.0030	<0.0030
Dissolved Metals															
Aluminum (Al)	mg/L	0.0025	0.0029	0.008	<0.05	<0.0030	<0.0030	0.112	0.105	0.0566	0.0194	0.0030	<0.0030	<0.0030	0.0032
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.0001	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00017	0.00016	0.0006	<0.005	0.00010	<0.00010	0.00014	0.00018	0.00013	0.00012	0.00013	0.00012	0.00011	0.00010
Barium (Ba)	mg/L	0.173	0.210	0.2	0.218	0.219	0.212	0.153	0.0746	0.0836	0.126	0.198	0.210	0.201	0.198
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	0.011	0.009	<0.04	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000017	<0.00001	<0.0001	0.000012	<0.000010	0.000013	0.000017	0.000013	0.000015	0.000014	<0.000010	<0.000010	0.000013
Calcium (Ca)	mg/L	43.8	51.4	49.8	52.1	54.3	49.0	42.1	21.3	23.7	35.2	49.1	55.6	53.5	51.6
Chromium (Cr)	mg/L	<0.00020	<0.00050	0.0009	<0.005	<0.00010	<0.00010	0.00022	0.00025	0.00022	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	0.00008	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00024	0.00085	0.001	<0.001	<0.00050	<0.00050	0.00089	0.00148	0.00110	0.00118	0.00099	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.075	<0.030	0.072	<0.1	<0.030	<0.030	0.047	0.124	0.073	0.041	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.0001	<0.001	<0.000050	<0.000050	<0.000050	0.000075	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	0.0057	0.0068	0.0062	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00526	0.00572	0.00528	0.00463	0.00433
Magnesium (Mg)	mg/L	9.86	13.3	18.1	17.6	15.5	15.5	11.4	7.28	8.09	12.2	14.8	16.3	15.6	14.9
Manganese (Mn)	mg/L	0.0118	0.000120	0.0023	<0.002	0.000372	0.000357	0.00669	0.00832	0.00554	0.00505	0.00244	0.00130	0.00104	0.00120
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.00005	<0.0005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000224	0.000606	0.0006	<0.001	0.000452	0.000457	0.000320	0.000292	0.000315	0.000424	0.000483	0.000484	0.000452	0.000410
Nickel (Ni)	mg/L	0.00057	<0.00050	0.0018	<0.002	<0.00050	<0.00050	0.00071	0.00125	0.00108	0.00089	0.00059	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.254	0.713	-	-	0.549	0.519	0.610	0.524	0.416	0.495	0.661	0.625	0.599	0.542
Selenium (Se)	mg/L	<0.00020	0.00127	0.0026	0.0042	0.00125	0.00116	0.00087	0.00089	0.00143	0.00213	0.00141	0.00126	0.00124	0.00118
Silicon (Si)	mg/L	1.74	1.99	-	-	2.07	1.86	1.93	1.76	1.71	1.72	1.96	2.06	1.92	1.89
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.00005	<0.0005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	10.7	13.2	10.3	10.4	10.2	9.1	4.1	5.7	8.5	10.0	10.5	10.1	9.0
Strontium (Sr)	mg/L	0.0662	0.169	0.203	0.188	0.165	0.161	0.123	0.0805	0.101	0.167	0.177	0.186	0.176	0.162
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00002	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00026	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.005	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000087	0.000524	0.00058	0.00054	0.000526	0.000573	0.000441	0.000136	0.000208	0.000397	0.000434	0.000500	0.000530	0.000471
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.001	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0010	<0.0010	0.0044	<0.01	<0.0030	<0.0030	<0.0030	0.0037	0.0040	0.0033	0.0039	<0.0030	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-05 - 2012										
Month Sampled		January	February	March	April	May	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	26-Jun-12	24-Jul-12	21-Aug-12	23-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-7	L1117841-5	L1127031-5	L1137305-5	L1148502-5	L1169751-5	L1184612-5	L1197851-16	L1228768-15	L1243937-5	L1251738-11
Physical Tests												
Colour, True	CU	5.5	<5.0	<5.0	6.8	30.8	16.4	8.7	6.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	377	382	389	370	198	280	372	394	417	411	432
Hardness (as $CaCO_3$)	mg/L	178	183	199	184	97.3	125	177	198	217	211	214
pH	pH	8.25	8.34	8.31	8.32	8.19	8.29	8.40	8.40	8.15	8.26	8.33
Total Suspended Solids	mg/L	8.7	5.3	3.3	14.0	127	31.3	9.8	9.3	3.2	3.3	3.8
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	11.2	3.61	3.10	19.9	101	32.0	8.61	6.35	4.54	3.67	4.60
Anions and Nutrients												
Acidity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	170	172	180	169	84.5	104	154	163	161	171	170
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	3.7	<1.0	1.6	<2.0	<2.0	<1.0	4.3	<1.0	<2.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<1.0	<1.0	<2.0	<2.0	<1.0	<1.0	<1.0	<2.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	170	176	180	170	84.5	104	154	167	161	171	170
Ammonia (as N)	mg/L	0.0071	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0053	0.0060	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.68	0.68	0.79	0.73	<0.50	<0.50	<0.50	<0.50	0.68	0.57	0.57
Fluoride (F)	mg/L	0.078	0.079	0.080	0.080	0.069	0.085	0.090	0.091	0.082	0.078	0.080
Nitrate (as N)	mg/L	0.0990	0.0921	0.0871	0.0513	0.0550	0.0708	0.0494	0.0622	0.0707	0.111	0.120
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	0.069	0.215	0.109	<0.050	0.088	<0.050	0.082	0.076
Total Nitrogen	mg/L	0.100	0.070	0.080	0.120	0.270	0.180	0.090	0.150	0.110	-	0.186
Orthophosphate (as P)-Dissolved	mg/L	0.0018	0.0035	0.0020	0.0012	0.0025	0.0015	<0.0010	0.0013	0.0011	0.0021	0.0018
Phosphorus-Total Dissolved	mg/L	0.0021	0.0033	0.0047	0.0025	0.0059	0.0027	0.0026	<0.0020	<0.0020	0.0028	0.0041
Phosphorus-Total	mg/L	0.0114	0.0086	0.0078	0.0241	0.136	0.0440	0.0059	0.0097	0.0043	0.0080	0.0065
Sulphate (SO_4)	mg/L	39.8	39.2	39.0	35.9	21.8	48.2	65.6	57.9	75.0	70.5	68.5
Cyanides												
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0022	0.0012	0.0018	0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon												
Total Organic Carbon	mg/L	2.63	2.53	2.24	3.11	9.27	4.76	3.44	3.02	2.56	1.98	2.14
Total Metals												
Aluminum (Al)	mg/L	0.367	0.108	0.117	0.655	3.47	0.878	0.319	0.161	0.148	0.0986	0.116
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00011	<0.00010	0.00026	0.00013	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00017	0.00011	0.00014	0.00027	0.00138	0.00041	0.00028	0.00021	0.00018	0.00018	0.00013
Barium (Ba)	mg/L	0.191	0.194	0.207	0.194	0.191	0.146	0.204	0.241	0.229	0.223	0.231
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.013	<0.010	<0.010	0.011	0.014	0.011	0.016	0.011	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000025	0.000018	<0.000020	0.000031	0.000252	0.000050	0.000033	0.000022	0.000019	0.000014	0.000016
Calcium (Ca)	mg/L	52.1	50.3	56.8	50.6	38.1	32.6	44.4	53.0	56.4	58.5	60.2
Chromium (Cr)	mg/L	0.00089	0.00024	0.00031	0.00114	0.00398	0.00154	0.00062	0.00035	0.00030	0.00029	0.00027
Cobalt (Co)	mg/L	0.00013	<0.00010	<0.00010	0.00024	0.00159	0.00041	0.00020	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00068	<0.00050	0.00076	0.00101	0.00528	0.00152	0.00093	0.00067	0.00051	0.00051	0.00073
Iron (Fe)	mg/L	0.273	0.088	0.093	0.585	3.72	0.935	0.413	0.181	0.190	0.116	0.119
Lead (Pb)	mg/L	0.000168	0.000064	0.000083	0.000291	0.00211	0.000496	0.000229	0.000098	0.000100	0.000061	0.000066
Lithium (Li)	mg/L	0.00434	0.00402	0.00425	0.00426	0.00495	0.00622	0.00772	0.00624	0.00546	0.00543	0.00588
Magnesium (Mg)	mg/L	13.9	13.3	15.3	13.4	11.1	11.2	14.0	15.3	17.2	17.2	17.5
Manganese (Mn)	mg/L	0.00502	0.00221	0.00198	0.00895	0.0772	0.0197	0.00878	0.00511	0.00441	0.00238	0.00247
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-05 - 2012										
Month Sampled		January	February	March	April	May	June	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	26-Jun-12	24-Jul-12	21-Aug-12	23-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-7	L1117841-5	L1127031-5	L1137305-5	L1148502-5	L1169751-5	L1184612-5	L1197851-16	L1228768-15	L1243937-5	L1251738-11
Total Metals (*cont'd*)												
Molybdenum (Mo)	mg/L	0.000460	0.000425	0.000430	0.000440	0.000631	0.000538	0.000568	0.000501	0.000459	0.000464	0.000477
Nickel (Ni)	mg/L	0.00087	0.00061	0.00067	0.00132	0.00712	0.00220	0.00112	0.00070	0.00062	0.00054	0.00056
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.643	0.545	0.558	0.747	1.28	0.818	0.693	0.716	0.616	0.589	0.629
Selenium (Se)	mg/L	0.00090	0.00081	0.00085	0.00070	0.00103	0.00281	0.00282	0.00153	0.00205	0.00186	0.00180
Silicon (Si)	mg/L	2.83	2.21	2.24	3.34	9.10	3.46	2.44	2.62	2.51	2.18	2.30
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000066	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	8.2	8.0	8.5	7.3	4.5	7.4	11.4	10.3	12.0	11.3	11.9
Strontium (Sr)	mg/L	0.149	0.139	0.158	0.136	0.121	0.157	0.213	0.190	0.196	0.194	0.199
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	0.000016	0.000073	0.000022	0.000015	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.017	<0.010	<0.010	0.027	0.114	0.031	0.013	0.011	0.011	0.010	0.013
Uranium (U)	mg/L	0.000512	0.000494	0.000522	0.000504	0.000391	0.000489	0.000565	0.000554	0.000586	0.000609	0.000604
Vanadium (V)	mg/L	0.0013	<0.0010	<0.0010	0.0024	0.0082	0.0033	0.0012	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0055	<0.0030	0.0062	0.0043	0.0235	0.0069	0.0035	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals												
Aluminum (Al)	mg/L	0.0050	0.0069	0.0037	0.0099	0.0221	0.0265	0.0079	0.0032	0.0032	0.0042	0.0034
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00011	0.00011	0.00012	0.00012	0.00013	0.00012	0.00013	0.00015	0.00012	0.00010	<0.00010
Barium (Ba)	mg/L	0.170	0.192	0.196	0.187	0.0927	0.122	0.189	0.223	0.232	0.210	0.216
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000011	0.000024	<0.000010	0.000013	0.000012	0.000011	<0.000010	0.000012	<0.000010	0.000011
Calcium (Ca)	mg/L	49.2	51.0	55.5	50.4	26.5	32.2	46.9	54.5	57.9	56.2	58.9
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00042	0.00012	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00052	0.00065	0.00077	0.00053	0.00064	0.00117	0.00099	0.00066	<0.00050	0.00091	0.00079
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.058	0.040	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00400	0.00434	0.00435	0.00430	0.00235	0.00591	0.00864	0.00692	0.00563	0.00525	0.00567
Magnesium (Mg)	mg/L	13.4	13.5	14.7	14.0	7.58	11.0	14.6	14.9	17.5	17.2	16.3
Manganese (Mn)	mg/L	0.000803	0.000892	0.00118	0.00119	0.00480	0.00528	0.00305	0.00171	0.00100	0.00157	0.00139
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000398	0.000402	0.000426	0.000391	0.000320	0.000495	0.000546	0.000639	0.000451	0.000441	0.000452
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00051	0.00096	0.00093	0.00066	0.00053	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.513	0.543	0.522	0.558	0.398	0.549	0.646	0.682	0.578	0.588	0.572
Selenium (Se)	mg/L	0.00093	0.00089	0.00103	0.00088	0.00075	0.00308	0.00306	0.00176	0.00212	0.00198	0.00208
Silicon (Si)	mg/L	2.02	2.05	2.00	1.94	1.62	1.79	1.85	2.19	2.00	1.98	2.02
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	8.5	9.0	9.1	8.1	3.5	8.7	12.8	11.4	12.5	12.8	12.7
Strontium (Sr)	mg/L	0.146	0.139	0.156	0.138	0.0877	0.162	0.226	0.197	0.195	0.195	0.189
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000460	0.000402	0.000494	0.000492	0.000182	0.000447	0.000546	0.000511	0.000506	0.000504	0.000520
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-06 - 2012			M20-04 - 2010						
Month Sampled		October	November	December	May	June	June	July	August	October	December
Date Sampled		22-Oct-12	27-Nov-12	18-Dec-12	31-May-10	14-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L1228768-8	L1243937-10	L1251738-7	L892473-4	L897909-7	L897909-8	L915316-6	L921658-5	R010261-08	R012173-11
Physical Tests											
Colour, True	CU	6.5	5.4	<5.0	26.9	18.2	18.5	8.3	9.7	-	-
Conductivity	µS/cm	436	399	415	228	243	243	396	410	-	407
Hardness (as $CaCO_3$)	mg/L	217	202	214	102	117	114	179	184	212	221
pH	pH	8.32	8.24	8.35	8.00	7.68	7.99	8.51	8.40	7.93	8.25
Total Suspended Solids	mg/L	11.0	9.3	6.2	113	57.9	41.9	6.0	5.3	32	40
Total Dissolved Solids	mg/L	-	-	-	187	179	192	240	260	260	238
Turbidity	NTU	32.5	26.2	20.9	170	84.7	86.6	8.47	4.91	-	86
Anions and Nutrients											
Acidity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	4.5	2.5	2.3	<1.0	<1.0	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	170	171	170	96.5	115	103	148	165	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	3.2	<2.0	<1.0	<1.0	<1.0	<1.0	7.2	8.3	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	173	171	170	96.5	115	103	156	173	-	164
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	0.04
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	1.13	0.90	0.94	<0.50	<0.50	<0.50	<0.50	0.53	-	2.07
Fluoride (F)	mg/L	0.128	0.109	0.114	0.067	0.075	0.073	0.110	0.113	-	<0.10
Nitrate (as N)	mg/L	0.0186	0.102	0.118	0.0883	0.0703	0.0700	<0.0050	<0.0050	-	0.02
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	0.0012	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	0.061	0.113	0.156	0.475	0.206	0.199	0.150	0.120	-	0.2
Total Nitrogen	mg/L	0.080	-	0.202	0.563	0.278	0.270	0.150	0.120	-	-
Orthophosphate (as P)-Dissolved	mg/L	0.0025	0.0049	0.0051	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	0.0031	0.0065	0.0072	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.0289	0.0268	0.0215	0.140	0.0819	0.0754	0.0109	0.0107	-	<0.010
Sulphate (SO_4)	mg/L	80.1	63.3	61.1	29.3	35.7	35.6	51.6	51.0	-	49.4
Cyanides											
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	-	-	-	0.0013	<0.0010	-	<0.002
Cyanide, Total	mg/L	0.0031	<0.0010	<0.0010	0.0089	0.0049	0.0052	0.0024	0.0028	-	<0.01
Organic Carbon											
Total Organic Carbon	mg/L	3.54	2.89	2.79	8.10	5.37	4.86	3.27	3.00	-	3.4
Total Metals											
Aluminum (Al)	mg/L	1.03	0.994	0.581	4.20	2.42	2.41	0.208	0.0900	1.75	3.99
Antimony (Sb)	mg/L	0.00014	0.00012	<0.00010	0.00024	0.00014	0.00014	0.00012	0.00015	0.0002	<0.0010
Arsenic (As)	mg/L	0.00048	0.00047	0.00030	0.00138	0.00065	0.00069	0.00022	0.00025	0.0008	<0.0050
Barium (Ba)	mg/L	0.184	0.185	0.183	0.186	0.155	0.158	0.156	0.164	0.191	0.231
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.013	0.011	0.010	0.017	0.013	0.012	0.017	0.017	0.022	<0.040
Cadmium (Cd)	mg/L	0.000060	0.000042	0.000030	0.000196	0.000096	0.000096	0.000024	0.000020	0.00006	<0.00010
Calcium (Ca)	mg/L	57.9	56.0	56.6	37.8	36.6	36.3	49.1	48.6	55.1	54.7
Chromium (Cr)	mg/L	0.00161	0.00154	0.00093	0.00714	0.00383	0.00393	<0.00050	0.00028	0.0035	0.0062
Cobalt (Co)	mg/L	0.00063	0.00035	0.00022	0.00200	0.00096	0.00096	0.00017	<0.00010	0.00071	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-06 - 2012			M20-04 - 2010						
Month Sampled		October	November	December	May	June	June	July	August	October	December
Date Sampled		22-Oct-12	27-Nov-12	18-Dec-12	31-May-10	14-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L1228768-8	L1243937-10	L1251738-7	L892473-4	L897909-7	L897909-8	L915316-6	L921658-5	R010261-08	R012173-11
Total Metals (*cont'd*)											
Copper (Cu)	mg/L	0.00188	0.00205	0.00170	0.00618	0.00323	0.00323	0.00120	0.00105	0.0027	0.0033
Iron (Fe)	mg/L	0.941	0.777	0.491	4.24	2.06	2.15	0.219	0.063	1.38	2.25
Lead (Pb)	mg/L	0.000477	0.000386	0.000230	0.00240	0.00107	0.00109	0.000138	<0.000050	0.0007	0.0011
Lithium (Li)	mg/L	0.0110	0.00970	0.0103	0.0083	0.0069	0.0071	0.0098	0.0113	0.009	0.0128
Magnesium (Mg)	mg/L	17.0	16.3	15.1	11.1	12.1	11.9	13.4	15.1	18	20.4
Manganese (Mn)	mg/L	0.0157	0.0112	0.00696	0.0737	0.0358	0.0360	0.00526	0.00243	0.0199	0.0319
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Molybdenum (Mo)	mg/L	0.000719	0.000645	0.000669	0.000651	0.000583	0.000607	0.000686	0.000888	0.0007	<0.0010
Nickel (Ni)	mg/L	0.00366	0.00217	0.00157	0.00819	0.00425	0.00442	0.00129	0.00108	0.0046	0.0056
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.956	0.900	0.773	2.00	1.36	1.40	0.791	0.867	-	-
Selenium (Se)	mg/L	0.00178	0.00153	0.00144	0.00144	0.00125	0.00134	0.00076	0.00092	0.0025	0.0036
Silicon (Si)	mg/L	4.84	4.29	3.39	14.4	5.37	6.11	2.20	2.22	-	-
Silver (Ag)	mg/L	0.000012	0.000011	0.000015	0.000059	0.000029	0.000035	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	13.3	12.5	13.2	5.2	6.7	6.7	11.2	11.8	14.2	12.4
Strontium (Sr)	mg/L	0.205	0.191	0.192	0.116	0.122	0.122	0.157	0.177	-	-
Thallium (Tl)	mg/L	0.000028	0.000025	0.000013	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00005	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	0.047	0.038	0.028	0.196	0.039	0.050	<0.010	<0.010	0.057	0.124
Uranium (U)	mg/L	0.000683	0.000638	0.000604	0.000538	0.000457	0.000469	0.000558	0.000635	0.00061	0.00068
Vanadium (V)	mg/L	0.0037	0.0036	0.0023	0.0160	0.0085	0.0089	<0.0010	<0.0010	0.006	<0.0100
Zinc (Zn)	mg/L	0.0087	0.0052	0.0039	0.0215	0.0097	0.0100	0.0022	0.0012	0.01	0.017
Dissolved Metals											
Aluminum (Al)	mg/L	0.0299	0.0232	0.0188	0.129	0.0812	0.0667	0.0074	0.0052	0.014	0.063
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00015	<0.0001	<0.001
Arsenic (As)	mg/L	0.00016	0.00017	0.00017	0.00017	0.00015	0.00014	0.00021	0.00023	0.0006	<0.005
Barium (Ba)	mg/L	0.175	0.165	0.172	0.0897	0.109	0.110	0.160	0.166	0.163	0.181
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.011	<0.010	<0.010	0.010	<0.010	<0.010	0.015	0.016	0.01	<0.04
Cadmium (Cd)	mg/L	0.000019	<0.000010	0.000013	0.000014	0.000011	0.000011	0.000015	0.000016	<0.00001	<0.0001
Calcium (Ca)	mg/L	58.6	53.7	59.7	27.6	30.6	30.0	50.2	48.8	49.9	50.9
Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00833	0.00030	0.00028	0.00024	<0.00050	<0.00010	<0.0005	<0.005
Cobalt (Co)	mg/L	0.00022	<0.00010	<0.00010	0.00016	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.0005
Copper (Cu)	mg/L	0.00073	0.00110	0.00174	0.00140	0.00107	0.00112	0.00115	0.00086	0.0013	0.0088
Iron (Fe)	mg/L	<0.030	<0.030	0.238	0.111	0.055	0.050	<0.030	<0.030	0.058	2.05
Lead (Pb)	mg/L	<0.000050	<0.000050	0.000064	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	0.0106	0.00896	0.00951	<0.0050	0.0051	<0.0050	0.0097	0.0113	0.008	0.0091
Magnesium (Mg)	mg/L	17.1	16.4	15.9	7.92	9.84	9.52	13.0	15.1	16	16.8
Manganese (Mn)	mg/L	0.00273	0.00151	0.00276	0.00679	0.00411	0.00382	0.000148	0.000383	0.0014	0.0217
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Molybdenum (Mo)	mg/L	0.000616	0.000567	0.00378	0.000355	0.000413	0.000453	0.000726	0.000881	0.0006	<0.001

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-06 - 2012			M20-04 - 2010						
Month Sampled		October	November	December	May	June	June	July	August	October	December
Date Sampled		22-Oct-12	27-Nov-12	18-Dec-12	31-May-10	14-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L1228768-8	L1243937-10	L1251738-7	L892473-4	L897909-7	L897909-8	L915316-6	L921658-5	R010261-08	R012173-11
Dissolved Metals (*cont'd*)											
Nickel (Ni)	mg/L	0.00224	0.00101	0.00139	0.00133	0.00103	0.00100	0.00076	0.00077	0.002	0.0051
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.637	0.600	0.632	0.459	0.501	0.487	0.742	0.853	-	-
Selenium (Se)	mg/L	0.00178	0.00158	0.00168	0.00119	-	0.00166	0.00111	0.00088	0.002	<0.003
Silicon (Si)	mg/L	2.11	1.97	2.13	2.03	1.95	1.90	1.85	2.02	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Sodium (Na)	mg/L	13.9	13.6	15.2	5.3	6.6	6.5	11.5	12.0	11.8	12.4
Strontium (Sr)	mg/L	0.205	0.188	0.181	0.0997	0.115	0.114	0.162	0.180	0.184	0.174
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000549	0.000493	0.000572	0.000281	0.000343	0.000343	0.000553	0.000639	0.00055	0.00053
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01
Zinc (Zn)	mg/L	0.0061	<0.0030	0.0035	0.0011	<0.0010	0.0010	<0.0010	<0.0010	0.0029	0.119

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010 samples which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-04 - 2010							M20-04 - 2011															
Month Sampled		May	June	June	July	August	October	December	January	January	February	March	April	May	May	May	May	June	June	July	July	August	September	October	November
Date Sampled		31-May-10	14-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Oct-10	7-Dec-10	5-Jan-11	5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	11-May-11	11-May-11	18-May-11	25-May-11	2-Jun-11	8-Jun-11	19-Jul-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L892473-4	L897909-7	L897909-8	L915316-6	L921658-5	R010261-08	R012173-11	R101042-09	R101042-10	L981301-8	L990825-9	L999009-4	L1004821-5	L1004821-6	L1006884-6	L1009390-5	L1012487-3	L1015493-5	L1034422-12	L1034422-13	L1049771-8	L1064458-12	L1073725-10	L1091894-7
Physical Tests																								
Colour, True	CU	26.9	18.2	18.5	8.3	9.7	-	-	6	7	<5.0	<5.0	11.1	36.2	35.9	45.2	39.9	27.3	22.4	24.5	25.5	10.2	7.3	7.1	12.5
Conductivity	µS/cm	228	243	243	396	410	-	407	392	395	419	432	381	233	233	182	196	188	200	287	290	389	430	421	358
Hardness (as $CaCO_3$)	mg/L	102	117	114	179	184	212	221	179	181	197	189	184	115	115	84.2	90.9	88.8	96.8	136	137	182	207	193	180
pH	pH	8.00	7.68	7.99	8.51	8.40	7.93	8.25	8.26	8.27	8.32	8.20	8.26	8.14	8.13	8.08	8.17	8.17	8.19	8.26	8.26	8.41	8.44	8.30	8.34
Total Suspended Solids	mg/L	113	57.9	41.9	6.0	5.3	32	40	43	48	11.6	12.5	115	1020	983	779	364	365	225	52.5	60.5	11.3	6.7	<1.0	<1.0
Total Dissolved Solids	mg/L	187	179	192	240	260	260	238	251	252	-	275	-	182	181	-	134	-	145	-	-	-	-	4.0	3.3
Turbidity	NTU	170	84.7	86.6	8.47	4.91	-	86	110	110	29.7	30.2	140	734	761	590	295	340	229	105	105	33.8	34.0	26.3	42.9
Anions and Nutrients																									
Acidity (as $CaCO_3$)	mg/L	4.5	2.5	2.3	<1.0	<1.0	-	-	<2	<2	<1.0	3.4	1.6	<1.0	2.0	2.7	2.2	1.6	3.3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	96.5	115	103	148	165	-	-	176	175	179	169	157	112	113	80.2	82.5	75.3	81.3	122	118	156	165	166	151
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	7.2	8.3	-	-	<1.0	<1.0	1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	8.0	5.2	7.4	2.1
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	<1.0	<1.0	<1.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	96.5	115	103	156	173	-	164	176	175	181	169	157	112	113	80.2	82.5	75.3	81.3	122	118	164	170	174	154
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	0.04	<0.02	<0.02	<0.0050	0.0054	0.0120	0.0165	0.0252	0.0202	0.0147	0.0112	0.0140	0.0099	0.0058	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10	<0.10	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	0.53	-	2.07	1.97	1.98	1.71	1.46	2.82	1.08	1.09	1.14	1.10	0.55	0.67	0.90	0.90	1.26	1.14	1.21	1.10
Fluoride (F)	mg/L	0.067	0.075	0.073	0.110	0.113	-	<0.10	0.11	0.12	0.104	0.167	0.151	0.073	0.073	0.068	0.085	0.069	0.068	0.092	0.092	0.124	0.123	0.123	0.115
Nitrate (as N)	mg/L	0.0883	0.0703	0.0700	<0.0050	<0.0050	-	0.02	0.12	0.12	0.126	0.128	0.0977	0.153	0.153	0.0817	0.0586	0.0539	0.0502	0.0202	0.0192	<0.0050	<0.0050	0.0082	0.0700
Nitrite (as N)	mg/L	<0.0010	0.0017	0.0012	<0.0010	<0.0010	-	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.475	0.206	0.199	0.150	0.120	-	0.2	0.27	0.22	0.075	0.082	0.332	1.43	1.13	1.08	0.681	0.616	0.490	0.455	0.441	0.180	<0.050	0.122	<0.050
Total Nitrogen	mg/L	0.563	0.278	0.270	0.150	0.120	-	-	-	-	0.200	0.210	0.430	1.58	1.28	1.17	0.740	0.670	0.540	0.475	0.460	0.180	<0.050	0.130	0.110
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-	-	-	0.0062	0.0048	0.0041	0.0026	0.0028	0.0034	0.0019	0.0029	0.0025	0.0014	0.0014	0.0023	0.0032	0.0065	0.0036
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-	-	-	0.0068	0.0058	0.0056	0.0060	0.0069	0.0087	0.0071	0.0049	0.0050	0.0026	0.0033	0.0038	0.0043	0.0077	0.0073
Phosphorus-Total	mg/L	0.140	0.0819	0.0754	0.0109	0.0107	-	<0.010	0.08	0.08	0.0330	0.0297	0.185	0.468	0.518	0.529	0.449	0.405	0.225	0.091	0.091	0.0313	0.0322	0.0281	0.0369
Sulphate (SO_4)	mg/L	29.3	35.7	35.6	51.6	51.0	-	49.4	48.7	49.4	48.6	66.8	51.6	17.9	18.0	17.0	22.1	23.4	25.3	38.8	38.7	45.6	60.8	53.9	45.8
Cyanides																									
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	0.0013	<0.0010	-	<0.002	<0.002	<0.002	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	0.0068	<0.0010	<0.0020	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	0.0089	0.0049	0.0052	0.0024	0.0028	-	<0.01	<0.01	<0.01	0.0023	0.0020	0.0049	<0.0020	<0.0020	0.0171	0.0127	0.0097	0.0053	0.0039	0.0086	0.0034	0.0036	<0.0020	0.0065
Organic Carbon																									
Total Organic Carbon	mg/L	8.10	5.37	4.86	3.27	3.00	-	3.4	2.8	2.8	2.87	2.38	7.27	27.6	26.5	18.8	17.8	13.3	11.8	8.90	8.97	4.15	3.24	3.18	4.72
Total Metals																									
Aluminum (Al)	mg/L	4.20	2.42	2.41	0.208	0.0900	1.75	3.99	4.78	3.92	1.18	1.19	2.87	13.7	14.1	10.7	8.19	6.57	4.18	2.46	2.29	1.06	0.892	0.779	1.18
Antimony (Sb)	mg/L	0.00024	0.00014	0.00014	0.00012	0.00015	0.0002	<0.0010	<0.0010	<0.0010	0.00011	<0.00010	0.00017	0.00045	0.00049	0.00039	0.00030	0.00029	0.00020	0.00017	0.00018	0.00015	0.00013	0.00011	0.00011
Arsenic (As)	mg/L	0.00138	0.00065	0.00069	0.00022	0.00025	0.0008	<0.0050	<0.0050	<0.0050	0.00045	0.00039	0.00117	0.00582	0.00635	0.00639	0.00320	0.00293	0.00181	0.00098	0.00094	0.00040	0.00039	0.00035	0.00047
Barium (Ba)	mg/L	0.186	0.155	0.158	0.156	0.164	0.191	0.231	0.235	0.235	0.191	0.180	0.201	0.514	0.568	0.569	0.274	0.263	0.200	0.174	0.174	0.170	0.179	0.164	0.152
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	0.00071	0.00076	0.00070	<0.00050	<0.00050	<0.00050	0.00013	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.017	0.013	0.012	0.017	0.017	0.022	<0.040	<0.040	<0.040	0.016	0.016	0.017	0.028	0.029	0.024	0.019	0.017	0.015	0.017	0.017	0.014	0.015	0.014	0.013
Cadmium (Cd)	mg/L	0.000196	0.000096	0.000096	0.000024	0.000020	0.00006	<0.00010	<0.00010	<0.00010	0.000053	0.000104	0.000260	0.000825	0.000895	0.000684	0.000398	0.000355	0.000244	0.000124	0.000126	0.000041	0.000046	0.000040	0.000062
Calcium (Ca)	mg/L	37.8	36.6	36.3	49.1	48.6	55.1	54.7	42.3	42.6	53.0	50.1	56.2	81.7	83.2	49.0	42.1	40.0	35.2	40.3	40.9	49.0	56.8	51.5	49.1
Chromium (Cr)	mg/L	0.00714	0.00383	0.00393	<0.00050	0.00028	0.0035	0.0062	0.0074	0.0069	0.00184	0.00169	0.00419	0.0182	0.0205	0.0173	0.00950	0.0101	0.00655	0.00412	0.00373	0.00175	0.00155	0.00132	0.00174
Cobalt (Co)	mg/L	0.00200	0.00096	0.00096	0.00017	<0.00010	0.00071	<0.00050	0.00111	0.00098	0.00041	0.00150	0.00288	0.00778	0.00854	0.00750	0.00400	0.00359	0.00217	0.00115	0.00115	0.00034	0.00045	0.00030	0.00072
Copper (Cu)	mg/L	0.00618	0.00323	0.00323	0.00120	0.00105	0.0027	0.0033	0.0039	0.0031	0.00163	0.00261	0.00676	0.0204	0.0219	0.0213	0.0115	0.0108	0.00686	0.00384	0.00376	0.00759	0.00169	0.00133	0.00203
Iron (Fe)	mg/L	4.24	2.06	2.15	0.219	0.063	1.38	2.25	2.47	2.35	0.911	0.744	3.30	17.9	19.9	18.5	9.40	8.93	5.41	2.59	2.54	0.767	0.712	0.542	0.984
Lead (Pb)	mg/L	0.00240	0.00107	0.00109	0.000138	<0.000050	0.0007	0.0011	0.0013	0.0011	0.000446	0.000369	0.00178	0.0105	0.0115	0.00985	0.00509	0.00460	0.00256	0.00128	0.00129	0.000957	0.000367	0.000270	0.000447
Lithium (Li)	mg/L	0.0083	0.0069	0.0071	0.0098	0.0113	0.009	0.0128	0.0122	0.0115	0.0109	0.0159	0.0169	0.0169	0.0184	0.0149	0.0103	0.0099	0.0075	0.00820	0.00835	0.00927	0.00980	0.00954	0.00819
Magnesium (Mg)	mg/L	11.1	12.1	11.9	13.4	15.1	18	20.4	17.9	18	14.8	16.4	15.9	20.0	20.4	15.9	11.9	12.0	10.5	12.7	13.0	13.5	16.2	15.2	14.0
Manganese (Mn)	mg/L	0.0737	0.0358	0.0360	0.00526	0.00243	0.0199	0.0319	0.0443	0.0424	0.0146	0.0236	0.0754	0.341	0.367	0.292	0.165	0.135	0.0891	0.0450	0.0452	0.0118	0.0127	0.00938	0.0170
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050	<0.00020	<0.00020	<0.000010	<0.000010	<0.000010	0.000044	0.000042	0.000042	0.000021	0.000019	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-04 - 2010							M20-04 - 2011															
Month Sampled		May	June	June	July	August	October	December	January	January	February	March	April	May	May	May	May	June	June	July	July	August	September	October	November
Date Sampled		31-May-10	14-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	16-Oct-10	7-Dec-10	5-Jan-11	5-Jan-11	23-Feb-11	29-Mar-11	26-Apr-11	11-May-11	11-May-11	18-May-11	25-May-11	2-Jun-11	8-Jun-11	19-Jul-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	L892473-4	L897909-7	L897909-8	L915316-6	L921658-5	R010261-08	R012173-11	R101042-09	R101042-10	L981301-8	L990825-9	L999009-4	L1004821-5	L1004821-6	L1006884-6	L1009390-5	L1012487-3	L1015493-5	L1034422-12	L1034422-13	L1049771-8	L1064458-12	L1073725-10	L1091894-7
Total Metals (*cont'd*)																								
Molybdenum (Mo)	mg/L	0.000651	0.000583	0.000607	0.000686	0.000888	0.0007	<0.0010	<0.0010	<0.0010	0.000768	0.000715	0.000690	0.00142	0.00153	0.00125	0.000840	0.000906	0.000653	0.000598	0.000587	0.000681	0.000721	0.000680	0.000578
Nickel (Ni)	mg/L	0.00819	0.00425	0.00442	0.00129	0.00108	0.0046	0.0056	0.0054	0.0046	0.00229	0.00725	0.0127	0.0275	0.0301	0.0275	0.0164	0.0148	0.00918	0.00551	0.00558	0.00229	0.00280	0.00191	0.00387
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-	<0.20	<0.20	<0.30	<0.30	<0.30	0.86	0.91	0.83	0.42	0.36	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	2.00	1.36	1.40	0.791	0.867	-	-	2.26	1.82	1.01	0.965	1.68	4.10	4.63	3.97	2.59	2.80	1.79	1.40	1.35	1.04	1.02	0.970	1.01
Selenium (Se)	mg/L	0.00144	0.00125	0.00134	0.00076	0.00092	0.0025	0.0036	<0.0050	<0.0050	0.00110	0.00102	0.00093	0.00091	0.00096	0.00112	0.00099	0.00111	0.00117	0.00151	0.00151	0.00098	0.00101	0.00088	0.00082
Silicon (Si)	mg/L	14.4	5.37	6.11	2.20	2.22	-	-	13	9.1	5.80	4.25	7.27	32.6	39.0	22.7	19.8	12.2	14.5	5.56	5.58	4.26	3.72	3.46	5.25
Silver (Ag)	mg/L	0.000059	0.000029	0.000035	<0.000010	<0.000010	<0.00005	<0.00050	<0.00050	<0.00050	0.000016	0.000013	0.000041	0.000221	0.000245	0.000271	0.000133	0.000127	0.000067	0.000035	0.000033	<0.000010	0.000013	<0.000010	0.000013
Sodium (Na)	mg/L	5.2	6.7	6.7	11.2	11.8	14.2	12.4	12.9	13	14.1	14.3	9.2	3.8	3.9	3.7	3.5	4.0	3.9	5.6	5.7	8.9	11.5	11.6	8.7
Strontium (Sr)	mg/L	0.116	0.122	0.122	0.157	0.177	-	-	0.2	0.2	0.172	0.180	0.163	0.152	0.157	0.128	0.109	0.113	0.108	0.145	0.147	0.170	0.193	0.170	0.152
Thallium (Tl)	mg/L	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00005	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	0.00033	0.00037	0.00030	0.00018	0.00017	0.00011	0.000062	0.000064	0.000028	0.000025	0.000020	0.000033
Tin (Sn)	mg/L	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	-	-	<0.0020	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00045	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.196	0.039	0.050	<0.010	<0.010	0.057	0.124	0.158	0.092	0.067	0.034	0.166	0.407	0.500	0.221	0.248	0.105	0.188	0.042	0.043	0.037	0.024	0.022	0.053
Uranium (U)	mg/L	0.000538	0.000457	0.000469	0.000558	0.000635	0.00061	0.00068	0.00073	0.00066	0.000651	0.000665	0.000654	0.00108	0.00112	0.000987	0.000617	0.000556	0.000427	0.000443	0.000448	0.000538	0.000552	0.000583	0.000489
Vanadium (V)	mg/L	0.0160	0.0085	0.0089	<0.0010	<0.0010	0.006	<0.0100	0.016	0.013	0.0042	0.0034	0.0100	0.0420	0.0473	0.0378	0.0218	0.0235	0.0155	0.0091	0.0085	0.0039	0.0033	0.0028	0.0044
Zinc (Zn)	mg/L	0.0215	0.0097	0.0100	0.0022	0.0012	0.01	0.017	<0.040	<0.040	0.0056	0.0192	0.0343	0.0848	0.0916	0.0912	0.0470	0.0392	0.0276	0.0168	0.0157	0.0046	0.0065	0.0053	0.0094
Dissolved Metals																									
Aluminum (Al)	mg/L	0.129	0.0812	0.0667	0.0074	0.0052	0.014	0.063	<0.05	<0.05	0.0136	0.120	0.0919	0.128	0.0363	0.259	0.127	0.106	0.0671	0.0392	0.0376	0.0113	0.0183	0.0106	0.0232
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00013	0.00015	<0.0001	<0.001	<0.001	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00017	0.00015	0.00014	0.00021	0.00023	0.0006	<0.005	<0.005	<0.005	0.00020	0.00017	0.00015	0.00020	0.00021	0.00027	0.00021	0.00021	0.00015	0.00016	0.00017	0.00019	0.00019	0.00019	0.00017
Barium (Ba)	mg/L	0.0897	0.109	0.110	0.160	0.166	0.163	0.181	0.179	0.179	0.170	0.166	0.131	0.0819	0.0943	0.0617	0.0705	0.0669	0.0772	0.118	0.120	0.159	0.167	0.157	0.143
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001	<0.001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	<0.001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.010	<0.010	<0.010	0.015	0.016	0.01	<0.04	<0.04	<0.04	<0.010	0.014	0.011	0.010	0.013	<0.010	<0.010	<0.010	<0.010	0.010	0.010	0.012	0.010	0.010	<0.010
Cadmium (Cd)	mg/L	0.000014	0.000011	0.000011	0.000015	0.000016	<0.00001	<0.0001	<0.0001	<0.0001	<0.000010	0.000071	0.000058	0.000019	0.000016	0.000030	0.000024	0.000019	0.000017	0.000012	0.000122	0.000011	0.000017	0.000011	0.000025
Calcium (Ca)	mg/L	27.6	30.6	30.0	50.2	48.8	49.9	50.9	27.2	27.7	53.7	48.9	49.8	32.6	33.2	22.1	24.8	23.6	25.8	35.4	35.8	49.8	56.3	52.2	48.9
Chromium (Cr)	mg/L	0.00030	0.00028	0.00024	<0.00050	<0.00010	<0.0005	<0.005	<0.005	<0.005	<0.00010	<0.00010	<0.00010	0.00034	0.00028	0.00055	0.00032	0.00027	0.00024	0.00015	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	0.00016	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.0005	<0.0005	<0.0005	<0.00010	0.00113	0.00116	0.00017	0.00014	0.00022	0.00024	0.00011	0.00011	0.00012	0.00013	<0.00010	0.00014	<0.00010	0.00032
Copper (Cu)	mg/L	0.00140	0.00107	0.00112	0.00115	0.00086	0.0013	0.0088	<0.002	<0.002	0.00073	0.00115	0.00189	0.00229	0.00212	0.00283	0.00185	0.00170	0.00174	0.00161	0.00162	0.00141	0.00098	0.00090	0.00091
Iron (Fe)	mg/L	0.111	0.055	0.050	<0.030	<0.030	0.058	2.05	<0.1	<0.1	<0.030	<0.030	<0.030	0.104	0.102	0.229	0.128	0.099	0.076	0.046	0.043	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	<0.0001	<0.001	<0.001	<0.001	<0.000050	<0.000050	<0.000050	0.000127	<0.000050	0.000172	0.000117	0.000069	0.000076	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	0.0051	<0.0050	0.0097	0.0113	0.008	0.0091	0.0072	0.007	0.0101	0.0156	0.0136	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00611	0.00604	0.00926	0.00936	0.00905	0.00773
Magnesium (Mg)	mg/L	7.92	9.84	9.52	13.0	15.1	16	16.8	15.9	16.1	15.2	16.3	14.5	8.08	7.84	7.02	7.03	7.24	7.88	11.5	11.5	14.1	16.2	15.2	14.0
Manganese (Mn)	mg/L	0.00679	0.00411	0.00382	0.000148	0.000383	0.0014	0.0217	<0.002	<0.002	0.000672	0.0123	0.0151	0.00753	0.00557	0.0118	0.00987	0.00865	0.00624	0.00415	0.00401	0.00101	0.00197	0.00187	0.00463
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005	<0.0002	<0.0002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000355	0.000413	0.000453	0.000726	0.000881	0.0006	<0.001	<0.001	<0.001	0.000694	0.000682	0.000465	0.000311	0.000350	0.000280	0.000304	0.000338	0.000330	0.000393	0.000389	0.000623	0.000636	0.000665	0.000485
Nickel (Ni)	mg/L	0.00133	0.00103	0.00100	0.00076	0.00077	0.002	0.0051	<0.002	<0.002	0.00095	0.00589	0.00662	0.00170	0.00151	0.00209	0.00244	0.00143	0.00138	0.00165	0.00169	0.00113	0.00154	0.00102	0.00226
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-	<0.2	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.459	0.501	0.487	0.742	0.853	-	-	0.509	0.502	0.592	0.617	0.689	0.589	0.564	0.630	0.539	0.493	0.442	0.505	0.508	0.714	0.715	0.712	0.600
Selenium (Se)	mg/L	0.00119	-	0.00166	0.00111	0.00088	0.002	<0.003	<0.005	<0.005	0.00116	0.00108	0.00085	0.00051	0.00050	0.00071	0.00091	0.00119	0.00121	0.00146	0.00150	0.00117	0.00117	0.00104	0.00093
Silicon (Si)	mg/L	2.03	1.95	1.90	1.85	2.02	-	-	<5	<5	2.20	2.08	2.15	2.08	2.00	2.29	2.09	1.90	1.91	1.99	2.00	2.01	2.10	1.96	1.97
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005	<0.005	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	5.3	6.6	6.5	11.5	12.0	11.8	12.4	11	11.2	14.2	14.4	9.9	6.0	3.4	6.1	4.9	5.0	6.1	7.3	7.3	11.0	11.9	12.1	8.8
Strontium (Sr)	mg/L	0.0997	0.115	0.114	0.162	0.180	0.184	0.174	0.169	0.171	0.170	0.177	0.151	0.0848	0.0849	0.0747	0.0814	0.0848	0.0968	0.140	0.142	0.174	0.193	0.178	0.152
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002	<0.0002	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	<0.002	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05	<0.05	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000281	0.000343	0.000343	0.000553	0.000639	0.00055	0.00053	0.00037	0.0004	0.000555	0.000636	0.000500	0.000217	0.000268	0.000122	0.000216	0.000209	0.000214	0.000337	0.000341	0.000466	0.000522	0.000585	0.000461
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0011	<0.0010	0.0010	<0.0010	<0.0010	0.0029	0.119	<0.04	<0.04	<0.0030	0.0088	0.0090	0.0060	<0.0030	0.0081	0.0060	0.0033	0.0049	0.0048	0.0047	0.0041	<0.0030	<0.0030	0.0034

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010, and January 2011 sample which were analyzed by CARO Analytical Services

< = less than the detection limited indicated

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-04 - 2012															
Month Sampled		January	February	March	April	May	May	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-10	L1117841-17	L1127031-8	L1137305-8	L1148502-8	L1154387-5	L1157872-5	L1162268-5	L1166580-3	L1169751-8	L1174000-3	L1184612-8	L1197851-3	L1228768-7	L1243937-8	L1251738-6
Physical Tests																	
Colour, True	CU	9.3	7.3	6.5	10.5	26.6	30.8	22.6	27.0	23.8	18.0	13.3	9.9	7.4	6.4	5.3	<5.0
Conductivity	µS/cm	356	380	390	366	205	171	193	187	200	260	286	357	387	433	403	413
Hardness (as $CaCO_3$)	mg/L	171	175	189	178	103	77.4	85.5	89.4	102	116	136	170	197	211	201	197
pH	pH	8.28	8.36	8.33	8.31	8.21	8.20	8.30	8.16	8.17	8.26	8.33	8.43	8.55	8.31	8.26	8.34
Total Suspended Solids	mg/L	28.0	4.7	3.3	18.0	1140	474	186	115	141	64.6	759	22.4	5.5	9.2	6.0	19.5
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	63.4	16.3	15.3	44.1	1050	384	216	169	183	106	1120	52.3	19.2	33.7	27.9	35.3
Anions and Nutrients																	
Acidity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	1.4	2.4	1.5	1.8	3.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	168	170	182	161	96.4	72.2	74.4	79.6	98.3	107	122	159	159	166	169	167
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	7.5	<1.0	3.1	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	10.2	2.7	<2.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	168	177	182	164	96.4	72.2	74.4	79.6	98.3	107	122	159	170	169	169	167
Ammonia (as N)	mg/L	0.0082	0.0060	<0.0050	0.0093	0.0195	0.0099	0.0078	<0.0050	0.0055	0.0168	0.0178	<0.0050	<0.0050	<0.0050	<0.0050	0.0054
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1.58	1.60	2.06	1.74	0.56	<0.50	<0.50	<0.50	<0.50	0.55	<0.50	0.65	0.88	1.14	0.90	0.94
Fluoride (F)	mg/L	0.102	0.110	0.109	0.125	0.078	0.078	0.072	0.074	0.081	0.085	0.100	0.104	0.132	0.128	0.109	0.114
Nitrate (as N)	mg/L	0.0845	0.0843	0.0882	0.0884	0.0520	0.0328	0.0463	0.0493	0.0563	0.0548	0.0724	0.0208	<0.0050	0.0168	0.103	0.116
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.056	0.096	<0.050	0.092	0.358	0.417	0.244	0.281	0.264	0.185	0.688	0.059	0.110	0.123	0.122	0.143
Total Nitrogen	mg/L	0.140	0.180	0.120	0.180	0.410	0.450	0.290	0.330	0.320	0.240	0.760	0.080	0.110	0.140	-	0.202
Orthophosphate (as P)-Dissolved	mg/L	0.0041	0.0061	0.0055	0.0048	0.0030	0.0044	0.0022	0.0032	0.0022	0.0026	0.0025	0.0018	0.0020	0.0029	0.0053	0.0051
Phosphorus-Total Dissolved	mg/L	0.0049	0.0069	0.0081	0.0061	0.0068	0.0071	0.0048	0.0049	0.0050	0.0047	0.0046	0.0040	0.0029	0.0034	0.0058	0.0069
Phosphorus-Total	mg/L	0.0501	0.0209	0.0220	0.0462	1.03	0.350	0.282	0.192	0.183	0.097	0.840	0.0407	0.0156	0.0338	0.0285	0.119
Sulphate (SO_4)	mg/L	32.1	33.0	33.4	36.2	21.0	19.4	25.0	24.8	26.0	37.6	45.5	57.6	56.5	80.4	63.2	61.2
Cyanides																	
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0022	0.0029	0.0025	0.0039	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																	
Total Organic Carbon	mg/L	4.50	3.47	3.42	4.59	11.8	14.7	10.9	9.19	9.43	7.18	25.7	4.28	3.16	3.64	2.91	2.71
Total Metals																	
Aluminum (Al)	mg/L	1.95	0.611	0.754	1.47	10.7	6.28	6.43	4.54	2.43	2.94	10.3	1.51	0.837	1.06	0.930	0.773
Antimony (Sb)	mg/L	0.00012	<0.00010	0.00011	0.00011	0.00047	0.00036	0.00028	0.00026	0.00020	0.00019	0.00050	0.00018	0.00018	0.00012	0.00012	0.00011
Arsenic (As)	mg/L	0.00054	0.00028	0.00031	0.00051	0.00703	0.00406	0.00208	0.00166	0.00119	0.00102	0.00649	0.00064	0.00045	0.00049	0.00045	0.00041
Barium (Ba)	mg/L	0.159	0.155	0.157	0.160	0.506	0.341	0.220	0.178	0.165	0.185	0.419	0.184	0.205	0.187	0.178	0.182
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00071	0.00040	0.00025	0.00021	0.00015	0.00013	0.00074	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.016	0.010	0.012	0.015	0.019	0.017	0.016	0.017	0.015	0.013	0.021	0.022	0.019	0.013	<0.010	0.011
Cadmium (Cd)	mg/L	0.000069	0.000027	<0.000050	0.000086	0.000975	0.000435	0.000241	0.000198	0.000196	0.000127	0.00100	0.000073	0.000039	0.000057	0.000045	0.000049
Calcium (Ca)	mg/L	48.3	49.0	54.9	51.6	77.6	38.2	34.0	31.9	37.2	34.5	84.9	48.5	55.4	59.2	55.0	56.1
Chromium (Cr)	mg/L	0.00321	0.00098	0.00113	0.00226	0.0176	0.0106	0.00929	0.00750	0.00374	0.00467	0.0172	0.00226	0.00139	0.00163	0.00156	0.00129
Cobalt (Co)	mg/L	0.00061	0.00020	0.00021	0.00120	0.00947	0.00466	0.00228	0.00193	0.00157	0.00116	0.00906	0.00063	0.00031	0.00063	0.00032	0.00037
Copper (Cu)	mg/L	0.00217	0.00106	0.00143	0.00257	0.0258	0.0132	0.00711	0.00573	0.00454	0.00367	0.0250	0.00223	0.00175	0.00174	0.00209	0.00242
Iron (Fe)	mg/L	1.43	0.397	0.396	1.09	21.2	11.5	5.81	4.60	3.10	2.71	21.1	1.37	0.570	0.930	0.739	0.795
Lead (Pb)	mg/L	0.000678	0.000194	0.000207	0.000518	0.0121	0.00621	0.00307	0.00242	0.00214	0.00131	0.0109	0.000730	0.000331	0.000472	0.000363	0.000377
Lithium (Li)	mg/L	0.00825	0.00871	0.00980	0.0103	0.0158	0.00992	0.00834	0.00808	0.00707	0.00756	0.0209	0.0114	0.0117	0.0112	0.00931	0.0102
Magnesium (Mg)	mg/L	12.3	13.1	14.7	13.5	22.1	11.1	10.2	9.85	10.4	11.0	24.0	13.6	17.0	17.3	15.9	15.1
Manganese (Mn)	mg/L	0.0201	0.00606	0.00580	0.0260	0.390	0.168	0.0889	0.0717	0.0684	0.0446	0.338	0.0213	0.00983	0.0166	0.0107	0.0133
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000064	0.000034	0.000012	0.000018	0.000012	<0.000010	0.000068	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-04 - 2012															
Month Sampled		January	February	March	April	May	May	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	19-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-10	L1117841-17	L1127031-8	L1137305-8	L1148502-8	L1154387-5	L1157872-5	L1162268-5	L1166580-3	L1169751-8	L1174000-3	L1184612-8	L1197851-3	L1228768-7	L1243937-8	L1251738-6
Total Metals (*cont'd*)																	
Molybdenum (Mo)	mg/L	0.000604	0.000606	0.000652	0.000545	0.00135	0.000937	0.000685	0.000653	0.000552	0.000600	0.00152	0.000737	0.000836	0.000713	0.000657	0.000673
Nickel (Ni)	mg/L	0.00327	0.00174	0.00190	0.00559	0.0339	0.0174	0.0102	0.00798	0.00655	0.00532	0.0338	0.00311	0.00227	0.00376	0.00202	0.00205
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	0.92	0.47	<0.30	<0.30	<0.30	<0.30	0.82	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.20	0.757	0.834	1.09	3.16	2.42	2.44	1.98	1.22	1.52	3.23	1.15	1.13	1.00	0.866	0.848
Selenium (Se)	mg/L	0.00068	0.00066	0.00072	0.00066	0.00132	0.00124	0.00142	0.00147	0.00132	0.00222	0.00264	0.00231	0.00146	0.00170	0.00153	0.00142
Silicon (Si)	mg/L	6.08	3.63	3.63	5.16	22.0	20.9	13.0	14.7	8.11	7.74	45.4	5.26	4.54	5.04	4.18	3.92
Silver (Ag)	mg/L	0.000020	<0.000010	<0.000010	0.000014	0.000298	0.000156	0.000094	0.000068	0.000042	0.000044	0.000249	0.000019	<0.000010	0.000013	0.000015	<0.000010
Sodium (Na)	mg/L	8.0	9.6	10.6	7.8	3.4	3.2	4.3	4.2	4.3	6.2	7.3	10.2	12.8	13.6	12.1	13.0
Strontium (Sr)	mg/L	0.137	0.138	0.162	0.141	0.158	0.105	0.112	0.109	0.138	0.134	0.218	0.204	0.212	0.206	0.184	0.182
Thallium (Tl)	mg/L	0.000049	0.000015	0.000017	0.000033	0.000321	0.000194	0.000124	0.000103	0.000072	0.000069	0.000303	0.000043	0.000021	0.000031	0.000030	0.000017
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00013	0.00013	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.058	0.027	0.025	0.052	0.185	0.237	0.161	0.188	0.098	0.103	0.685	0.053	0.047	0.048	0.036	0.034
Uranium (U)	mg/L	0.000516	0.000496	0.000548	0.000548	0.00114	0.000680	0.000539	0.000508	0.000502	0.000531	0.00131	0.000658	0.000697	0.000705	0.000611	0.000609
Vanadium (V)	mg/L	0.0069	0.0021	0.0026	0.0050	0.0379	0.0231	0.0210	0.0164	0.0084	0.0107	0.0383	0.0052	0.0033	0.0038	0.0033	0.0030
Zinc (Zn)	mg/L	0.0102	0.0043	0.0093	0.0131	0.107	0.0565	0.0299	0.0231	0.0183	0.0139	0.107	0.0083	0.0050	0.0093	0.0050	0.0058
Dissolved Metals																	
Aluminum (Al)	mg/L	0.0248	0.0204	0.0202	0.0688	0.0760	0.155	0.152	0.153	0.0843	0.0485	0.280	0.0200	0.0111	0.0313	0.0249	0.0180
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00013	0.00012	0.00013	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00018	0.00016	0.00020	0.00018	0.00021	0.00022	0.00017	0.00017	0.00016	0.00016	0.00026	0.00019	0.00022	0.00017	0.00014	0.00019
Barium (Ba)	mg/L	0.144	0.146	0.142	0.140	0.0666	0.0575	0.0808	0.0837	0.0945	0.110	0.0975	0.164	0.186	0.173	0.165	0.166
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	0.012	0.013	0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000010	0.000012	0.000029	0.000035	0.000015	0.000022	0.000022	0.000022	0.000018	0.000011	0.000020	0.000013	0.000012	0.000017	<0.000010	<0.000010
Calcium (Ca)	mg/L	46.6	49.0	51.9	49.6	27.8	21.0	22.8	23.7	27.2	30.3	35.6	45.5	53.1	56.5	54.1	53.5
Chromium (Cr)	mg/L	0.00011	<0.00010	0.00011	<0.00010	0.00024	0.00038	0.00039	0.00039	0.00025	0.00014	0.00047	<0.00010	<0.00010	0.00014	0.00011	0.00014
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	0.00066	0.00013	0.00014	0.00012	0.00012	0.00016	<0.00010	0.00032	<0.00010	<0.00010	0.00023	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00093	0.00091	0.00140	0.00179	0.00273	0.00276	0.00111	0.00110	0.00085	0.00151	0.00409	0.00141	0.00093	0.00079	0.00103	0.00101
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.160	0.161	0.119	0.112	0.082	0.044	0.200	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	0.000139	0.000158	0.000075	0.000065	<0.000050	<0.000050	0.000149	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00692	0.00857	0.00918	0.00975	0.00277	0.00289	0.00371	0.00398	0.00463	0.00538	0.00753	0.00850	0.0109	0.0106	0.00893	0.00976
Magnesium (Mg)	mg/L	13.3	12.9	14.3	13.3	8.05	6.08	6.94	7.35	8.23	9.73	11.4	13.7	15.7	16.8	16.0	15.3
Manganese (Mn)	mg/L	0.000943	0.000883	0.00152	0.00952	0.00775	0.00911	0.00536	0.00482	0.00448	0.00387	0.0118	0.00158	0.00161	0.00256	0.00130	0.00144
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000476	0.000534	0.000579	0.000461	0.000339	0.000308	0.000337	0.000340	0.000366	0.000446	0.000531	0.000600	0.000715	0.000608	0.000577	0.000638
Nickel (Ni)	mg/L	0.00113	0.00105	0.00127	0.00375	0.00152	0.00146	0.00142	0.00148	0.00172	0.00119	0.00245	0.00102	0.00117	0.00227	0.00098	0.00094
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.567	0.544	0.641	0.601	0.536	0.497	0.417	0.436	0.433	0.520	0.724	0.683	0.789	0.625	0.600	0.591
Selenium (Se)	mg/L	0.00073	0.00073	0.00082	0.00075	0.00078	0.00088	0.00104	0.00148	0.00149	0.00220	0.00221	0.00235	0.00140	0.00179	0.00163	0.00166
Silicon (Si)	mg/L	2.16	2.09	2.11	2.04	2.28	2.08	1.91	1.96	1.88	1.89	2.37	1.97	1.99	2.09	2.02	2.05
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	8.8	10.1	11.4	8.8	5.7	6.1	4.3	4.1	4.4	7.4	11.5	11.8	12.5	13.8	13.9	14.4
Strontium (Sr)	mg/L	0.138	0.138	0.154	0.137	0.0909	0.0746	0.0911	0.0935	0.119	0.131	0.145	0.191	0.191	0.201	0.187	0.181
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000419	0.000398	0.000455	0.000443	0.000202	0.000106	0.000213	0.000200	0.000264	0.000365	0.000233	0.000525	0.000470	0.000492	0.000525	0.000492
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0047	<0.0030	0.0075	0.0068	0.0060	0.0085	0.0033	0.0031	0.0034	<0.0030	0.0059	<0.0030	<0.0030	0.0052	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M17-02 - 2012			
Month Sampled		July	August	October	December
Date Sampled		24-Jul-12	21-Aug-12	23-Oct-12	17-Dec-12
Lab Sample ID	Units	L1184612-17	L1197851-13	L1228768-16	L1251738-15
Physical Tests					
Colour, True	CU	20.4	18.6	13.6	16.2
Conductivity	µS/cm	794	952	918	530
Hardness (as $CaCO_3$)	mg/L	443	539	525	303
pH	pH	8.49	8.43	8.35	8.30
Total Suspended Solids	mg/L	<3.0	6.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-
Turbidity	NTU	3.15	4.32	1.45	1.24
Anions and Nutrients					
Acidity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	247	261	258	286
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	11.8	13.1	9.6	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	259	274	267	286
Ammonia (as N)	mg/L	<0.0050	0.0061	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.50	<0.50	<0.50	<0.050
Chloride (Cl)	mg/L	8.4	13.9	17.4	<0.50
Fluoride (F)	mg/L	<0.20	<0.20	<0.20	0.089
Nitrate (as N)	mg/L	0.106	0.075	<0.050	0.0208
Nitrite (as N)	mg/L	<0.010	<0.010	<0.010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.054	0.325	0.160	0.192
Total Nitrogen	mg/L	0.160	0.400	0.160	0.205
Orthophosphate (as P)-Dissolved	mg/L	0.0039	0.0034	0.0019	<0.0010
Phosphorus-Total Dissolved	mg/L	0.0088	0.0060	0.0047	0.0022
Phosphorus-Total	mg/L	0.0097	0.0109	0.0058	0.0036
Sulphate (SO_4)	mg/L	256	309	286	29.3
Cyanides					
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon					
Total Organic Carbon	mg/L	7.73	7.64	6.08	5.67
Total Metals					
Aluminum (Al)	mg/L	0.116	0.149	0.0334	0.0297
Antimony (Sb)	mg/L	0.00022	0.00024	0.00016	0.00016
Arsenic (As)	mg/L	0.00043	0.00046	0.00029	0.00024
Barium (Ba)	mg/L	0.138	0.180	0.110	0.0918
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.028	0.023	0.018	<0.010
Cadmium (Cd)	mg/L	0.000026	0.000025	0.000016	<0.000010
Calcium (Ca)	mg/L	105	114	112	84.2
Chromium (Cr)	mg/L	0.00030	0.00031	0.00012	0.00012
Cobalt (Co)	mg/L	<0.00010	0.00012	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00165	0.00282	0.00096	0.00068
Iron (Fe)	mg/L	0.112	0.157	0.048	0.045
Lead (Pb)	mg/L	0.000077	0.000125	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0201	0.0246	0.0209	0.00673
Magnesium (Mg)	mg/L	44.4	59.0	61.4	25.7
Manganese (Mn)	mg/L	0.00343	0.00541	0.00163	0.00154
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M17-02 - 2012			
Month Sampled		July	August	October	December
Date Sampled		24-Jul-12	21-Aug-12	23-Oct-12	17-Dec-12
Lab Sample ID	Units	L1184612-17	L1197851-13	L1228768-16	L1251738-15
Total Metals (*cont'd*)					
Molybdenum (Mo)	mg/L	0.00150	0.00158	0.00143	0.00117
Nickel (Ni)	mg/L	0.00243	0.00246	0.00202	0.00080
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.50	1.79	1.54	0.626
Selenium (Se)	mg/L	0.00069	0.00067	0.00157	0.00043
Silicon (Si)	mg/L	3.30	3.57	2.44	3.35
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	10.9	15.1	14.4	3.2
Strontium (Sr)	mg/L	0.352	0.343	0.336	0.142
Thallium (Tl)	mg/L	0.000011	0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.013	0.016	<0.010	0.010
Uranium (U)	mg/L	0.00283	0.00328	0.00372	0.00101
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	0.0032	<0.0030	<0.0030
Dissolved Metals					
Aluminum (Al)	mg/L	0.0045	0.0047	<0.0030	0.0034
Antimony (Sb)	mg/L	0.00022	0.00021	0.00016	0.00016
Arsenic (As)	mg/L	0.00038	0.00039	0.00028	0.00023
Barium (Ba)	mg/L	0.141	0.173	0.111	0.0866
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.023	0.022	0.016	<0.010
Cadmium (Cd)	mg/L	0.000022	0.000016	0.000016	<0.000010
Calcium (Ca)	mg/L	106	123	111	81.9
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00134	0.00155	0.00090	0.00107
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0204	0.0252	0.0213	0.00651
Magnesium (Mg)	mg/L	43.4	56.3	60.1	24.0
Manganese (Mn)	mg/L	0.00147	0.00248	0.000796	0.00172
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.00145	0.00161	0.00139	0.00111
Nickel (Ni)	mg/L	0.00228	0.00230	0.00189	0.00071
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.46	1.76	1.52	0.605
Selenium (Se)	mg/L	0.00074	0.00077	0.00155	0.00047
Silicon (Si)	mg/L	2.99	3.23	2.44	3.21
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	11.1	16.3	14.6	4.3
Strontium (Sr)	mg/L	0.342	0.374	0.323	0.139
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00235	0.00312	0.00273	0.000792
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0031	<0.0030	<0.0030	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M19-01 - 2012					M19-02 - 2012		
Month Sampled		July	August	October	November	December	July	August	December
Date Sampled		24-Jul-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12	24-Jul-12	21-Aug-12	17-Dec-12
Lab Sample ID	Units	L1184612-18	L1197851-15	L1228768-12	L1243937-14	L1251738-18	L1184612-19	L1197851-10	L1251738-14
Physical Tests									
Colour, True	CU	29.7	27.1	34.7	24.8	19.7	22.0	7.8	16.7
Conductivity	µS/cm	277	286	253	264	295	340	1750	330
Hardness (as $CaCO_3$)	mg/L	145	151	137	138	151	173	1130	173
pH	pH	8.39	8.22	8.22	8.13	8.25	8.14	8.13	8.24
Total Suspended Solids	mg/L	<3.0	9.3	<3.0	<3.0	<3.0	<3.0	4.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	1.0	0.35	0.42
Turbidity	NTU	1.47	2.25	0.68	0.69	0.85	-	-	-
Anions and Nutrients									
Acidity (as $CaCO_3$)	mg/L	<1.0	1.6	1.5	<1.0	1.2	2.3	6.9	1.2
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	163	160	126	129	143	187	354	166
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	163	160	126	129	143	187	354	166
Ammonia (as N)	mg/L	<0.0050	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<1.0	<0.050
Chloride (Cl)	mg/L	1.73	1.59	2.85	2.60	2.69	2.37	13	3.83
Fluoride (F)	mg/L	0.083	0.088	0.077	0.065	0.073	0.084	<0.40	0.077
Nitrate (as N)	mg/L	0.0114	0.0329	0.0143	0.0822	0.0998	0.0860	0.50	0.132
Nitrite (as N)	mg/L	<0.0010	0.0029	<0.0010	<0.0010	<0.0010	<0.0010	<0.020	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.169	0.284	0.176	0.233	0.204	0.134	<0.094	0.265
Total Nitrogen	mg/L	0.180	0.320	0.190	-	0.303	0.220	0.470	0.362
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	0.0023	<0.0010
Phosphorus-Total Dissolved	mg/L	0.0040	0.0051	<0.0020	0.0040	0.0029	0.0026	0.0038	0.0024
Phosphorus-Total	mg/L	0.0049	0.0090	0.0047	0.0036	0.0040	0.0031	0.0047	0.0033
Sulphate (SO_4)	mg/L	6.92	9.00	15.0	17.5	15.4	7.04	887	13.3
Cyanides									
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Total Organic Carbon	mg/L	9.77	9.24	10.8	8.26	6.92	8.59	4.59	6.65
Total Metals									
Aluminum (Al)	mg/L	0.0430	0.103	0.0155	0.0157	0.0123	0.0103	<0.0060	0.0079
Antimony (Sb)	mg/L	0.00010	0.00012	<0.00010	<0.00010	<0.00010	0.00010	<0.00020	<0.00010
Arsenic (As)	mg/L	0.00028	0.00027	0.00021	0.00024	0.00019	0.00021	<0.00020	0.00018
Barium (Ba)	mg/L	0.153	0.157	0.120	0.127	0.141	0.167	0.0443	0.137
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050
Boron (B)	mg/L	0.014	0.011	<0.010	<0.010	<0.010	0.014	0.055	<0.010
Cadmium (Cd)	mg/L	0.000016	0.000020	<0.000010	<0.000010	<0.000010	0.000016	<0.000020	0.000011
Calcium (Ca)	mg/L	40.9	43.3	37.5	38.6	45.3	45.2	246	49.8
Chromium (Cr)	mg/L	0.00021	0.00028	0.00012	0.00013	0.00010	0.00013	<0.00020	<0.00010
Cobalt (Co)	mg/L	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Copper (Cu)	mg/L	0.00105	0.00125	0.00077	0.00139	0.00097	0.00099	<0.0010	0.00082
Iron (Fe)	mg/L	0.091	0.248	0.069	0.062	0.049	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	0.000114	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050
Lithium (Li)	mg/L	0.00280	0.00342	0.00252	0.00258	0.00298	0.00320	0.0541	0.00311
Magnesium (Mg)	mg/L	10.8	11.4	10.4	11.1	12.3	12.2	138	13.3
Manganese (Mn)	mg/L	0.00667	0.0147	0.00218	0.00190	0.00195	0.00210	0.00020	0.000412
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M19-01 - 2012					M19-02 - 2012		
Month Sampled		July	August	October	November	December	July	August	December
Date Sampled		24-Jul-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12	24-Jul-12	21-Aug-12	17-Dec-12
Lab Sample ID	Units	L1184612-18	L1197851-15	L1228768-12	L1243937-14	L1251738-18	L1184612-19	L1197851-10	L1251738-14
Total Metals (*cont'd*)									
Molybdenum (Mo)	mg/L	0.000313	0.000320	0.000228	0.000217	0.000255	0.000249	0.00069	0.000259
Nickel (Ni)	mg/L	0.00107	0.00131	0.00100	0.00089	0.00083	0.00078	0.0060	0.00072
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.601	0.653	0.457	0.457	0.508	0.640	3.62	0.513
Selenium (Se)	mg/L	0.00014	0.00019	0.00016	0.00015	0.00013	0.00018	0.00507	0.00017
Silicon (Si)	mg/L	2.17	2.41	1.96	1.91	2.09	2.32	3.95	2.06
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Sodium (Na)	mg/L	4.3	4.4	4.5	4.5	5.3	5.2	34.5	6.3
Strontium (Sr)	mg/L	0.0933	0.0862	0.0755	0.0795	0.0877	0.103	0.964	0.0949
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Tin (Sn)	mg/L	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010
Uranium (U)	mg/L	0.000177	0.000183	0.000138	0.000144	0.000195	0.000199	0.00754	0.000243
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0160	<0.0030
Dissolved Metals									
Aluminum (Al)	mg/L	0.0066	0.0051	0.0079	0.0078	0.0051	0.0041	<0.0060	0.0034
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Arsenic (As)	mg/L	0.00025	0.00023	0.00016	0.00017	0.00016	0.00017	<0.00020	0.00013
Barium (Ba)	mg/L	0.154	0.148	0.121	0.118	0.129	0.159	0.0452	0.127
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	0.046	<0.010
Cadmium (Cd)	mg/L	<0.000010	0.000015	<0.000010	<0.000010	<0.000010	0.000015	<0.000020	<0.000010
Calcium (Ca)	mg/L	40.5	42.0	37.9	37.3	41.9	49.1	243	48.3
Chromium (Cr)	mg/L	0.00011	<0.00010	0.00012	0.0202	<0.00010	0.00011	<0.00020	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00020	<0.00010
Copper (Cu)	mg/L	0.00095	0.00114	0.00081	0.00162	0.00114	0.00091	<0.0010	0.00112
Iron (Fe)	mg/L	0.041	0.048	0.049	0.627	0.033	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050
Lithium (Li)	mg/L	0.00303	0.00374	0.00269	0.00261	0.00293	0.00392	0.0530	0.00308
Magnesium (Mg)	mg/L	10.5	11.1	10.4	11.0	11.4	12.1	126	12.7
Manganese (Mn)	mg/L	0.00477	0.00381	0.00184	0.00432	0.00248	0.00184	0.00036	0.00127
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000265	0.000306	0.000214	0.00665	0.000228	0.000244	0.00065	0.000238
Nickel (Ni)	mg/L	0.00104	0.00105	0.00102	0.00194	0.00079	0.00083	0.0057	0.00071
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.591	0.636	0.447	0.472	0.477	0.648	3.39	0.491
Selenium (Se)	mg/L	0.00017	0.00017	0.00015	0.00014	0.00013	0.00018	0.00562	0.00020
Silicon (Si)	mg/L	2.08	2.20	1.90	1.95	2.01	2.31	3.90	2.03
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Sodium (Na)	mg/L	4.3	5.1	4.4	5.8	6.2	5.2	33.4	7.3
Strontium (Sr)	mg/L	0.0875	0.0873	0.0731	0.0783	0.0816	0.107	0.984	0.0911
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010
Uranium (U)	mg/L	0.000144	0.000157	0.000117	0.000130	0.000151	0.000155	0.00758	0.000189
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0020	<0.0010
Zinc (Zn)	mg/L	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0060	<0.0030

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2010						
Month Sampled		May	June	June	July	August	October	December
Date Sampled		30-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L892473-6	L894623-1	L897909-10	L915316-7	L921658-6	R010261-10	R012173-01
Physical Tests								
Colour, True	CU	6.7	<5.0	8.3	<5.0	<5.0	-	389
Conductivity	µS/cm	380	253	262	313	349	191	209
Hardness (as $CaCO_3$)	mg/L	208	136	145	158	175	185	204
pH	pH	8.38	8.21	8.35	8.36	8.41	7.84	8.29
Total Suspended Solids	mg/L	7.1	3.2	7.9	<3.0	<3.0	6	22.0
Total Dissolved Solids	mg/L	221	150	161	186	217	190	217
Turbidity	NTU	1.07	0.79	4.56	0.17	0.29	-	0.5
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	3.4	1.9	<1.0	<1.0	<1.0	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	220	130	145	131	138	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	7.1	<2.0	4.0	3.6	6.3	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<1.0	<1.0	<1.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	227	130	149	135	144	-	162
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0075	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.10
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	-	0.19
Fluoride (F)	mg/L	0.057	0.039	0.061	0.053	0.059	-	<0.10
Nitrate (as N)	mg/L	0.125	0.0266	<0.0050	<0.0050	0.0139	-	0.03
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.01
Total Kjeldahl Nitrogen	mg/L	0.145	0.073	0.058	0.070	0.066	-	0.16
Total Nitrogen	mg/L	0.270	0.100	<0.060	0.070	0.080	-	-
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.0080	0.0093	0.0096	0.0059	0.0065	-	<0.010
Sulphate (SO_4)	mg/L	2.76	13.0	7.34	34.8	43.8	-	42.6
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	<0.0010	<0.0010	-	<0.002
Cyanide, Total	mg/L	0.0035	0.0020	0.0023	0.0015	0.0017	-	<0.01
Organic Carbon								
Total Organic Carbon	mg/L	4.76	1.31	2.31	1.29	2.18	-	1.00
Total Metals								
Aluminum (Al)	mg/L	0.0424	0.0407	0.173	0.0108	<0.0030	0.045	0.2290
Antimony (Sb)	mg/L	0.00011	0.00012	<0.00010	<0.00010	<0.00010	0.0001	<0.0010
Arsenic (As)	mg/L	0.00010	0.00015	<0.00020	0.00010	0.00014	<0.0005	<0.0050
Barium (Ba)	mg/L	0.148	0.0275	0.0879	0.0324	0.0393	0.0397	0.0476
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.012	<0.010	<0.010	0.011	0.011	0.014	<0.040
Cadmium (Cd)	mg/L	0.000031	0.000036	0.000022	0.000030	0.000021	0.00001	<0.00010
Calcium (Ca)	mg/L	61.7	42.0	44.8	45.9	50.4	53.1	58.200
Chromium (Cr)	mg/L	<0.00050	0.00041	0.00037	<0.00050	0.00024	0.001	<0.0050
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00050
Copper (Cu)	mg/L	0.00055	0.00024	<0.00050	<0.00030	<0.00020	0.0005	<0.0010
Iron (Fe)	mg/L	0.066	0.050	0.225	<0.030	<0.030	0.16	0.22
Lead (Pb)	mg/L	<0.000050	<0.000050	0.000100	<0.000050	<0.000050	<0.0001	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0026	0.003
Magnesium (Mg)	mg/L	13.7	8.17	10.5	10.3	13.0	14.2	15.4
Manganese (Mn)	mg/L	0.00235	0.00103	0.00886	0.000479	0.000349	0.0009	0.0021
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2010						
Month Sampled		May	June	June	July	August	October	December
Date Sampled		30-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	16-Oct-10	7-Dec-10
Lab Sample ID	Units	L892473-6	L894623-1	L897909-10	L915316-7	L921658-6	R010261-10	R012173-01
Total Metals (*cont'd*)								
Molybdenum (Mo)	mg/L	0.000441	0.00373	0.00123	0.00443	0.00467	0.0036	0.00410
Nickel (Ni)	mg/L	<0.00050	0.00070	0.00090	0.00052	0.00064	0.0022	0.003
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.483	0.261	0.374	0.288	0.347	-	-
Selenium (Se)	mg/L	0.00048	0.00067	0.00022	0.00043	0.00082	0.0011	<0.0030
Silicon (Si)	mg/L	2.14	1.16	1.60	1.31	1.63	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	1.26	1.15
Strontium (Sr)	mg/L	0.138	0.149	0.0847	0.261	0.382	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.00020
Tin (Sn)	mg/L	<0.00010	0.00019	0.00014	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.009	<0.050
Uranium (U)	mg/L	0.000240	0.000510	0.000281	0.000669	0.000757	0.00064	0.00089
Vanadium (V)	mg/L	<0.0010	0.0021	<0.0010	0.0014	0.0012	<0.001	<0.0100
Zinc (Zn)	mg/L	0.0046	0.0016	0.0013	0.0010	0.0012	0.003	<0.010
Dissolved Metals								
Aluminum (Al)	mg/L	0.0015	0.0021	0.0039	0.0014	<0.0010	0.006	<0.05
Antimony (Sb)	mg/L	<0.00010	0.00011	<0.00010	0.00010	<0.00010	0.0001	<0.001
Arsenic (As)	mg/L	<0.00010	0.00014	<0.00010	0.00013	0.00013	0.0006	<0.005
Barium (Ba)	mg/L	0.145	0.0268	0.0826	0.0332	0.0374	0.0423	<0.005
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0001	<0.001
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	0.011	<0.010	<0.010	<0.010	<0.010	0.007	<0.04
Cadmium (Cd)	mg/L	0.000025	0.000019	0.000011	0.000019	<0.000010	<0.00001	<0.0001
Calcium (Ca)	mg/L	60.7	41.1	42.6	46.9	49.4	49.6	55.3
Chromium (Cr)	mg/L	<0.00050	<0.00040	0.00026	<0.00050	0.00016	0.0006	<0.005
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00007	<0.0005
Copper (Cu)	mg/L	0.00036	0.00029	0.00025	0.00013	0.00012	0.0006	<0.001
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.061	<0.1
Lead (Pb)	mg/L	<0.000050	0.000105	<0.000050	<0.000050	<0.000050	<0.0001	<0.001
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0028	0.0039
Magnesium (Mg)	mg/L	13.6	8.07	9.39	9.90	12.5	14.9	16
Manganese (Mn)	mg/L	0.000169	0.000100	0.00311	<0.000050	0.000142	0.0008	<0.002
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Molybdenum (Mo)	mg/L	0.000450	0.00320	0.00119	0.00453	0.00443	0.0037	0.0042
Nickel (Ni)	mg/L	<0.00050	0.00054	<0.00050	0.00057	<0.00050	0.0017	0.0021
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	0.472	0.246	0.297	0.294	0.334	-	-
Selenium (Se)	mg/L	0.00048	0.00069	0.00020	0.00075	0.00077	0.0012	0.0046
Silicon (Si)	mg/L	2.08	1.13	1.40	1.30	1.53	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00005	<0.0005
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	1.52	1.08
Strontium (Sr)	mg/L	0.136	0.145	0.0840	0.263	0.361	0.279	0.36
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00002	<0.0002
Tin (Sn)	mg/L	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.05
Uranium (U)	mg/L	0.000232	0.000490	0.000263	0.000683	0.000744	0.00066	0.00089
Vanadium (V)	mg/L	<0.0010	0.0017	<0.0010	0.0013	0.0012	<0.001	<0.01
Zinc (Zn)	mg/L	0.0039	0.0012	<0.0010	<0.0010	<0.0010	0.0038	<0.01

Notes:

All parameters analyzed by ALS Environmental, except the October and December 2010 which were analyzed by CARO Analytical Services

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2011															
Month Sampled		January	February	March	April	May	May	May	June	June	June	July	August	September	September	October	November
Date Sampled		4-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	11-May-11	17-May-11	25-May-11	2-Jun-11	7-Jun-11	14-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-01	L981301-10	L990825-1	L999009-7	L1004821-1	L1007262-1	L1009390-1	L1012487-1	L1015493-1	L1018864-1	L1034422-3	L1049771-3	L1064458-1	L1064458-2	L1073725-1	L1091894-1
Physical Tests																	
Colour, True	CU	<5	<5.0	<5.0	<5.0	14.2	19.3	10.8	8.3	<5.0	5.5	<5.0	<5.0	6.9	6.8	<5.0	10.4
Conductivity	µS/cm	374	394	403	411	308	236	251	231	226	230	273	325	309	309	354	321
Hardness (as $CaCO_3$)	mg/L	179.0	210	222	202	164	122	133	123	125	118	146	165	165	164	176	180
pH	pH	8.29	8.33	8.26	8.37	8.27	8.21	8.22	8.30	8.19	8.30	8.30	8.36	8.39	8.29	8.39	8.38
Total Suspended Solids	mg/L	<1	<3.0	<3.0	<3.0	53.6	242	25.8	20.1	19.3	8.7	<3.0	<3.0	<3.0	<3.0	<3.0	<1.0
Total Dissolved Solids	mg/L	251	-	253	-	181	-	145	-	131	-	-	-	-	-	-	<3.0
Turbidity	NTU	0.3	0.29	0.23	1.45	17.6	88.0	10.4	12.0	6.62	3.08	1.21	0.80	1.33	1.38	0.36	0.78
Anions and Nutrients																	
Acidity (as $CaCO_3$)	mg/L	<2	<1.0	1.5	<1.0	1.3	<1.0	1.6	<1.0	2.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	162	164	166	177	147	125	131	116	117	115	121	134	141	143	150	152
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1.0	2.8	<2.0	3.5	<2.0	<2.0	<2.0	<1.0	<2.0	<1.0	<1.0	6.0	<1.0	<2.0	6.4	4.1
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<1.0	<2.0	<1.0	<2.0	<2.0	<2.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	162	167	166	180	147	125	131	116	117	115	121	140	141	143	156	156
Ammonia (as N)	mg/L	<0.02	<0.0050	<0.0050	0.0085	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0072	<0.0050	<0.0050	<0.0050	0.0157	<0.0050
Bromide (Br)	mg/L	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.18	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.10	0.079	0.080	0.082	0.060	0.045	0.054	0.022	0.028	0.031	0.054	0.066	0.056	0.056	0.069	0.072
Nitrate (as N)	mg/L	0.09	0.0875	0.0811	0.0907	0.194	0.129	0.0701	0.0471	0.0386	0.0150	0.0133	<0.0050	0.0291	0.0254	0.0259	0.0571
Nitrite (as N)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.14	<0.050	0.069	0.139	0.186	0.291	0.170	0.103	0.191	0.125	0.107	0.160	0.061	<0.050	0.114	<0.050
Total Nitrogen	mg/L	-	0.121	0.150	0.230	0.380	0.420	0.240	0.150	0.230	0.140	0.120	0.160	0.090	0.070	0.140	0.080
Orthophosphate (as P)-Dissolved	mg/L	-	0.0051	0.0044	0.0031	0.0034	0.0055	0.0043	0.0080	0.0071	0.0054	0.0040	0.0022	0.0056	0.0055	0.0032	0.0049
Phosphorus-Total Dissolved	mg/L	-	0.0054	0.0051	0.0037	0.0053	0.0102	0.0086	0.0082	0.0087	0.0070	0.0048	0.0033	0.0067	0.0064	0.0042	0.0061
Phosphorus-Total	mg/L	0.14	0.0060	0.0058	0.0068	0.0655	0.334	0.0456	0.0427	0.0253	0.0155	0.0077	0.0077	0.0122	0.0132	0.0056	0.0095
Sulphate (SO_4)	mg/L	50.3	50.7	57.2	47.8	19.2	9.31	10.3	8.49	9.21	10.2	23.3	33.2	23.8	23.8	34.4	24.9
Cyanides																	
Cyanide, Weak Acid Dissociable	mg/L	<0.002	<0.0010	<0.0010	<0.0010	<0.0020	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	-	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.01	0.0015	0.0010	0.0021	<0.0020	0.0089	<0.011	0.0036	0.0030	0.0022	0.0023	0.0018	0.0030	0.0035	0.0021	0.0033
Organic Carbon																	
Total Organic Carbon	mg/L	0.90	1.45	1.10	2.16	4.55	9.79	3.83	3.13	2.87	1.99	2.83	1.72	2.37	2.38	1.57	2.70
Total Metals																	
Aluminum (Al)	mg/L	<0.050	0.0030	0.0084	0.0246	0.665	2.11	0.431	0.315	0.121	0.122	0.0431	0.0222	0.0586	0.0573	0.0070	0.0177
Antimony (Sb)	mg/L	<0.0010	<0.00010	<0.00010	<0.00010	0.00012	0.00021	0.00010	<0.00010	0.00011	0.00011	0.00018	0.00010	0.00011	0.00011	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.0050	0.00012	0.00011	0.00012	0.00044	0.00162	0.00032	0.00028	0.00020	0.00018	0.00016	0.00015	0.00015	0.00017	0.00012	0.00013
Barium (Ba)	mg/L	0.0590	0.0415	0.0459	0.0482	0.0529	0.0961	0.0360	0.0297	0.0282	0.0253	0.0315	0.0361	0.0333	0.0339	0.0353	0.0369
Beryllium (Be)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.040	0.011	0.011	0.011	0.014	0.016	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.00010	0.000012	0.000013	0.000017	0.000080	0.000353	0.000067	0.000055	0.000044	0.000038	0.000033	0.000022	0.000033	0.000034	0.000019	0.000021
Calcium (Ca)	mg/L	44.9	61.3	66.7	58.4	48.4	48.4	39.0	36.0	39.2	37.0	42.9	50.2	50.3	50.2	50.3	49.9
Chromium (Cr)	mg/L	<0.0050	0.00024	0.00019	0.00023	0.00138	0.00406	0.00103	0.00074	0.00053	0.00058	0.00047	0.00024	0.00043	0.00045	0.00032	0.00021
Cobalt (Co)	mg/L	<0.00050	<0.00010	<0.00010	<0.00010	0.00032	0.00146	0.00022	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.0020	<0.00050	<0.00050	<0.00050	0.00107	0.00398	0.00081	0.00069	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.10	<0.030	<0.030	<0.030	0.796	3.51	0.512	0.405	0.128	0.122	0.045	<0.030	0.054	0.055	<0.030	0.033
Lead (Pb)	mg/L	<0.0010	<0.000050	<0.000050	<0.000050	0.000453	0.00227	0.000305	0.000232	0.000116	0.000061	<0.000050	<0.000050	0.000056	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0045	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00076	0.00185	0.00230	0.00222	0.00205	0.00285	0.00268
Magnesium (Mg)	mg/L	16.1	14.7	17.6	14.7	11.6	11.2	8.90	7.67	8.24	7.36	9.66	11.7	11.3	11.3	12.3	12.3
Manganese (Mn)	mg/L	<0.0020	0.000139	<0.00025	0.000684	0.0110	0.0577	0.00708	0.00598	0.00364	0.00190	0.000940	0.000875	0.00126	0.00121	0.000282	0.000572
Mercury (Hg)	mg/L	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2011															
Month Sampled		January	February	March	April	May	May	May	June	June	June	July	August	September	September	October	November
Date Sampled		4-Jan-11	22-Feb-11	29-Mar-11	27-Apr-11	11-May-11	17-May-11	25-May-11	2-Jun-11	7-Jun-11	14-Jun-11	19-Jul-11	22-Aug-11	26-Sep-11	26-Sep-11	17-Oct-11	29-Nov-11
Lab Sample ID	Units	R101042-01	L981301-10	L990825-1	L999009-7	L1004821-1	L1007262-1	L1009390-1	L1012487-1	L1015493-1	L1018864-1	L1034422-3	L1049771-3	L1064458-1	L1064458-2	L1073725-1	L1091894-1
Total Metals (*cont'd*)																	
Molybdenum (Mo)	mg/L	0.0049	0.00413	0.00437	0.00357	0.00196	0.00179	0.00190	0.00203	0.00229	0.00277	0.00342	0.00417	0.00351	0.00355	0.00377	0.00289
Nickel (Ni)	mg/L	<0.0020	0.00061	0.00057	0.00074	0.00197	0.00638	0.00140	0.00120	0.00085	0.00080	0.00074	0.00075	0.00082	0.00080	0.00060	0.00070
Phosphorus (P)	mg/L	<0.20	<0.30	<0.30	<0.30	<0.30	0.41	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.35	0.325	0.376	0.369	0.622	1.40	0.477	0.392	0.279	0.278	0.254	0.327	0.307	0.302	0.299	0.309
Selenium (Se)	mg/L	<0.0050	0.00072	0.00072	0.00066	0.00057	0.00055	0.00054	0.00040	0.00048	0.00053	0.00068	0.00077	0.00076	0.00078	0.00072	0.00052
Silicon (Si)	mg/L	<5.0	1.78	1.78	1.84	2.50	4.89	2.01	1.59	1.29	1.27	1.25	1.34	1.38	1.38	1.43	1.48
Silver (Ag)	mg/L	<0.00050	<0.000010	<0.000010	<0.000010	0.000012	0.000052	<0.000010	<0.000010	<0.000010	0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	1.610	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.4	0.465	0.548	0.428	0.223	0.156	0.145	0.113	0.126	0.130	0.186	0.312	0.226	0.224	0.293	0.285
Thallium (Tl)	mg/L	0.00046	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	0.000016	0.000014	0.000015	0.000015	0.000014	<0.000010	0.000010
Tin (Sn)	mg/L	<0.0020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.050	<0.010	<0.010	<0.010	0.011	0.040	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00115	0.000837	0.000936	0.000821	0.000455	0.000578	0.000352	0.000315	0.000332	0.000382	0.000536	0.000693	0.000561	0.000570	0.000711	0.000568
Vanadium (V)	mg/L	<0.010	<0.0010	<0.0010	<0.0010	0.0043	0.0141	0.0036	0.0034	0.0023	0.0026	0.0018	0.0015	0.0018	0.0018	0.0011	0.0010
Zinc (Zn)	mg/L	<0.040	<0.0030	<0.0030	<0.0030	0.0082	0.0254	0.0052	0.0042	0.0031	0.0032	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L	<0.05	<0.0030	<0.0030	<0.0030	0.0093	0.0267	0.0124	0.0137	0.0085	0.0043	0.0031	<0.0030	0.0032	0.0033	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00011	<0.00010	0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.005	0.00012	0.00012	0.00010	0.00011	0.00014	0.00014	0.00015	0.00013	0.00014	0.00013	0.00014	0.00014	0.00015	0.00012	0.00012
Barium (Ba)	mg/L	0.0687	0.0413	0.0444	0.0471	0.0422	0.0320	0.0301	0.0257	0.0246	0.0237	0.0303	0.0348	0.0326	0.0321	0.0367	0.0387
Beryllium (Be)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.04	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0001	0.000014	0.000012	0.000011	0.000016	0.000016	0.000015	0.000016	0.000020	0.000019	0.000014	0.000013	0.000014	0.000014	0.000012	0.000013
Calcium (Ca)	mg/L	31.9	60.0	61.9	56.7	46.8	34.9	39.1	36.2	36.9	35.5	42.5	47.3	47.7	47.2	50.0	51.6
Chromium (Cr)	mg/L	<0.005	0.00018	0.00012	<0.00010	0.00014	0.00021	0.00022	0.00020	0.00022	0.00022	0.00021	0.00016	0.00021	0.00023	0.00019	0.00013
Cobalt (Co)	mg/L	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.002	<0.00050	<0.00050	<0.00050	0.00069	0.00069	0.00063	0.00064	0.00056	0.00055	0.00076	0.00066	0.00079	0.00080	0.00054	<0.00050
Iron (Fe)	mg/L	<0.1	<0.030	<0.030	<0.030	<0.030	0.050	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.00098	0.00194	0.00240	0.00215	0.00206	0.00265	0.00282
Magnesium (Mg)	mg/L	15.9	14.7	16.3	14.6	11.5	8.37	8.65	7.88	7.86	7.13	9.59	11.3	11.1	11.2	12.4	12.3
Manganese (Mn)	mg/L	<0.002	0.000260	0.000085	0.000389	0.00156	0.00176	0.00103	0.000952	0.000945	0.000857	0.000526	0.000529	0.000565	0.000594	0.000834	0.000151
Mercury (Hg)	mg/L	<0.0002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0045	0.00391	0.00406	0.00279	0.00182	0.00142	0.00187	0.00205	0.00214	0.00253	0.00336	0.00380	0.00325	0.00325	0.00377	0.00288
Nickel (Ni)	mg/L	<0.002	0.00060	0.00052	0.00064	0.00088	0.00081	0.00086	0.00064	0.00059	0.00063	0.00067	0.00064	0.00078	0.00074	0.00069	0.00069
Phosphorus (P)	mg/L	<0.2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.359	0.343	0.349	0.374	0.360	0.371	0.300	0.266	0.237	0.233	0.245	0.330	0.293	0.295	0.318	0.311
Selenium (Se)	mg/L	<0.005	0.00079	0.00070	0.00073	0.00064	0.00042	0.00057	0.00054	0.00049	0.00052	0.00064	0.00079	0.00084	0.00086	0.00086	0.00064
Silicon (Si)	mg/L	<5	1.82	1.73	1.82	1.54	1.30	1.33	1.19	1.13	1.06	1.23	1.27	1.34	1.32	1.49	1.56
Silver (Ag)	mg/L	<0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	1.84	<2.0	<2.0	2.2	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	2.0	2.2	2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.425	0.452	0.507	0.406	0.222	0.134	0.149	0.114	0.119	0.123	0.184	0.289	0.213	0.212	0.293	0.287
Thallium (Tl)	mg/L	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.00096	0.000790	0.000890	0.000761	0.000397	0.000265	0.000307	0.000270	0.000289	0.000321	0.000485	0.000604	0.000507	0.000513	0.000566	0.000580
Vanadium (V)	mg/L	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0015	0.0016	0.0017	0.0013	0.0012	0.0014	0.0014	0.0011	<0.0010
Zinc (Zn)	mg/L	<0.04	<0.0030	<0.0030	0.0050	0.0034	0.0035	0.0037	0.0034	0.0033	0.0050	0.0045	0.0036	0.0046	0.0043	0.0032	<0.0030

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 sample which was analyzed by CARO Analytical Services

< indicate the value was less than the detection limited indicated

Dashes indicate parameter not analyzed

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	July	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	4-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-3	L1117841-1	L1127031-1	L1137305-1	L1148502-1	L1154387-1	L1157872-1	L1162268-1	L1166580-1	L1169751-1	L1174000-1	L1174000-9	L1184612-1	L1197851-1	L1228768-1	L1243937-1	L1251738-1
Physical Tests																		
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	13.1	10.5	6.4	8.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	362	376	400	393	271	246	243	213	214	219	228	226	236	285	318	340	368
Hardness (as $CaCO_3$)	mg/L	190	208	216	207	150	129	128	119	122	116	122	119	118	163	179	190	198
pH	pH	8.30	8.20	8.31	8.37	8.17	8.25	8.11	8.27	8.30	7.40	8.29	8.33	8.11	8.41	8.14	8.24	8.31
Total Suspended Solids	mg/L	8.7	<3.0	<3.0	<3.0	49.9	36.0	11.3	19.0	6.0	12.6	3.1	<3.0	31.8	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	2.18	0.38	0.32	0.56	13.9	14.8	6.29	11.2	3.86	3.09	1.86	1.48	12.7	0.77	0.57	0.59	0.43
Anions and Nutrients																		
Acidity (as $CaCO_3$)	mg/L	<1.0	1.2	<1.0	<1.0	1.5	<1.0	4.8	<1.0	<1.0	10.5	<1.0	<1.0	2.9	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	163	171	178	171	141	128	127	111	119	114	114	111	113	129	144	162	150
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	5.1	<2.0	<1.0	4.9	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	4.6	<2.0	3.9	<1.0	<2.0	16.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<1.0	<2.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	168	171	178	176	141	128	127	111	119	114	114	116	113	133	144	162	166
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0218	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	0.97	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.089	0.099	0.094	0.104	0.061	0.048	0.047	0.041	0.041	0.040	0.043	0.042	0.045	0.066	0.065	0.082	0.091
Nitrate (as N)	mg/L	0.0806	0.0793	0.0748	0.0713	0.0939	0.0539	0.0567	0.0378	0.0336	0.0253	0.0176	0.0164	0.0099	<0.0050	0.0589	0.0774	0.0948
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	0.086	0.096	0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	<0.050	<0.050
Total Nitrogen	mg/L	0.090	0.060	0.080	0.100	0.180	0.150	0.110	0.050	<0.050	0.050	<0.050	<0.050	<0.050	<0.050	0.110	-	0.132
Orthophosphate (as P)-Dissolved	mg/L	0.0050	0.0046	0.0079	0.0027	0.0056	0.0081	0.0063	0.0091	0.0074	0.0081	0.0069	0.0071	0.0051	0.0037	0.0079	0.0056	0.0050
Phosphorus-Total Dissolved	mg/L	0.0062	0.0055	0.0108	0.0037	0.0072	0.0091	0.0074	0.0087	0.0096	0.0090	0.0069	0.0080	0.0064	0.0043	0.0063	0.0054	0.0059
Phosphorus-Total	mg/L	0.0173	0.0058	0.0104	0.0044	0.0697	0.0528	0.0227	0.0400	0.0230	0.0192	0.0121	0.0193	0.0452	0.0057	0.0074	0.0085	0.0070
Sulphate (SO_4)	mg/L	34.0	42.7	48.6	42.9	11.8	7.66	8.78	7.53	9.56	10.5	13.0	13.0	18.7	31.5	34.3	42.6	48.1
Cyanides																		
Cyanide, Weak Acid Dissociable	mg/L	<0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	0.0016	0.0018	<0.0010	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																		
Total Organic Carbon	mg/L	1.84	1.68	1.58	2.13	4.51	4.29	2.85	2.32	1.81	1.69	1.30	1.25	1.45	1.00	1.62	1.17	1.46
Total Metals																		
Aluminum (Al)	mg/L	0.107	0.0132	0.0154	0.0120	0.469	0.473	0.231	0.323	0.114	0.119	0.0412	0.0406	0.473	0.0313	0.0221	0.0173	0.0158
Antimony (Sb)	mg/L	0.00011	<0.00010	<0.00010	<0.00010	0.00013	0.00012	0.00010	0.00012	0.00013	0.00013	0.00013	0.00012	0.00015	0.00011	0.00011	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00018	0.00011	0.00013	0.00011	0.00040	0.00043	0.00024	0.00030	0.00020	0.00024	0.00020	0.00023	0.00038	0.00016	0.00015	0.00017	0.00012
Barium (Ba)	mg/L	0.0435	0.0407	0.0435	0.0467	0.0453	0.0382	0.0312	0.0281	0.0245	0.0235	0.0237	0.0239	0.0391	0.0332	0.0357	0.0381	0.0381
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.013	<0.010	0.010	0.013	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000050	0.000014	<0.000020	0.000016	0.000111	0.000094	0.000053	0.000082	0.000048	0.000061	0.000038	0.000041	0.000047	0.000023	0.000019	0.000017	0.000012
Calcium (Ca)	mg/L	57.6	54.9	66.0	58.7	44.4	39.1	40.8	38.1	37.1	34.2	38.6	37.2	34.9	44.4	51.5	55.3	58.0
Chromium (Cr)	mg/L	0.00057	0.00017	0.00022	0.00024	0.00104	0.00108	0.00062	0.00089	0.00051	0.00047	0.00028	0.00032	0.00081	0.00022	0.00022	0.00019	0.00019
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00030	0.00029	0.00011	0.00018	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00079	<0.00050	0.00054	<0.00050	0.00107	0.00101	0.00059	0.00055	<0.00050	<0.00050	<0.00050	<0.00050	0.00076	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.129	<0.030	<0.030	<0.030	0.679	0.712	0.301	0.387	0.142	0.190	0.057	0.076	0.623	0.032	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.000106	<0.000050	0.000054	<0.000050	0.000443	0.000415	0.000345	0.000246	0.000083	0.000119	0.000063	<0.000050	0.000385	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00334	0.00343	0.00438	0.00490	0.00235	0.00153	0.00128	0.00133	0.00080	0.00096	0.00077	0.00087	<0.00050	0.00193	0.00221	0.00321	0.00330
Magnesium (Mg)	mg/L	13.8	13.8	16.4	15.4	9.94	8.05	8.38	7.44	7.30	6.90	7.50	7.46	7.44	10.8	11.9	13.9	13.8
Manganese (Mn)	mg/L	0.00208	0.000195	0.000557	0.000469	0.0120	0.0105	0.00416	0.00764	0.00243	0.00386	0.00140	0.00451	0.00680	0.000561	0.000517	0.000487	0.000339
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-1. Stream Water Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		REFST - 2012																
Month Sampled		January	February	March	April	May	May	June	June	June	June	July	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	17-Apr-12	15-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	26-Jun-12	4-Jul-12	4-Jul-12	23-Jul-12	20-Aug-12	22-Oct-12	27-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-3	L1117841-1	L1127031-1	L1137305-1	L1148502-1	L1154387-1	L1157872-1	L1162268-1	L1166580-1	L1169751-1	L1174000-1	L1174000-9	L1184612-1	L1197851-1	L1228768-1	L1243937-1	L1251738-1
Total Metals (*cont'd*)																		
Molybdenum (Mo)	mg/L	0.00343	0.00342	0.00387	0.00334	0.00175	0.00182	0.00212	0.00226	0.00287	0.00279	0.00345	0.00338	0.00350	0.00386	0.00412	0.00411	0.00428
Nickel (Ni)	mg/L	0.00095	0.00054	0.00068	0.00069	0.00184	<0.0020	0.00108	0.00121	0.00092	0.00086	0.00067	0.00068	0.00140	0.00058	0.00062	0.00055	0.00057
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.408	0.335	0.368	0.380	0.507	0.499	0.377	0.389	0.279	0.267	0.230	0.226	0.475	0.291	0.316	0.317	0.344
Selenium (Se)	mg/L	0.00066	0.00062	0.00065	0.00059	0.00046	0.00042	0.00050	0.00049	0.00048	0.00048	0.00053	0.00053	0.00054	0.00063	0.00089	0.00082	0.00079
Silicon (Si)	mg/L	1.80	1.64	1.74	1.66	2.10	2.21	1.63	1.85	1.24	1.22	1.11	1.10	1.83	1.34	1.47	1.56	1.66
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	0.369	0.401	0.542	0.446	0.189	0.131	0.135	0.112	0.134	0.115	0.140	0.142	0.167	0.284	0.316	0.430	0.480
Thallium (Tl)	mg/L	0.000014	<0.000010	<0.000010	<0.000010	0.000039	0.000036	0.000020	0.000032	0.000019	0.000023	0.000016	0.000015	0.000028	0.000015	0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	0.00252	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	0.011	0.017	<0.010	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000737	0.000747	0.000836	0.000787	0.000434	0.000378	0.000365	0.000367	0.000399	0.000404	0.000452	0.000438	0.000529	0.000604	0.000748	0.000783	0.000797
Vanadium (V)	mg/L	0.0016	<0.0010	<0.0010	<0.0010	0.0038	0.0043	0.0027	0.0041	0.0030	0.0033	0.0025	0.0024	0.0034	0.0014	0.0014	0.0010	0.0011
Zinc (Zn)	mg/L	0.0064	<0.0030	0.0048	<0.0030	0.0076	0.0082	0.0068	0.0049	0.0035	0.0039	0.0031	0.0031	0.0063	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																		
Aluminum (Al)	mg/L	<0.0030	0.0036	0.0039	<0.0030	0.0053	0.0092	0.0065	0.0083	0.0043	0.0042	<0.0030	0.0036	0.0060	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00010	0.00011	0.00011	0.00011	0.00012	0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00012	0.00016	0.00020	0.00013	0.00011	0.00014	0.00012	0.00013	0.00014	0.00013	0.00016	0.00015	0.00013	0.00016	0.00016	0.00013	0.00013
Barium (Ba)	mg/L	0.0405	0.0432	0.0430	0.0474	0.0377	0.0306	0.0277	0.0230	0.0229	0.0212	0.0225	0.0230	0.0277	0.0326	0.0364	0.0384	0.0380
Beryllium (Be)	mg/L	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000028	0.000016	0.000031	0.000013	0.000017	0.000017	0.000015	0.000018	0.000016	0.000019	0.000019	0.000018	0.000012	<0.000010	<0.000010	0.000012	0.000011
Calcium (Ca)	mg/L	54.1	56.1	60.2	57.3	43.7	38.2	38.3	35.8	36.8	35.0	36.8	35.7	34.8	46.9	52.0	53.5	56.8
Chromium (Cr)	mg/L	0.00016	0.00015	0.00029	0.00014	0.00018	0.00020	0.00017	0.00020	0.00022	0.00022	0.00021	0.00020	0.00015	0.00013	0.00024	0.00015	0.00787
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	0.00074	0.00139	0.00067	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050	<0.00050	0.00063	<0.00050	<0.00050	0.00073	0.00064
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.217
Lead (Pb)	mg/L	<0.000050	<0.000050	0.000088	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00305	0.00357	0.00437	0.00513	0.00219	0.00130	0.00112	0.00087	0.00090	0.00081	0.00102	0.00079	0.00052	0.00224	0.00228	0.00305	0.00337
Magnesium (Mg)	mg/L	13.4	16.6	16.0	15.6	9.96	8.17	7.86	7.15	7.20	6.84	7.24	7.16	7.62	11.1	12.1	13.8	13.6
Manganese (Mn)	mg/L	0.000450	0.000704	0.00117	0.000989	0.000472	0.000849	0.000178	0.000272	0.000180	0.000972	0.000342	0.000792	0.00107	0.000370	0.000193	0.00125	0.00181
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.00314	0.00332	0.00346	0.00317	0.00173	0.00168	0.00197	0.00209	0.00277	0.00269	0.00313	0.00301	0.00373	0.00414	0.00405	0.00398	0.00691
Nickel (Ni)	mg/L	0.00059	0.00080	0.00086	0.00073	0.00067	0.00060	0.00057	0.00058	0.00057	0.00057	0.00056	0.00059	0.00056	<0.00050	0.00068	0.00056	0.00103
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.365	0.369	0.529	0.389	0.330	0.311	0.250	0.223	0.215	0.224	0.203	0.222	0.245	0.299	0.303	0.331	0.355
Selenium (Se)	mg/L	0.00066	0.00071	0.00072	0.00073	0.00045	0.00042	0.00050	0.00049	0.00058	0.00048	0.00055	0.00054	0.00054	0.00075	0.00091	0.00082	0.00090
Silicon (Si)	mg/L	1.63	1.72	1.76	1.69	1.37	1.28	1.18	1.05	1.04	1.02	1.01	1.02	1.07	1.35	1.46	1.58	1.68
Silver (Ag)	mg/L	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	2.2	3.3	3.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	2.7
Strontium (Sr)	mg/L	0.345	0.404	0.485	0.419	0.196	0.131	0.129	0.107	0.128	0.114	0.134	0.131	0.166	0.294	0.311	0.403	0.458
Thallium (Tl)	mg/L	<0.000010	<0.000010	0.000016	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000688	0.000619	0.000723	0.000629	0.000391	0.000319	0.000299	0.000254	0.000293	0.000318	0.000276	0.000345	0.000425	0.000570	0.000422	0.000646	0.000785
Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	0.0012	0.0013	0.0017	0.0020	0.0019	0.0019	0.0019	0.0015	0.0012	0.0012	<0.0010	0.0016
Zinc (Zn)	mg/L	0.0047	<0.0030	0.0071	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0039	<0.0030	<0.0030	0.0039	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< indicate the value was less than the detection limited indicated
Dashes indicate parameter not analyzed

Appendix 1-2

Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

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Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2010						
Month Sampled		May	May	June	June	July	August	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	8-Dec-10
Lab Sample ID	Units	L889661-10	L892473-10	L894624-4	L897909-12	L915316-9	L921658-8	R012173-08
Physical Tests								
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	-	-
Conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.50
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<2
pH	pH	5.74	5.75	5.77	5.65	5.52	-	-
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	-	-
Total Dissolved Solids	mg/L	<10	<10	<10	<10	<10	-	-
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	-	-
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	1.5	2.6	2.7	2.0	2.2	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	-
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	-	-
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	-	-
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0141	-	-
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus (as P)-Total Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus (as P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	-	-
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L					<0.0010	<0.0010	-
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Organic Carbon								
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Total Metals								
Aluminum (Al)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.050
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0050
Barium (Ba)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.005
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.040
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010
Calcium (Ca)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1.0
Chromium (Cr)	mg/L	<0.00020	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.0050
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050
Copper (Cu)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0012

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2010						
Month Sampled		May	May	June	June	July	August	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	16-Aug-10	8-Dec-10
Lab Sample ID	Units	L889661-10	L892473-10	L894624-4	L897909-12	L915316-9	L921658-8	R012173-08
Total Metals (*cont'd*)								
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.10
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010
Magnesium (Mg)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.10
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0020
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-
Potassium (K)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Selenium (Se)	mg/L	<0.00020	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.0030
Silicon (Si)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.10
Strontium (Sr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050
Uranium (U)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00020
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0100
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.015

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2011											
Month Sampled		February	March	April	May	May	May	June	June	August	September	October	November
Date Sampled		24-Feb-11	30-Mar-11	27-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	7-Jun-11	22-Aug-11	27-Sep-11	17-Oct-11	30-Nov-11
Lab Sample ID	Units	L981301-13	L990825-15	L999009-14	L1004821-8	L1006884-9	L1009390-8	L1012487-7	L1015493-8	L1049771-4	L1064458-17	L1073725-16	L1091894-15
Physical Tests													
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	<0.50	<0.50	<0.50
pH	pH	5.73	5.59	5.98	5.62	5.68	5.70	5.60	5.66	5.57	5.65	5.74	5.62
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	<10	-	<10	-	<10	-	<10	-	-	-	-
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10
Anions and Nutrients													
Acidity (as $CaCO_3$)	mg/L	1.5	<1.0	2.6	1.0	1.5	2.9	2.5	3.1	3.1	1.1	3.2	2.9
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ammonia (as N)	mg/L	<0.0050	<0.0050	0.0064	<0.0050	<0.0050	<0.0050	0.0055	<0.0050	<0.0050	0.0115	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides													
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0020	-	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0020	-	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0011
Organic Carbon													
Total Organic Carbon	mg/L	<0.50	0.54	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals													
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.037	-	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2011											
Month Sampled		February	March	April	May	May	May	June	June	August	September	October	November
Date Sampled		24-Feb-11	30-Mar-11	27-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	7-Jun-11	22-Aug-11	27-Sep-11	17-Oct-11	30-Nov-11
Lab Sample ID	Units	L981301-13	L990825-15	L999009-14	L1004821-8	L1006884-9	L1009390-8	L1012487-7	L1015493-8	L1049771-4	L1064458-17	L1073725-16	L1091894-15
Total Metals (*cont'd*)													
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0077	-	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	<0.30
Potassium (K)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010
Uranium (U)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2012													
Month Sampled		January	February	March	April	May	May	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	15-May-12	28-May-12	12-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	21-Aug-12	23-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-14	L1117841-12	L1127031-12	L1137305-14	L1148502-14	L1154387-10	L1162268-11	L1169751-19	L1174000-11	L1184612-22	L1197851-12	L1228768-17	L1243937-16	L1251738-16
Physical Tests															
Colour, True	CU	<5.0	<5.0	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
pH	pH	5.61	5.99	5.97	-	6.09	6.25	5.96	5.80	5.79	6.10	5.84	6.14	5.61	5.94
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients															
Acidity (as $CaCO_3$)	mg/L	1.0	1.5	1.9	-	2.7	2.5	1.8	3.4	2.1	1.2	2.0	1.7	1.9	3.2
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.3	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.3	<2.0	<2.0
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0098	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus-Total	mg/L	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides															
Cyanide, Weak Acid Dissociable	mg/L	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon															
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals															
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		TRAVEL BLANK - 2012													
Month Sampled		January	February	March	April	May	May	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	15-May-12	28-May-12	12-Jun-12	26-Jun-12	4-Jul-12	24-Jul-12	21-Aug-12	23-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-14	L1117841-12	L1127031-12	L1137305-14	L1148502-14	L1154387-10	L1162268-11	L1169751-19	L1174000-11	L1184612-22	L1197851-12	L1228768-17	L1243937-16	L1251738-16
Total Metals (*cont'd*)															
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2010						
Month Sampled		May	May	June	June	July	August	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	8-Dec-10
Lab Sample ID	Units	L889661-9	L892473-9	L894624-5	L897909-13	L915316-8	L921658-9	R012173-10
Physical Tests								
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.50
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	-	<2
pH	pH	5.72	5.54	6.88	5.73	5.55	5.78	-
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	-
Total Dissolved Solids	mg/L	<10	<10	<10	<10	<10	<10	-
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	1.6	2.7	2.7	1.9	1.8	<1.0	
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.02
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0128	<0.0050	-
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	
Orthophosphate (as P)-Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus (as P)-Total Dissolved	mg/L	-	-	-	-	-	-	-
Phosphorus (as P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L	-	-	-	-	<0.0010	<0.0010	-
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Organic Carbon								
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Total Metals								
Aluminum (Al)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.050
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.0010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.0050
Barium (Ba)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	0.0057
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.0010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.040
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.00010
Calcium (Ca)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	-	<1.0
Chromium (Cr)	mg/L	<0.00020	<0.00010	<0.00010	<0.00020	<0.00010	-	<0.0050
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00050
Copper (Cu)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.0010
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.10
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.0010
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0010
Magnesium (Mg)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.10
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.0020
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.00050

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2010						
Month Sampled		May	May	June	June	July	August	December
Date Sampled		20-May-10	31-May-10	5-Jun-10	14-Jun-10	27-Jul-10	15-Aug-10	8-Dec-10
Lab Sample ID	Units	L889661-9	L892473-9	L894624-5	L897909-13	L915316-8	L921658-9	R012173-10
Total Metals (*cont'd*)								
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.0010
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.0020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Selenium (Se)	mg/L	<0.00020	<0.00010	<0.00010	<0.00020	<0.00010	-	<0.0030
Silicon (Si)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	-	-
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.00050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	-	<0.10
Strontium (Sr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00020
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.050
Uranium (U)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.00020
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0100
Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.010
Dissolved Metals								
Aluminum (Al)	mg/L	-	-	-	-	-	-	<0.05
Antimony (Sb)	mg/L	-	-	-	-	-	-	<0.001
Arsenic (As)	mg/L	-	-	-	-	-	-	<0.005
Barium (Ba)	mg/L	-	-	-	-	-	-	<0.005
Beryllium (Be)	mg/L	-	-	-	-	-	-	<0.001
Bismuth (Bi)	mg/L	-	-	-	-	-	-	-
Boron (B)	mg/L	-	-	-	-	-	-	<0.04
Cadmium (Cd)	mg/L	-	-	-	-	-	-	<0.0001
Calcium (Ca)	mg/L	-	-	-	-	-	-	<1
Chromium (Cr)	mg/L	-	-	-	-	-	-	<0.005
Cobalt (Co)	mg/L	-	-	-	-	-	-	<0.0005
Copper (Cu)	mg/L	-	-	-	-	-	-	<0.001
Iron (Fe)	mg/L	-	-	-	-	-	-	<0.1
Lead (Pb)	mg/L	-	-	-	-	-	-	<0.001
Lithium (Li)	mg/L	-	-	-	-	-	-	<0.001
Magnesium (Mg)	mg/L	-	-	-	-	-	-	0.136
Manganese (Mn)	mg/L	-	-	-	-	-	-	<0.002
Mercury (Hg)	mg/L	-	-	-	-	-	-	<0.0005
Molybdenum (Mo)	mg/L	-	-	-	-	-	-	<0.001
Nickel (Ni)	mg/L	-	-	-	-	-	-	<0.002
Phosphorus (P)	mg/L	-	-	-	-	-	-	-
Potassium (K)	mg/L	-	-	-	-	-	-	-
Selenium (Se)	mg/L	-	-	-	-	-	-	<0.003
Silicon (Si)	mg/L	-	-	-	-	-	-	-
Silver (Ag)	mg/L	-	-	-	-	-	-	<0.0005
Sodium (Na)	mg/L	-	-	-	-	-	-	0.502
Strontium (Sr)	mg/L	-	-	-	-	-	-	<0.005
Thallium (Tl)	mg/L	-	-	-	-	-	-	<0.0002
Tin (Sn)	mg/L	-	-	-	-	-	-	-
Titanium (Ti)	mg/L	-	-	-	-	-	-	<0.05
Uranium (U)	mg/L	-	-	-	-	-	-	<0.0002
Vanadium (V)	mg/L	-	-	-	-	-	-	<0.01
Zinc (Zn)	mg/L	-	-	-	-	-	-	<0.01

Notes:
All parameters analyzed by ALS Environmental, except the December 2010 sample which was analyzed by CARO Analytical Services
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2011													
Month Sampled		February	March	April	May	May	May	June	June	June	July	August	September	October	November
Date Sampled		24-Feb-11	30-Mar-11	27-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	7-Jun-11	14-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11
Lab Sample ID	Units	L981301-12	L990825-14	L999009-13	L1004821-7	L1006884-8	L1009390-7	L1012487-6	L1015493-7	L1018864-4	L1034422-15	L1049771-2	L1064458-4	L1073725-15	L1091894-12
Physical Tests															
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	1.15	1.14	<0.50	1.24	1.20	1.23	-	1.81	1.45	1.49	<0.50
pH	pH	5.77	5.81	6.01	5.68	5.52	5.68	5.62	5.65	5.45	5.61	5.48	5.94	5.56	5.57
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<1.0	<1.0
Total Dissolved Solids	mg/L	-	<10	-	<10	-	<10	-	<10	-	-	-	-	<3.0	<3.0
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.18	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients															
Acidity (as $CaCO_3$)	mg/L	1.6	<1.0	2.7	2.6	3.1	3.0	2.5	3.4	1.1	2.3	2.6	<1.0	3.4	2.9
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	1.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	1.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ammonia (as N)	mg/L	<0.0050	<0.005	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (as P)-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus (as P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides															
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0020	<0.0020	<0.0020	<0.0011
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0020	<0.0020	<0.0011
Organic Carbon															
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	<0.50	<0.50	<0.50	<0.50
Total Metals															
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	<0.000050	<0.000050	<0.000050	0.000061	<0.000050	0.000257	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	<0.020	<0.020	<0.020	0.022	<0.020	0.245	<0.020	<0.020	<0.020	-	<0.020	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	<0.0050	<0.0050	<0.0050	0.0064	<0.0050	0.0756	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	0.000196	0.000054	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2011												
Month Sampled		February	March	April	May	May	May	June	June	June	July	August	September	October	November
Date Sampled		24-Feb-11	30-Mar-11	27-Apr-11	11-May-11	18-May-11	25-May-11	2-Jun-11	7-Jun-11	14-Jun-11	19-Jul-11	23-Aug-11	26-Sep-11	17-Oct-11	30-Nov-11
Lab Sample ID	Units	L981301-12	L990825-14	L999009-13	L1004821-7	L1006884-8	L1009390-7	L1012487-6	L1015493-7	L1018864-4	L1034422-15	L1049771-2	L1064458-4	L1073725-15	L1091894-12
Total Metals (*cont'd*)															
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00088	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals															
Aluminum (Al)	mg/L	-	-	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	-	-	-	0.000389	0.000327	<0.000050	0.000370	0.000346	0.000364	-	0.000448	0.000329	0.000379	<0.000050
Beryllium (Be)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	-	-	-	0.305	0.297	<0.020	0.315	0.325	0.317	-	0.452	0.362	0.365	<0.020
Chromium (Cr)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	0.00086	0.00058	0.00061	<0.00050
Iron (Fe)	mg/L	-	-	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	-	-	-	0.0950	0.0972	<0.0050	0.111	0.0954	0.106	-	0.165	0.132	0.140	<0.0050
Manganese (Mn)	mg/L	-	-	-	0.000338	0.000319	<0.000050	0.000334	0.000275	0.000295	-	0.000161	0.000126	0.000100	<0.000050
Mercury (Hg)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	-	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	-	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	-	-	-	0.00105	0.00113	<0.00010	0.00129	0.00112	0.00118	-	0.00201	0.00160	0.00167	<0.00010
Thallium (Tl)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	-	-	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2012															
Month Sampled		January	February	March	April	May	May	June	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	27-Jun-12	4-Jul-12	24-Jul-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-12	L1117841-11	L1127031-11	L1137305-13	L1148502-13	L1154387-9	L1157872-7	L1162268-10	L1166580-10	L1169751-18	L1174000-10	L1184612-21	L1197851-11	L1228768-18	L1243937-15	L1251738-17
Physical Tests																	
Colour, True	CU	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L	-	0.88	1.25	0.86	<0.50	1.60	<0.50	<0.50	<0.50	<0.50	0.82	<0.50	<0.50	<0.50	1.13	1.42
pH	pH	5.63	5.83	5.82	5.83	5.81	6.29	8.86	5.60	5.58	5.85	5.78	5.84	5.91	5.70	5.95	5.81
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients																	
Acidity (as $CaCO_3$)	mg/L	<1.0	1.5	2.3	1.6	3.0	2.6	<1.0	<1.0	<1.0	3.6	1.5	1.3	3.2	1.6	1.8	2.1
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Total Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050		<0.050
Orthophosphate (as P)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (as P)-Total Dissolved	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Phosphorus (as P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulphate (SO_4)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides																	
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon																	
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals																	
Aluminum (Al)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 1-2. Stream Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010 to 2012

Sample ID		FIELD BLANK - 2012														
Month Sampled		January	February	March	April	May	May	June	June	June	July	July	August	October	November	December
Date Sampled		24-Jan-12	21-Feb-12	20-Mar-12	18-Apr-12	16-May-12	28-May-12	5-Jun-12	12-Jun-12	21-Jun-12	27-Jun-12	4-Jul-12	24-Jul-12	21-Aug-12	22-Oct-12	28-Nov-12	18-Dec-12
Lab Sample ID	Units	L1108712-12	L1117841-11	L1127031-11	L1137305-13	L1148502-13	L1154387-9	L1157872-7	L1162268-10	L1166580-10	L1169751-18	L1174000-10	L1184612-21	L1197851-11	L1228768-18	L1243937-15	L1251738-17
Total Metals (*cont'd*)																	
Molybdenum (Mo)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	-	0.000265	0.000325	0.000209	<0.000050	0.000418	<0.000050	<0.000050	<0.000050	<0.000050	0.000231	<0.000050	<0.000050	<0.000050	0.000305	0.000388
Beryllium (Be)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	-	0.237	0.334	0.223	<0.020	0.413	<0.020	<0.020	<0.020	0.027	0.223	0.022	0.119	0.037	0.297	0.374
Chromium (Cr)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00059	0.00057
Iron (Fe)	mg/L	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)	mg/L	-	0.0700	0.102	0.0729	<0.0050	0.139	<0.0050	<0.0050	<0.0050	<0.0050	0.0642	<0.0050	<0.0050	<0.0050	0.0943	0.117
Manganese (Mn)	mg/L	-	0.000179	0.000251	0.000068	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000158	<0.000050	<0.000050	<0.000050	0.000198	0.000248
Mercury (Hg)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	-	0.00078	0.00114	0.00089	<0.00020	0.00178	<0.00020	<0.00020	<0.00020	<0.00020	0.00073	<0.00020	<0.00020	<0.00020	0.00096	0.00130
Thallium (Tl)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Notes:
All parameters analyzed by ALS Environmental
< = less than the detection limit
Dashes indicate parameter not analyzed

Appendix 1-3

Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

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Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR1				MR3				M20-03				MR-REF				MR6			
Date Sampled		2010 DL		20-May-10		>5x DL?		31-May-10		>5x DL?		14-Jun-10		>5x DL?		15-Aug-10		>5x DL?		8-Dec-10		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L889661-4	L889661-5	Y/N/<DL	RPD	L892473-1	L892473-8	Y/N/<DL	RPD	L897909-7	L897909-8	Y/N/<DL	RPD	L921658-4	L921658-7	Y/N/<DL	RPD	R012173-06	R012173-07	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	11.7	11.5	N	-	8.6	8.9	N	-	18.2	18.5	N	-	<5.0	<5.0	<DL	-	327	326	Y	0%
Conductivity	µS/cm	2	10	178	179	Y	0%	212	208	Y	0%	243	243	Y	0%	175	174	Y	0%	190	185.0	Y	1%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	95.1	96.0	Y	0%	107	107	Y	0%	117	114	Y	1%	80.8	82.7	Y	1%	171	177.0	Y	1%
pH	pH	0.01	0.05	8.21	8.22	Y	0%	8.34	8.27	Y	0%	7.68	7.99	Y	1%	8.16	8.25	Y	0%	8.09	8.05	Y	0%
Total Suspended Solids	mg/L	1	5	70.5	68.5	Y	1%	12.1	17.6	Y	9%	57.9	41.9	Y	8%	4.8	4.8	Y	0%	<1	<1	<DL	-
Total Dissolved Solids	mg/L	5	25	98	97	Y	0%	127	119	Y	2%	179	192	Y	2%	99	97	Y	1%	178	177	Y	0%
Turbidity	NTU	0.1	0.5	31.5	31.9	Y	0%	9.02	10.4	Y	4%	84.7	86.6	Y	1%	0.79	0.82	Y	1%	0.8	0.8	Y	0%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	1.4	1.3	N	-	<1.0	<1.0	<DL	-	2.5	2.3	N	-	<1.0	1.3	N	-	-	-	-	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	91.4	91.7	Y	0%	67.3	102	Y	10%	115	103	Y	3%	87.5	87.3	Y	0%	-	-	-	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<1.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	-	-	-	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<1.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	-	-	-	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	91.4	91.7	Y	0%	67.3	102	Y	10%	115	103	Y	3%	87.5	87.3	Y	0%	151	151	Y	0%
Ammonia (as N)	mg/L	0.005	0.025	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.02	<0.02	<DL	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.10	<0.10	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	0.51	0.51	Y	0%	1.24	1.28	Y	1%
Fluoride (F)	mg/L	0.02	0.1	0.028	0.028	N	-	0.030	0.030	N	-	0.075	0.073	N	-	0.023	0.023	N	-	<0.10	<0.10	<DL	-
Nitrate (as N)	mg/L	0.005	0.025	0.0879	0.0906	Y	1%	0.0842	0.0823	Y	1%	0.0703	0.0700	Y	0%	0.0177	0.0186	N	-	0.01	0.02	N	-
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0017	0.0012	N	-	<0.0010	<0.0010	<DL	-	<0.01	<0.01	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	0.066	0.058	N	-	0.206	0.199	N	-	<0.050	0.051	N	-	0.07	0.07	N	-
Total Nitrogen	mg/L	0.01	0.05	0.130	0.130	Y	0%	0.150	0.140	Yes	2%	0.278	0.270	Y	1%	0.050	0.070	Y	8%	-	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	0.05	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus-Total	mg/L	0.002	0.01	0.0728	0.0671	Y	2%	0.0136	0.0177	Y	7%	0.0819	0.0754	Y	2%	0.0031	0.0026	N	-	<0.010	0.025	Y	-
Sulphate (SO_4)	mg/L	0.5	2.5	3.80	3.80	Y	0%	7.08	7.15	Y	0%	35.7	35.6	Y	0%	7.45	7.47	Y	0%	17.6	18.2	Y	1%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	-	-	-	-	-	-	-	-	-	-	-	-	<0.0010	<0.0010	<DL	-	<0.002	<0.002	<DL	-
Cyanide, Total	mg/L	0.001	0.005	0.0036	0.0039	N	-	0.0033	0.0031	N	-	0.0049	0.0052	Y	1%	0.0014	0.0011	N	-	<0.01	<0.01	<DL	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	2.95	2.98	Y	0%	2.42	2.62	Y	2%	5.37	4.86	Y	2%	0.78	1.66	N	-	1.00	1.00	N	-
Total Metals																							
Aluminum (Al)	mg/L	0.001	0.005	1.33	1.30	Y	1%	0.315	0.288	Y	2%	2.42	2.41	Y	0%	0.0132	0.0230	Y	14%	<0.050	0.074	Y	-
Antimony (Sb)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00014	0.00014	N	-	<0.00010	<0.00010	<DL	-	<0.0010	<0.0010	<DL	-
Arsenic (As)	mg/L	0.0001	0.0005	0.00057	0.00053	Y	2%	0.00021	0.00020	N	-	0.00065	0.00069	Y	1%	<0.00010	0.00012	N	-	<0.0050	<0.0050	<DL	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0543	0.0534	Y	0%	0.0470	0.0485	Y	1%	0.155	0.158	Y	0%	0.0282	0.0300	Y	2%	0.0755	0.083	Y	2%
Beryllium (Be)	mg/L	0.0001	0.0005	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.0010	<0.0010	<DL	-
Bismuth (Bi)	mg/L	0.0005	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	-	-	-	-
Boron (B)	mg/L	0.004	0.02	0.010	<0.010	N	-	0.010	0.011	N	-	0.013	0.012	N	-	0.010	0.010	N	-	<0.040	<0.040	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000083	0.000074	Y	3%	0.000029	0.000033	N	-	0.000096	0.000096	Y	0%	<0.000010	<0.000010	<DL	-	<0.00010	<0.00010	<DL	-
Calcium (Ca)	mg/L	0.02	0.1	32.0	31.4	Y	0%	33.1	32.9	Y	0%	36.6	36.3	Y	0%	21.4	23.3	Y	2%	51.9	49.1	Y	1%
Chromium (Cr)	mg/L	0.0001	0.0005	0.00191	0.00179	Y	2%	0.00075	0.00057	Y	7%	0.00383	0.00393	Y	1%	0.00013	0.00017	N	-	<0.0050	<0.0050	<DL	-
Cobalt (Co)	mg/L	0.00005	0.00025	0.00071	0.00065	Y	2%	0.00018	0.00018	N	-	0.00096	0.00096	Y	0%	<0.00010	<0.00010	<DL	-	<0.00050	<0.00050	<DL	-
Copper (Cu)	mg/L	0.0001	0.0005	0.00171	0.00177	Y	1%	0.00064	0.00068	Y	2%	0.00323	0.00323	Y	0%	<0.00030	<0.00030	<DL	-	<0.0010	<0.0010	<DL	-
Iron (Fe)	mg/L	0.01	0.05	1.57	1.52	Y	1%	0.353	0.382	Y	2%	2.06	2.15	Y	1%	0.044	0.060	Y	8%	0.13	<0.10	Y	-
Lead (Pb)	mg/L	0.00005	0.00025	0.000846	0.000775	Y	2%	0.000192	0.000227	N	-	0.00107	0.00109	Y	0%	0.000087	0.000052	N	-	<0.0010	<0.0010	<DL	-
Lithium (Li)	mg/L	0.0001	0.0005	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	0.0069	0.0071	Y	1%	<0.0050	<0.0050	<DL	-	0.0067	0.0072	Y	2%
Magnesium (Mg)	mg/L	0.005	0.025	8.89	8.66	Y	1%	7.98	7.83	Y	0%	12.1	11.9	Y	0%	6.16	6.61	Y	2%	14.7	15.2	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0447	0.0413	Y	2%	0.0115	0.0116	Y	0%	0.0358	0.0360	Y	0%	0.00483	0.00610	Y	6%	0.0053	0.0051	Y	1%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.00050	<0.00050	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR1				MR3				M20-03				MR-REF				MR6			
Date Sampled		2010 DL		20-May-10		>5x DL?		31-May-10		>5x DL?		14-Jun-10		>5x DL?		15-Aug-10		>5x DL?		8-Dec-10		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L889661-4	L889661-5	Y/N/<DL	RPD	L892473-1	L892473-8	Y/N/<DL	RPD	L897909-7	L897909-8	Y/N/<DL	RPD	L921658-4	L921658-7	Y/N/<DL	RPD	R012173-06	R012173-07	Y/N/<DL	RPD
Total Metals (*cont'd*)																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000559	0.000573	Y	1%	0.000593	0.000636	Y	2%	0.000583	0.000607	Y	1%	0.000526	0.000533	Y	0%	<0.0010	<0.0010	<DL	-
Nickel (Ni)	mg/L	0.0002	0.001	0.00237	0.00215	Y	2%	0.00093	0.00086	N	-	0.00425	0.00442	Y	1%	<0.00050	<0.00050	<DL	-	0.0023	<0.0020	Y	-
Phosphorus (P)	mg/L	0.3	1.5	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	-	-	-	-
Potassium (K)	mg/L	0.05	0.25	0.723	0.705	Y	1%	0.400	0.394	Y	0%	1.36	1.40	Y	1%	0.272	0.303	Y	3%	-	-	-	-
Selenium (Se)	mg/L	0.0001	0.0005	<0.00020	<0.00020	<DL	-	0.00028	0.00024	N	-	0.00125	0.00134	Y	2%	0.00010	<0.00010	N	-	<0.0030	<0.0030	<DL	-
Silicon (Si)	mg/L	0.05	0.25	2.73	2.80	Y	1%	1.52	1.54	Y	0%	5.37	6.11	Y	3%	0.887	0.900	Y	0%	-	-	-	-
Silver (Ag)	mg/L	0.00001	0.00005	0.000014	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	0.000029	0.000035	N	-	<0.000010	<0.000010	<DL	-	<0.00050	<0.00050	<DL	-
Sodium (Na)	mg/L	0.01	0.05	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	6.7	6.7	Y	0%	<2.0	<2.0	<DL	-	2.1	2.19	Y	1%
Strontium (Sr)	mg/L	0.0001	0.0005	0.0750	0.0727	Y	1%	0.0692	0.0696	Y	0%	0.122	0.122	Y	0%	0.0774	0.0805	Y	1%	-	-	-	-
Thallium (Tl)	mg/L	0.00002	0.0001	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00020	<0.00020	<DL	-
Tin (Sn)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	0.00014	N	-	<0.00010	<0.00010	<DL	-	-	-	-	-
Titanium (Ti)	mg/L	0.005	0.025	0.022	0.022	N	-	<0.010	<0.010	<DL	-	0.039	0.050	Y	6%	<0.010	<0.010	<DL	-	<0.050	<0.050	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000208	0.000206	Y	0%	0.000198	0.000201	Y	0%	0.000457	0.000469	Y	1%	0.000139	0.000149	Y	2%	0.00033	0.00032	Y	1%
Vanadium (V)	mg/L	0.001	0.005	0.0047	0.0046	N	-	0.0012	0.0011	N	-	0.0085	0.0089	Y	1%	<0.0010	<0.0010	<DL	-	<0.0100	<0.0100	<DL	-
Zinc (Zn)	mg/L	0.001	0.005	0.0076	0.0075	Y	0%	0.0020	0.0022	N	-	0.0097	0.0100	Y	1%	<0.0010	<0.0010	<DL	-	<0.010	<0.010	<DL	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.001	0.005	0.0161	0.0168	Y	1%	0.0090	0.0096	Y	2%	0.0812	0.0667	Y	5%	0.0029	0.0027	N	2%	<0.05	<0.05	<DL	-
Antimony (Sb)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.001	<0.001	<DL	-
Arsenic (As)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	0.00011	N	-	0.00015	0.00014	N	-	<0.00010	<0.00010	<DL	-	<0.005	<0.005	<DL	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0306	0.0307	Y	0%	0.0408	0.0415	Y	0%	0.109	0.110	Y	0%	0.0290	0.0290	Y	0%	0.0747	0.0829	Y	3%
Beryllium (Be)	mg/L	0.0001	0.0005	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.001	<0.001	<DL	-
Bismuth (Bi)	mg/L	0.0005	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	-	-	-	-
Boron (B)	mg/L	0.004	0.02	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.04	<0.04	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000011	0.000011	N	-	0.000011	0.000015	N	-	0.000011	0.000011	N	-	<0.000010	<0.000010	<DL	-	<0.0001	<0.0001	<DL	-
Calcium (Ca)	mg/L	0.02	0.1	26.3	26.6	Y	0%	31.0	30.8	Y	0%	30.6	30.0	Y	0%	22.0	22.7	Y	1%	45	46.8	Y	1%
Chromium (Cr)	mg/L	0.0001	0.0005	<0.00020	<0.00020	<DL	-	<0.00050	<0.00050	<DL	-	0.00028	0.00024	N	-	<0.00010	<0.00010	<DL	-	<0.005	<0.005	<DL	-
Cobalt (Co)	mg/L	0.00005	0.00025	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.0005	<0.0005	<DL	-
Copper (Cu)	mg/L	0.0001	0.0005	0.00032	0.00063	Y	16%	0.00025	0.00026	N	1%	0.00107	0.00112	Y	1%	0.00017	0.00013	N	-	<0.001	<0.001	<DL	-
Iron (Fe)	mg/L	0.01	0.05	<0.030	0.031	N	-	<0.030	<0.030	<DL	-	0.055	0.050	Y	2%	<0.030	<0.030	<DL	-	<0.1	<0.1	<DL	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.001	<0.001	<DL	-
Lithium (Li)	mg/L	0.0001	0.0005	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	0.0051	<0.0050	Y	-	<0.0050	<0.0050	<DL	-	0.0063	0.0068	Y	2%
Magnesium (Mg)	mg/L	0.005	0.025	7.13	7.20	Y	0%	7.28	7.25	Y	0%	9.84	9.52	Y	1%	6.30	6.32	Y	0%	14.2	14.5	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.000378	0.000330	Y	3%	0.00221	0.00201	Y	2%	0.00411	0.00382	Y	2%	0.000151	0.000153	N	-	0.0049	0.0047	Y	1%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.0005	<0.0005	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000448	0.000451	Y	0%	0.000593	0.000568	Y	1%	0.000413	0.000453	Y	2%	0.000522	0.000536	Y	1%	<0.001	<0.001	<DL	-
Nickel (Ni)	mg/L	0.0002	0.001	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00103	0.00100	Y	1%	<0.00050	<0.00050	<DL	-	<0.002	<0.002	<DL	-
Phosphorus (P)	mg/L	0.3	1.5	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	-	-	-	-
Potassium (K)	mg/L	0.05	0.25	0.277	0.275	Y	0%	0.269	0.277	Y	1%	0.501	0.487	Y	1%	0.291	0.285	Y	1%	-	-	-	-
Selenium (Se)	mg/L	0.0001	0.0005	<0.00020	<0.00020	<DL	-	0.00024	0.00023	N	-	-	0.00166	Y	-	<0.00010	<0.00010	<DL	-	<0.003	0.0033	Y	-
Silicon (Si)	mg/L	0.05	0.25	1.02	1.04	Y	0%	1.09	1.10	Y	0%	1.95	1.90	Y	1%	0.858	0.840	Y	1%	-	-	-	-
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.0005	<0.0005	<DL	-
Sodium (Na)	mg/L	0.01	0.05	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	6.6	6.5	Y	0%	<2.0	<2.0	<DL	-	2.06	2.12	Y	1%
Strontium (Sr)	mg/L	0.0001	0.0005	0.0524	0.0536	Y	1%	0.0660	0.0679	Y	1%	0.115	0.114	Y	0%	0.0786	0.0779	Y	0%	0.154	0.157	Y	0%
Thallium (Tl)	mg/L	0.00002	0.0001	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.0002	<0.0002	<DL	-
Tin (Sn)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	-	-	-	-
Titanium (Ti)	mg/L	0.005	0.025	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.05	<0.05	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000139	0.000141	Y	0%	0.000172	0.000167	Y	1%	0.000343	0.000343	Y	0%	0.000141	0.000139	Y	0%	0.00037	0.00037	Y	0%
Vanadium (V)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.01	<0.01	<DL	-
Zinc (Zn)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.01	<0.01	<DL	-

Notes:

All parameters analyzed by ALS Environmental, except the December 2010 samples which was analyzed by CARO Analytical Services

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				M20-04				M20-03				M20-03				MR3				M20-04			
Date Sampled		2011 DL		5-Jan-11		>5x DL?		23-Feb-11		>5x DL?		29-Mar-11		>5x DL?		26-Apr-11		>5x DL?		11-May-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	R101042-09	R101042-10	Y/N/<DL	RPD	L981301-7	L981301-11	Y/N/<DL	RPD	L990825-7	L990825-8	Y/N/<DL	RPD	L999009-3	L999009-5	Y/N/<DL	RPD	L1004821-5	L1004821-6	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	6	7	N	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	36.2	35.9	Y	0%
Conductivity	µS/cm	2	10	392	395	Y	0%	414	413	Y	0%	415	417	Y	0%	338	338	Y	0%	233	233	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	179	181	Y	0%	196	195	Y	0%	190	187	Y	0%	175	170	Y	1%	115	115	Y	0%
pH	pH	0.01	0.05	8.26	8.27	Y	0%	8.21	8.23	Y	0%	8.11	8.14	Y	0%	8.29	8.31	Y	0%	8.14	8.13	Y	0%
Total Suspended Solids	mg/L	1	5	43	48	Y	3%	<3.0	<3.0	<DL	-	4.0	4.0	N	-	4.3	5.3	Y	5%	1020	983	Y	1%
Total Dissolved Solids	mg/L	10	50	251	252	Y	0%	-	-	-	-	257	257	Y	0%	-	-	-	-	182	181	Y	0%
Turbidity	NTU	0.1	0.5	110	110	Y	0%	0.51	0.52	Y	0%	12.9	12.3	Y	1%	3.85	3.68	Y	1%	734	761	Y	1%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	<2	<2	<DL	-	1.0	<1.0	N	-	4.7	4.6	N	-	<1.0	<1.0	<DL	-	<1.0	2.0	N	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	176	175	Y	0%	170	167	Y	0%	173	166	Y	1%	168	157	Y	2%	112	113	Y	0%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<1.0	<DL	-	<1.0	<1.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<1.0	<DL	-	<1.0	<1.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	176	175	Y	0%	170	167	Y	0%	173	166	Y	1%	168	157	Y	2%	112	113	Y	0%
Ammonia (as N)	mg/L	0.005	0.025	<0.02	<0.02	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	0.0076	0.0076	N	-	0.0165	0.0252	N	-
Bromide (Br)	mg/L	0.05	0.25	<0.10	<0.10	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	1.97	1.98	Y	0%	0.69	0.67	Y	1%	0.81	0.81	Y	0%	1.76	1.77	Y	0%	1.08	1.09	Y	0%
Fluoride (F)	mg/L	0.02	0.1	0.11	0.12	Y	2%	0.068	0.069	N	-	0.066	0.064	N	-	0.051	0.052	N	-	0.073	0.073	N	-
Nitrate (as N)	mg/L	0.005	0.025	0.12	0.12	Y	0%	0.134	0.134	Y	0%	0.133	0.135	Y	0%	0.0576	0.0577	Y	0%	0.153	0.153	Y	0%
Nitrite (as N)	mg/L	0.001	0.005	<0.01	<0.01	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	0.27	0.22	Y	5%	<0.050	<0.050	<DL	-	0.077	0.076	N	-	0.122	0.102	N	-	1.43	1.13	N	-
Total Nitrogen	mg/L	0.01	0.05	-	-	-	-	0.167	0.172	Y	1%	0.210	0.210	Y	0%	0.180	0.160	Y	3%	1.58	1.28	Y	5%
Orthophosphate-Dissolved (as P)	mg/L	0.05	0.25	-	-	-	-	0.0028	0.0024	N	-	0.0020	0.0022	N	-	<0.0010	<0.0010	<DL	-	0.0026	0.0028	<DL	-
Phosphorus-Total Dissolved	mg/L	0.002	0.01	-	-	-	-	0.0037	0.0027	N	-	0.0024	0.0027	N	-	<0.0020	<0.0020	<DL	-	0.0060	0.0069	<DL	-
Phosphorus-Total	mg/L	0.002	0.01	0.08	0.08	Y	0%	0.0039	0.0035	N	-	0.0109	0.0104	Y	1%	0.0063	0.0054	N	-	0.468	0.518	N	-
Sulphate (SO_4)	mg/L	0.5	2.5	48.7	49.4	Y	0%	59.7	59.8	Y	0%	58.6	58.5	Y	0%	26.2	26.1	Y	0%	17.9	18.0	Y	0%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.002	<0.002	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0011	<DL	-	<0.0011	<0.0010	<DL	-	<0.0020	<0.0020	<DL	-
Cyanide, Total	mg/L	0.001	0.005	<0.01	<0.01	<DL	-	0.0016	0.0019	N	-	0.0021	0.0014	N	-	0.0017	0.0018	N	-	<0.0020	<0.0020	N	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	2.8	2.8	Y	0%	2.08	2.50	N	-	1.83	1.95	N	-	1.52	1.39	N	-	27.6	26.5	N	-
Total Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	4.78	3.92	Y	5%	0.0086	0.0047	N	-	0.670	0.706	Y	1%	0.0878	0.0864	Y	0%	13.7	14.1	Y	1%
Antimony (Sb)	mg/L	0.00010	0.0005	<0.0010	<0.0010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00045	0.00049	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	<0.0050	<0.0050	<DL	-	0.00014	0.00011	N	-	0.00020	0.00025	N	-	0.00019	0.00020	N	-	0.00582	0.00635	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.235	0.235	Y	0%	0.222	0.218	Y	0%	0.234	0.233	Y	0%	0.0792	0.0769	Y	1%	0.514	0.568	Y	2%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.0010	<0.0010	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00071	0.00076	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.0010	<0.0010	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.040	<0.040	<DL	-	0.011	0.011	N	-	0.011	0.011	N	-	0.014	0.014	N	-	0.028	0.029	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	<0.00010	<0.00010	<DL	-	0.000011	<0.000010	N	-	0.000015	0.000011	N	-	0.000016	0.000017	N	-	0.000825	0.000895	N	-
Calcium (Ca)	mg/L	0.02000	0.1	42.3	42.6	Y	0%	54.9	53.3	Y	1%	50.3	51.2	Y	0%	49.3	48.7	Y	0%	81.7	83.2	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.0074	0.0069	Y	2%	0.00015	0.00019	N	-	0.00108	0.00114	Y	1%	0.00017	0.00021	N	-	0.0182	0.0205	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	0.00111	0.00098	Y	3%	<0.00010	<0.00010	<DL	-	0.00013	0.00014	N	-	<0.00010	<0.00010	<DL	-	0.00778	0.00854	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	0.0039	0.0031	Y	6%	0.00072	<0.00050	N	-	0.00060	0.00062	N	-	<0.00050	<0.00050	<DL	-	0.0204	0.0219	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	2.47	2.35	Y	1%	0.060	0.055	N	-	0.373	0.384	Y	1%	0.258	0.257	Y	0%	17.9	19.9	Y	3%
Lead (Pb)	mg/L	0.00005	0.00025	0.0013	0.0011	Y	4%	<0.000050	<0.000050	<DL	-	0.000196	0.000210	N	-	0.000083	0.000084	N	-	0.0105	0.0115	N	-
Lithium (Li)	mg/L	0.00050	0.0025	0.0122	0.0115	Y	1%	0.0052	0.0051	Y	0%	0.0055	0.0055	Y	0%	0.0086	0.0083	Y	1%	0.0169	0.0184	Y	2%
Magnesium (Mg)	mg/L	0.00500	0.025	17.9	18	Y	0%	15.9	15.4	Y	1%	16.8	16.9	Y	0%	13.8	13.6	Y	0%	20.0	20.4	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0443	0.0424	Y	1%	0.00791	0.00719	Y	2%	0.0103	0.0108	Y	1%	0.0157	0.0157	Y	0%	0.341	0.367	Y	2%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.00020	<0.00020	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	0.000044	0.000042	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				M20-04				M20-03				M20-03				MR3				M20-04			
Date Sampled		2011 DL		5-Jan-11		>5x DL?		23-Feb-11		>5x DL?		29-Mar-11		>5x DL?		26-Apr-11		>5x DL?		11-May-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	R101042-09	R101042-10	Y/N/<DL	RPD	L981301-7	L981301-11	Y/N/<DL	RPD	L990825-7	L990825-8	Y/N/<DL	RPD	L999009-3	L999009-5	Y/N/<DL	RPD	L1004821-5	L1004821-6	Y/N/<DL	RPD
Total Metals (*cont'd*)																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	<0.0010	<0.0010	<DL	-	0.000467	0.000471	Y	0%	0.000471	0.000473	Y	0%	0.000960	0.000922	Y	1%	0.00142	0.00153	Y	2%
Nickel (Ni)	mg/L	0.00050	0.0025	0.0054	0.0046	Y	4%	<0.00050	<0.00050	<DL	-	0.00086	0.00088	N	-	0.00054	0.00052	N	-	0.0275	0.0301	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.20	<0.20	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	0.86	0.91	<DL	-
Potassium (K)	mg/L	0.05000	0.25	2.26	1.82	Y	5%	0.530	0.506	Y	1%	0.772	0.792	Y	1%	0.562	0.559	Y	0%	4.10	4.63	Y	3%
Selenium (Se)	mg/L	0.00010	0.0005	<0.0050	<0.0050	<DL	-	0.00188	0.00138	Y	-	0.00130	0.00131	Y	0%	0.00039	0.00033	N	-	0.00091	0.00096	N	-
Silicon (Si)	mg/L	0.05000	0.25	13	9.1	Y	9%	2.08	2.04	Y	0%	3.56	3.66	Y	1%	1.75	1.72	Y	0%	32.6	39.0	Y	4%
Silver (Ag)	mg/L	0.00001	0.00005	<0.00050	<0.00050	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	0.000221	0.000245	<DL	-
Sodium (Na)	mg/L	0.20000	1	12.9	13	Y	0%	12.2	11.9	Y	1%	12.4	12.4	Y	0%	3.1	3.1	Y	0%	3.8	3.9	Y	1%
Strontium (Sr)	mg/L	0.00010	0.0005	0.2	0.2	Y	0%	0.190	0.193	Y	0%	0.189	0.191	Y	0%	0.190	0.186	Y	1%	0.152	0.157	Y	1%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.00020	<0.00020	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00033	0.00037	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.0020	<0.0020	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	0.158	0.092	Y	13%	<0.010	<0.010	<DL	-	0.030	0.035	N	-	<0.010	<0.010	<DL	-	0.407	0.500	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.00073	0.00066	Y	3%	0.000601	0.000595	Y	0%	0.000642	0.000640	Y	0%	0.000349	0.000343	Y	0%	0.00108	0.00112	Y	1%
Vanadium (V)	mg/L	0.00100	0.005	0.016	0.013	Y	5%	<0.0010	<0.0010	<DL	-	0.0022	0.0022	N	-	<0.0010	<0.0010	<DL	-	0.0420	0.0473	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	<0.040	<0.040	<DL	-	<0.0030	<0.0030	<DL	-	0.0030	<0.0030	N	-	<0.0030	<0.0030	<DL	-	0.0848	0.0916	<DL	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	<0.05	<0.05	<DL	-	<0.0030	<0.0030	<DL	-	0.0122	0.0113	N	-	<0.0030	<0.0030	<DL	-	0.128	0.0363	<DL	-
Antimony (Sb)	mg/L	0.00010	0.0005	<0.001	<0.001	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	0.00011	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	<0.005	<0.005	<DL	-	0.00012	0.00011	<DL	-	<0.00010	<0.00010	<DL	-	0.00012	0.00013	N	-	0.00020	0.00021	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.179	0.179	Y	0%	0.212	0.217	Y	1%	0.212	0.206	Y	1%	0.0735	0.0737	Y	0%	0.0819	0.0943	Y	4%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.001	<0.001	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.001	<0.001	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.04	<0.04	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	0.011	0.011	N	-	0.010	0.013	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	<0.0001	<0.0001	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	0.000011	<DL	-	0.000019	0.000016	<DL	-
Calcium (Ca)	mg/L	0.02000	0.1	27.2	27.7	Y	0%	52.6	52.6	Y	0%	49.2	48.1	Y	1%	47.9	46.4	Y	1%	32.6	33.2	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	<0.005	<0.005	<DL	-	<0.00010	<0.00010	<DL	-	0.00010	0.00011	N	-	<0.00010	<0.00010	<DL	-	0.00034	0.00028	<DL	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.0005	<0.0005	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00017	0.00014	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	<0.002	<0.002	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00229	0.00212	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	<0.1	<0.1	<DL	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	0.050	<0.030	<DL	-	0.104	0.102	<DL	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.001	<0.001	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	0.000127	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.0072	0.007	<DL	-	0.0052	0.0051	<DL	-	0.0050	<0.0050	Y	-	0.0081	0.0080	Y	0%	<0.0050	<0.0050	<DL	-
Magnesium (Mg)	mg/L	0.00500	0.025	15.9	16.1	Y	0%	15.6	15.4	Y	0%	16.3	16.3	Y	0%	13.4	13.1	Y	1%	8.08	7.84	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	<0.002	<0.002	<DL	-	0.00666	0.00669	Y	0%	0.00644	0.00632	Y	0%	0.0118	0.0113	Y	1%	0.00753	0.00557	Y	7%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.0002	<0.0002	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	<0.001	<0.001	<DL	-	0.000425	0.000444	<DL	-	0.000442	0.000428	Y	1%	0.000897	0.000878	Y	1%	0.000311	0.000350	Y	3%
Nickel (Ni)	mg/L	0.00050	0.0025	<0.002	<0.002	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00170	0.00151	<DL	-
Phosphorus (P)	mg/L	0.20000	1	<0.2	<0.2	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.509	0.502	Y	0%	0.542	0.512	Y	1%	0.528	0.532	Y	0%	0.530	0.526	Y	0%	0.589	0.564	Y	1%
Selenium (Se)	mg/L	0.00010	0.0005	<0.005	<0.005	<DL	-	0.00142	0.00157	<DL	-	0.00127	0.00127	Y	0%	0.00035	0.00038	N	-	0.00051	0.00050	N	-
Silicon (Si)	mg/L	0.05000	0.25	<5	<5	<DL	-	2.05	2.05	Y	0%	1.92	1.91	Y	0%	1.56	1.56	Y	0%	2.08	2.00	Y	1%
Silver (Ag)	mg/L	0.00001	0.00005	<0.005	<0.005	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	11	11.2	Y	0%	12.1	11.9	Y	0%	12.0	12.0	Y	0%	3.3	3.3	Y	0%	6.0	3.4	Y	14%
Strontium (Sr)	mg/L	0.00010	0.0005	0.169	0.171	Y	0%	0.185	0.183	Y	0%	0.180	0.182	Y	0%	0.178	0.178	Y	0%	0.0848	0.0849	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.0002	<0.0002	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.002	<0.002	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.05	<0.05	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.00037	0.0004	Y	2%	0.000563	0.000553	Y	0%	0.000595	0.000599	Y	0%	0.000325	0.000322	Y	0%	0.000217	0.000268	Y	5%
Vanadium (V)	mg/L	0.00100	0.005	<0.01	<0.01	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	<0.04	<0.04	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	0.0060	<0.0030	<DL	-

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 samples which was analyzed by CARO Analytical Services

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR6				MR3				MR3				MR10				MR3			
Date Sampled		2011 DL		17-May-11		>5x DL?		25-May-11		>5x DL?		2-Jun-11		>5x DL?		8-Jun-11		>5x DL?		14-Jun-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1007262-3	L1007262-4	Y/N/<DL	RPD	L1009390-4	L1009390-6	Y/N/<DL	RPD	L1012487-5	L1012487-8	Y/N/<DL	RPD	L1015493-10	L1015493-6	Y/N/<DL	RPD	L1018864-3	L1018864-5	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	20.3	20.3	N	-	12.9	13.3	N	-	9.6	9.4	N	-	9.5	9.6	N	-	7.1	7.1	N	-
Conductivity	µS/cm	2	10	208	209	Y	0%	212	214	Y	0%	191	190	Y	0%	191	190	Y	0%	180	179	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	108	108	Y	0%	109	109	Y	0%	98.5	102	Y	1%	99.5	99.8	Y	0%	90.0	91.0	Y	0%
pH	pH	0.01	0.05	8.05	8.20	Y	0%	8.27	8.26	Y	0%	8.21	8.22	Y	0%	8.16	8.17	Y	0%	8.25	8.25	Y	0%
Total Suspended Solids	mg/L	1	5	213	206	Y	1%	84.4	83.8	Y	0%	29.5	32.8	Y	3%	56.7	60.0	Y	1%	48.7	36.7	Y	7%
Total Dissolved Solids	mg/L	10	50	-	-	-	-	115	117	Y	0%	-	-	-	-	115	111	-	-	-	-	-	-
Turbidity	NTU	0.1	0.5	89.8	90.1	Y	0%	34.1	32.5	Y	1%	20.7	21.3	Y	1%	28.3	27.6	Y	1%	15.8	14.5	Y	2%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	2.5	1.7	N	-	1.4	1.5	N	-	1.5	1.4	N	-	3.4	3.3	N	-	1.4	<1.0	N	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	114	112	Y	0%	112	110	Y	0%	96.8	100	Y	1%	92.1	91.5	Y	0%	91.7	92.5	Y	0%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	114	112	Y	0%	112	110	Y	0%	96.8	100	Y	1%	92.1	91.5	Y	0%	91.7	92.5	Y	0%
Ammonia as N	mg/L	0.005	0.025	0.0103	0.0070	N	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	0.0058	<DL	-	0.0080	0.0076	N	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	3.24	<0.50	Y	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-
Fluoride (F)	mg/L	0.02	0.1	0.038	0.037	N	-	0.039	0.040	N	-	0.035	0.034	N	-	0.023	0.022	N	-	<0.020	<0.020	<DL	-
Nitrate (as N)	mg/L	0.005	0.025	0.109	0.111	Y	0%	0.0707	0.0695	Y	0%	0.0555	0.0541	Y	1%	0.0929	0.0966	Y	1%	0.0304	0.0303	Y	0%
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	0.292	0.259	Y	3%	0.169	0.161	N	-	0.095	0.096	N	-	0.157	0.173	N	-	0.120	0.130	N	-
Total Nitrogen	mg/L	0.01	0.05	0.400	0.370	Y	2%	0.240	0.230	Y	1%	0.150	0.150	Y	0%	0.250	0.270	Y	2%	0.150	0.160	Y	2%
Orthophosphate-Dissolved (as P)	mg/L	0.05	0.25	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0014	0.0013	N	-	<0.0010	<0.0010	<DL	-
Phosphorus-Total Dissolved	mg/L	0.002	0.01	0.0034	0.0040	N	-	0.0028	0.0023	N	-	<0.0020	<0.0020	<DL	-	0.0027	0.0026	N	-	<0.0020	<0.0020	<DL	-
Phosphorus-Total	mg/L	0.002	0.01	0.359	0.163	Y	19%	0.078	0.084	Y	2%	0.0366	0.0335	Y	2%	0.0395	0.0629	Y	11%	0.0431	0.0238	Y	14%
Sulphate (SO_4)	mg/L	0.5	2.5	6.46	6.45	Y	0%	5.96	5.97	Y	0%	5.08	5.04	Y	0%	9.25	9.32	Y	0%	4.83	4.77	Y	0%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	0.0011	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Cyanide, Total	mg/L	0.001	0.005	0.0074	0.0076	Y	1%	0.0054	0.0053	Y	0%	0.0040	0.0037	N	-	0.0020	<0.0010	N	-	0.0012	0.0027	N	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	9.98	9.52	Y	1%	4.06	4.21	Y	1%	3.05	3.12	Y	1%	3.44	3.50	Y	0%	2.27	2.48	N	-
Total Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	2.89	3.08	Y	2%	1.15	1.10	Y	1%	0.688	0.628	Y	2%	0.983	0.984	Y	0%	0.662	0.541	Y	5%
Antimony (Sb)	mg/L	0.00010	0.0005	0.00017	0.00017	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00158	0.00157	Y	0%	0.00064	0.00057	Y	3%	0.00036	0.00034	N	-	0.00050	0.00051	Y	0%	0.00033	0.00029	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.125	0.127	Y	0%	0.0744	0.0718	Y	1%	0.0568	0.0550	Y	1%	0.0682	0.0649	Y	1%	0.0427	0.0427	Y	0%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	0.014	0.015	N	-	0.011	0.011	N	-	<0.010	<0.010	<DL	-	0.011	<0.010	N	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000242	0.000206	Y	4%	0.000111	0.000101	Y	2%	0.000047	0.000052	Y	3%	0.000067	0.000065	Y	1%	0.000045	0.000040	N	-
Calcium (Ca)	mg/L	0.02000	0.1	40.3	40.3	Y	0%	35.5	36.1	Y	0%	32.4	31.9	Y	0%	30.3	28.7	Y	1%	27.3	27.0	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00476	0.00498	Y	1%	0.00205	0.00188	Y	2%	0.00115	0.00103	Y	3%	0.00173	0.00162	Y	2%	0.00126	0.00110	Y	3%
Cobalt (Co)	mg/L	0.00010	0.0005	0.00181	0.00176	Y	1%	0.00067	0.00066	Y	0%	0.00035	0.00035	N	-	0.00049	0.00048	N	-	0.00033	0.00028	N	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00457	0.00460	<DL	-	0.00218	0.00337	Y	11%	0.00114	0.00164	N	-	0.00168	0.00221	N	-	0.00214	0.00181	N	-
Iron (Fe)	mg/L	0.03000	0.15	4.11	4.17	Y	0%	1.58	1.46	Y	2%	0.826	0.788	Y	1%	1.16	1.20	Y	1%	0.808	0.707	Y	3%
Lead (Pb)	mg/L	0.00005	0.00025	0.00240	0.00235	Y	1%	0.000966	0.000887	Y	2%	0.000448	0.000451	Y	0%	0.000598	0.000627	Y	1%	0.000406	0.000351	Y	4%
Lithium (Li)	mg/L	0.00050	0.0025	0.0054	0.0055	Y	0%	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	0.00170	0.00158	N	-
Magnesium (Mg)	mg/L	0.00500	0.025	11.0	11.0	Y	0%	8.88	8.95	Y	0%	8.12	7.93	Y	1%	8.15	7.69	Y	1%	6.57	6.68	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0993	0.0971	Y	1%	0.0359	0.0380	Y	1%	0.0208	0.0210	Y	0%	0.0243	0.0234	Y	1%	0.0183	0.0170	Y	2%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR6				MR3				MR3				MR10				MR3			
Date Sampled		2011 DL		17-May-11		>5x DL?		25-May-11		>5x DL?		2-Jun-11		>5x DL?		8-Jun-11		>5x DL?		14-Jun-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1007262-3	L1007262-4	Y/N/<DL	RPD	L1009390-4	L1009390-6	Y/N/<DL	RPD	L1012487-5	L1012487-8	Y/N/<DL	RPD	L1015493-10	L1015493-6	Y/N/<DL	RPD	L1018864-3	L1018864-5	Y/N/<DL	RPD
Total Metals (*cont'd*)																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000771	0.000763	Y	0%	0.000602	0.000606	Y	0%	0.000536	0.000525	Y	1%	0.000640	0.000603	Y	1%	0.000531	0.000559	Y	1%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00655	0.00657	Y	0%	0.00275	0.00272	Y	0%	0.00158	0.00158	N	-	0.00217	0.00210	N	-	0.00137	0.00128	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	1.40	1.47	Y	1%	0.789	0.771	Y	1%	0.532	0.506	Y	1%	0.624	0.634	Y	0%	0.449	0.413	Y	2%
Selenium (Se)	mg/L	0.00010	0.0005	0.00034	0.00038	N	-	0.00024	0.00023	N	-	0.00015	0.00014	N	-	0.00044	0.00045	N	-	0.00015	0.00013	N	-
Silicon (Si)	mg/L	0.05000	0.25	6.32	6.82	Y	2%	3.45	3.27	Y	1%	2.49	2.09	Y	4%	2.69	2.71	Y	0%	2.02	1.87	Y	2%
Silver (Ag)	mg/L	0.00001	0.00005	0.000050	0.000050	<DL	-	0.000018	0.000013	N	-	<0.000010	<0.000010	<DL	-	0.000010	0.000012	N	-	0.000034	0.000021	N	-
Sodium (Na)	mg/L	0.20000	1	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.0829	0.0834	Y	0%	0.0718	0.0722	Y	0%	0.0626	0.0607	Y	1%	0.0670	0.0639	Y	1%	0.0564	0.0554	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.000019	0.000017	N	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	0.064	0.076	Y	4%	0.025	0.024	N	-	0.023	0.016	N	-	0.020	0.023	N	-	0.013	0.014	N	-
Uranium (U)	mg/L	0.00001	0.00005	0.000379	0.000359	Y	1%	0.000247	0.000234	Y	1%	0.000180	0.000173	Y	1%	0.000220	0.000205	Y	2%	0.000163	0.000164	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	0.0110	0.0117	Y	2%	0.0047	0.0045	N	-	0.0026	0.0025	N	-	0.0039	0.0040	N	-	0.0026	0.0021	N	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0210	0.0209	Y	0%	0.0097	0.0084	N	-	0.0050	0.0050	N	-	0.0071	0.0070	N	-	0.0055	0.0039	N	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	0.0339	0.0348	Y	1%	0.0207	0.0204	Y	0%	0.0189	0.0195	Y	1%	0.0243	0.0249	Y	1%	0.0120	0.0116	N	-
Antimony (Sb)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00013	0.00014	N	-	0.00013	0.00013	N	-	0.00011	0.00011	N	-	0.00011	0.00011	N	-	0.00011	<0.00010	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0491	0.0493	Y	0%	0.0484	0.0489	Y	0%	0.0425	0.0436	Y	1%	0.0448	0.0451	Y	0%	0.0350	0.0344	Y	0%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000014	0.000012	N	-	0.000012	0.000011	N	-	0.000011	0.000011	N	-	0.000014	0.000014	N	-	<0.000010	<0.000010	<DL	-
Calcium (Ca)	mg/L	0.02000	0.1	30.3	30.2	Y	0%	30.8	30.9	Y	0%	27.9	28.9	Y	1%	27.8	27.8	Y	0%	25.8	26.0	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00017	0.00017	N	-	0.00012	0.00012	N	-	<0.00010	0.00012	N	-	0.00017	0.00015	N	-	<0.00010	0.00010	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00084	0.00094	N	-	0.00071	0.00071	N	-	<0.00050	0.00070	N	-	0.00075	0.00092	N	-	0.00067	0.00078	N	-
Iron (Fe)	mg/L	0.03000	0.15	0.056	0.056	N	-	0.043	0.042	N	-	<0.030	<0.030	<DL	-	0.035	0.038	N	-	<0.030	<0.030	<DL	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	0.00138	0.00139	<DL	-
Magnesium (Mg)	mg/L	0.00500	0.025	7.92	7.82	Y	0%	7.77	7.77	Y	0%	7.01	7.23	Y	1%	7.31	7.38	Y	0%	6.19	6.32	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00571	0.00550	Y	1%	0.00351	0.00368	Y	1%	0.00280	0.00322	Y	3%	0.00287	0.00300	Y	1%	0.00367	0.00318	Y	4%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000479	0.000482	Y	0%	0.000499	0.000493	Y	0%	0.000463	0.000472	Y	0%	0.000548	0.000561	Y	1%	0.000448	0.000458	Y	1%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00070	0.00072	N	-	0.00059	0.00058	N	-	<0.00050	<0.00050	<DL	-	0.00061	0.00064	N	-	<0.00050	0.00061	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.367	0.374	Y	0%	0.373	0.375	Y	0%	0.252	0.281	Y	3%	0.281	0.291	Y	1%	0.229	0.229	N	-
Selenium (Se)	mg/L	0.00010	0.0005	0.00028	0.00025	N	-	0.00022	0.00021	N	-	0.00018	0.00018	N	-	0.00045	0.00044	N	-	0.00014	0.00013	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.33	1.28	Y	1%	1.30	1.33	Y	1%	1.09	1.13	Y	1%	1.15	1.16	Y	0%	0.973	0.970	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	2.2	<2.0	Y	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	2.2	2.3	Y	1%	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.0696	0.0702	Y	0%	0.0666	0.0670	Y	0%	0.0555	0.0568	Y	1%	0.0638	0.0645	Y	0%	0.0559	0.0552	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000165	0.000167	Y	0%	0.000152	0.000149	Y	0%	0.000131	0.000128	Y	1%	0.000160	0.000156	Y	1%	0.000123	0.000123	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	<0.0030	0.0039	N	-	0.0032	0.0031	N	-	<0.0030	0.0031	N	-	0.0031	0.0050	N	-	<0.0030	0.0046	N	-

Notes:

All parameters analyzed by ALS Environmental

RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				M20-04				M20-03				REFST				MR8				MR7			
Date Sampled		2011 DL		19-Jul-11		>5x DL?		22-Aug-11		>5x DL?		26-Sep-11		>5x DL?		18-Oct-11		>5x DL?		29-Nov-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1034422-12	L1034422-13	Y/N/<DL	RPD	L1049152-4	L1049152-5	Y/N/<DL	RPD	L1064458-1	L1064458-2	Y/N/<DL	RPD	L1073725-13	L1073725-14	Y/N/<DL	RPD	L1091894-6	L1091894-11	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	24.5	25.5	Y	1%	8.6	8.5	N	-	6.9	6.8	N	-	<5.0	<5.0	<DL	-	10.2	9.6	N	-
Conductivity	µS/cm	2	10	287	290	Y	0%	408	405	Y	0%	309	309	Y	0%	264	255	Y	1%	238	244	Y	1%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	136	137	Y	0%	188	189	Y	0%	165	164	Y	0%	122	127	Y	1%	129	133	Y	1%
pH	pH	0.01	0.05	8.26	8.26	Y	0%	8.32	8.31	Y	0%	8.39	8.29	Y	0%	8.32	8.32	Y	0%	8.29	8.29	Y	0%
Total Suspended Solids	mg/L	1	5	52.5	60.5	Y	4%	<3.0	<3.0	<DL	-	<3.0	<3.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-
Total Dissolved Solids	mg/L	10	50	-	-	-	-	-	-	-	-	-	-	-	-	<3.0	<3.0	<DL	-	8.7	3.3	N	-
Turbidity	NTU	0.1	0.5	105	105	Y	0%	0.70	0.72	Y	1%	1.33	1.38	Y	1%	2.76	2.76	Y	0%	8.16	4.45	Y	15%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	122	118	Y	1%	153	152	Y	0%	141	143	Y	0%	122	123	Y	0%	120	135	Y	3%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	122	118	Y	1%	153	152	Y	0%	141	143	Y	0%	122	123	Y	0%	120	135	Y	3%
Ammonia as N	mg/L	0.005	0.025	0.0099	0.0058	N	-	0.0052	0.0054	N	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	0.90	0.90	Y	0%	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	0.73	0.73	Y	0%	0.78	0.97	Y	5%
Fluoride (F)	mg/L	0.02	0.1	0.092	0.092	N	-	0.091	0.091	N	-	0.056	0.056	N	-	0.042	0.042	N	-	0.043	0.044	N	-
Nitrate (as N)	mg/L	0.005	0.025	0.0202	0.0192	N	1%	0.0166	0.0207	N	-	0.0291	0.0254	Y	3%	0.0209	0.0210	N	-	0.0614	0.0532	Y	4%
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	0.455	0.441	Y	1%	0.163	0.109	N	-	0.061	<0.050	N	-	<0.050	0.059	N	-	<0.050	<0.050	<DL	-
Total Nitrogen	mg/L	0.01	0.05	0.475	0.460	Y	1%	0.180	0.130	Y	8%	0.090	0.070	Y	6%	0.070	0.080	Y	3%	0.060	<0.050	Y	-
Orthophosphate-Dissolved (as P)	mg/L	0.05	0.25	0.0014	0.0014	N	-	<0.0010	<0.0010	<DL	-	0.0056	0.0055	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Phosphorus-Total Dissolved	mg/L	0.002	0.01	0.0026	0.0033	N	-	0.0032	<0.0020	N	-	0.0067	0.0064	N	-	<0.0020	<0.0020	<DL	-	0.0036	<0.0020	N	-
Phosphorus-Total	mg/L	0.002	0.01	0.091	0.091	Y	0%	0.0044	0.0047	N	-	0.0122	0.0132	Y	2%	0.0036	0.0035	N	-	0.0135	0.0068	Y	17%
Sulphate (SO_4)	mg/L	0.5	2.5	38.8	38.7	Y	0%	64.4	64.5	Y	0%	23.8	23.8	Y	0%	12.4	12.3	Y	0%	11.6	9.51	Y	5%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	0.0068	<0.0010	Y	-	<0.0010	<0.0010	<DL	-	-	<0.0020	<DL	-	<0.0020	<0.0020	<DL	-	<0.0011	<0.0011	<DL	-
Cyanide, Total	mg/L	0.001	0.005	0.0039	0.0086	Y	19%	0.0034	0.0029	N	-	0.0030	0.0035	N	-	0.0028	<0.0020	N	-	0.0038	0.0029	N	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	8.90	8.97	Y	0%	2.95	2.57	Y	3%	2.37	2.38	N	-	1.64	1.57	N	-	2.57	2.67	Y	1%
Total Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	2.46	2.29	Y	2%	0.0188	0.0225	Y	4%	0.0586	0.0573	Y	1%	0.139	0.0816	Y	13%	0.262	0.115	Y	19%
Antimony (Sb)	mg/L	0.00010	0.0005	0.00017	0.00018	N	-	<0.00010	<0.00010	<DL	-	0.00011	0.00011	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00098	0.00094	Y	1%	0.00016	0.00014	N	-	0.00015	0.00017	N	-	0.00015	0.00013	N	-	0.00020	0.00014	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.174	0.174	Y	0%	0.216	0.209	Y	1%	0.0333	0.0339	Y	0%	0.0488	0.0477	Y	1%	0.0494	0.0537	Y	2%
Beryllium (Be)	mg/L	0.00010	0.0005	0.00013	0.00012	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	0.017	0.017	N	-	0.012	0.012	N	-	<0.010	<0.010	<DL	-	0.012	<0.010	N	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000124	0.000126	Y	0%	0.000013	0.000015	N	-	0.000033	0.000034	N	-	0.000013	0.000012	N	-	0.000025	0.000014	N	-
Calcium (Ca)	mg/L	0.02000	0.1	40.3	40.9	Y	0%	51.0	49.9	Y	1%	50.3	50.2	Y	0%	35.6	34.4	Y	1%	36.3	35.7	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00412	0.00373	Y	2%	0.00025	0.00013	N	-	0.00043	0.00045	N	-	0.00039	0.00028	N	-	0.00048	0.00026	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	0.00115	0.00115	Y	0%	0.00101	0.00071	Y	9%	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00015	<0.00010	N	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00384	0.00376	Y	1%	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00071	<0.00050	<DL	-	0.00069	<0.00050	N	-
Iron (Fe)	mg/L	0.03000	0.15	2.59	2.54	Y	0%	0.114	0.113	N	-	0.054	0.055	N	-	0.200	0.132	Y	10%	0.387	0.182	Y	18%
Lead (Pb)	mg/L	0.00005	0.00025	0.00128	0.00129	Y	0%	<0.000050	<0.000050	<DL	-	0.000056	<0.000050	N	-	0.000127	0.000065	N	-	0.000191	0.000084	N	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00820	0.00835	Y	0%	0.00653	0.00637	Y	1%	0.00222	0.00205	N	-	0.00377	0.00360	Y	1%	0.00354	0.00338	Y	1%
Magnesium (Mg)	mg/L	0.00500	0.025	12.7	13.0	Y	1%	16.3	15.7	Y	1%	11.3	11.3	Y	0%	9.81	9.58	Y	1%	9.95	9.99	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0450	0.0452	Y	0%	0.0185	0.0177	Y	1%	0.00126	0.00121	Y	1%	0.00905	0.00644	Y	8%	0.0133	0.00826	Y	12%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				M20-04				M20-03				REFST				MR8				MR7			
Date Sampled		2011 DL		19-Jul-11		>5x DL?		22-Aug-11		>5x DL?		26-Sep-11		>5x DL?		18-Oct-11		>5x DL?		29-Nov-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1034422-12	L1034422-13	Y/N/<DL	RPD	L1049152-4	L1049152-5	Y/N/<DL	RPD	L1064458-1	L1064458-2	Y/N/<DL	RPD	L1073725-13	L1073725-14	Y/N/<DL	RPD	L1091894-6	L1091894-11	Y/N/<DL	RPD
Total Metals																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000598	0.000587	Y	0%	0.000553	0.000509	Y	2%	0.00351	0.00355	Y	0%	0.000688	0.000653	Y	1%	0.000665	0.000608	Y	2%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00551	0.00558	Y	0%	0.00061	0.00058	N	-	0.00082	0.00080	N	-	<0.00050	<0.00050	<DL	-	0.00078	0.00052	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	1.40	1.35	Y	1%	0.675	0.651	Y	1%	0.307	0.302	Y	0%	0.395	0.363	Y	2%	0.478	0.410	Y	4%
Selenium (Se)	mg/L	0.00010	0.0005	0.00151	0.00151	N	-	0.00163	0.00157	N	-	0.00076	0.00078	Y	1%	0.00018	0.00016	N	-	0.00018	0.00015	N	-
Silicon (Si)	mg/L	0.05000	0.25	5.56	5.58	Y	0%	1.90	1.85	Y	1%	1.38	1.38	Y	0%	1.37	1.28	Y	2%	1.78	1.63	Y	2%
Silver (Ag)	mg/L	0.00001	0.00005	0.000035	0.000033	N	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	5.6	5.7	Y	0%	10.2	10.0	Y	0%	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.145	0.147	Y	0%	0.212	0.207	Y	1%	0.226	0.224	Y	0%	0.100	0.0985	Y	0%	0.108	0.101	Y	2%
Thallium (Tl)	mg/L	0.00001	0.00005	0.000062	0.000064	Y	1%	<0.000010	<0.000010	<DL	-	0.000015	0.000014	N	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	0.00010	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	0.042	0.043	N	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	0.011	<0.010	N	-
Uranium (U)	mg/L	0.00001	0.00005	0.000443	0.000448	Y	0%	0.000529	0.000518	Y	1%	0.000561	0.000570	Y	0%	0.000228	0.000221	Y	1%	0.000234	0.000211	Y	3%
Vanadium (V)	mg/L	0.00100	0.005	0.0091	0.0085	Y	2%	<0.0010	<0.0010	<DL	-	0.0018	0.0018	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0168	0.0157	Y	2%	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	0.0031	<0.0030	N	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	0.0392	0.0376	Y	1%	0.0038	0.0032	N	-	0.0032	0.0033	N	-	0.0037	0.0038	N	-	0.0069	0.0069	N	-
Antimony (Sb)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	0.00010	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00016	0.00017	N	-	0.00012	0.00014	N	-	0.00014	0.00015	N	-	0.00012	0.00010	N	-	0.00010	0.00012	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.118	0.120	Y	0%	0.205	0.202	Y	0%	0.0326	0.0321	Y	0%	0.0443	0.0459	Y	1%	0.0462	0.0541	Y	4%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	0.010	0.010	N	-	<0.010	0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000012	0.000122	Y	41%	0.000011	0.000012	N	-	0.000014	0.000014	N	-	<0.000010	<0.000010	<DL	-	0.000012	0.000010	N	-
Calcium (Ca)	mg/L	0.02000	0.1	35.4	35.8	Y	0%	49.4	49.4	Y	0%	47.7	47.2	Y	0%	33.0	35.1	Y	2%	35.6	36.9	Y	1%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00015	0.00017	N	-	<0.00010	0.00010	N	-	0.00021	0.00023	N	-	0.00011	<0.00010	N	-	<0.00010	<0.00010	<DL	-
Cobalt (Co)	mg/L	0.00010	0.0005	0.00012	0.00013	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00161	0.00162	N	-	0.00085	0.00101	N	-	0.00079	0.00080	N	-	0.00094	<0.00050	N	-	<0.00050	<0.00050	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	0.046	0.043	N	-	0.034	0.034	N	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	0.068	0.039	N	-
Lead (Pb)	mg/L	0.00005	0.00025	0.000052	<0.000050	N	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00611	0.00604	Y	0%	0.00644	0.00660	Y	1%	0.00215	0.00206	N	-	0.00351	0.00354	Y	0%	0.00354	0.00349	Y	0%
Magnesium (Mg)	mg/L	0.00500	0.025	11.5	11.5	Y	0%	15.7	16.0	Y	0%	11.1	11.2	Y	0%	9.61	9.68	Y	0%	9.67	10.0	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00415	0.00401	Y	1%	0.0154	0.0151	Y	0%	0.000565	0.000594	Y	1%	0.00433	0.00454	Y	1%	0.00611	0.00550	Y	3%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000393	0.000389	Y	0%	0.000473	0.000496	Y	1%	0.00325	0.00325	Y	0%	0.000639	0.000656	Y	1%	0.000658	0.000594	Y	3%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00165	0.00169	N	-	0.00054	0.00061	N	-	0.00078	0.00074	N	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.505	0.508	Y	0%	0.666	0.676	Y	0%	0.293	0.295	Y	0%	0.367	0.374	Y	0%	0.393	0.383	Y	1%
Selenium (Se)	mg/L	0.00010	0.0005	0.00146	0.00150	Y	1%	0.00179	0.00175	Y	1%	0.00084	0.00086	Y	1%	0.00018	0.00018	N	-	0.00021	0.00019	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.99	2.00	Y	0%	1.88	1.87	Y	0%	1.34	1.32	Y	0%	1.18	1.24	Y	1%	1.32	1.53	Y	4%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	7.3	7.3	Y	0%	11.5	11.5	Y	0%	2.2	2.0	Y	2%	3.2	<2.0	Y	-	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.140	0.142	Y	0%	0.204	0.204	Y	0%	0.213	0.212	Y	0%	0.0980	0.104	Y	1%	0.104	0.102	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000337	0.000341	Y	0%	0.000500	0.000507	Y	0%	0.000507	0.000513	Y	0%	0.000195	0.000228	Y	4%	0.000217	0.000211	Y	1%
Vanadium (V)	mg/L	0.00100	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0014	0.0014	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0048	0.0047	N	-	0.0033	0.0041	N	-	0.0046	0.0043	N	-	0.0040	<0.0030	N	-	<0.0030	<0.0030	N	-

Notes:

All parameters analyzed by ALS Environmental

RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR8				M20-03				MR3				MR6				MR3			
Date Sampled		2012 DL		24-Jan-12		>5x DL?		21-Feb-12		>5x DL?		20-Mar-12		>5x DL?		17-Apr-12		>5x DL?		16-May-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1108712-1	L1108712-11	Y/N/<DL	RPD	L1117841-4	L1117841-10	Y/N/<DL	RPD	L1127031-9	L1127031-10	Y/N/<DL	RPD	L1137305-12	L1137305-16	Y/N/<DL	RPD	L1148502-9	L1148502-15	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	12.6	12.6	N	-
Conductivity	µS/cm	2	10	319	312	Y	1%	384	383	Y	0%	326	324	Y	0%	326	326	Y	0%	230	231	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	169	157	Y	2%	180	188	Y	1%	164	177	Y	2%	172	172	Y	0%	123	124	Y	0%
pH	pH	0.01	0.05	8.13	8.15	Y	0%	8.28	8.29	Y	0%	8.31	8.30	Y	0%	8.24	8.27	Y	0%	8.30	8.31	Y	0%
Total Suspended Solids	mg/L	1	5	6.7	<3.0	Y	-	<3.0	<3.0	<DL	-	5.3	4.0	Y	7%	4.7	<3.0	N	-	87.9	77.2	Y	3%
Total Dissolved Solids	mg/L	10	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.1	0.5	3.10	62.8	Y	45%	0.62	0.50	Y	5%	2.34	2.48	Y	1%	3.87	3.55	Y	2%	28.8	28.3	Y	0%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	1.4	1.2	N	-	<1.0	<1.0	N	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-	<1.0	<1.0	<DL	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	167	158	N	-	163	165	Y	0%	161	160	Y	0%	167	161	Y	1%	120	128	Y	2%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<1.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<1.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	167	158	Y	1%	163	165	Y	0%	161	160	Y	0%	167	161	Y	1%	120	128	Y	2%
Ammonia (as N)	mg/L	0.005	0.025	0.0060	0.0071	N	-	0.0050	<0.0050	N	-	0.0082	0.0070	N	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	1.23	1.16	Y	1%	0.70	0.67	Y	1%	2.69	2.29	Y	4%	1.50	1.50	Y	0%	<0.50	<0.50	<DL	-
Fluoride (F)	mg/L	0.02	0.1	0.056	0.053	N	-	0.081	0.081	N	-	0.049	0.049	N	-	0.058	0.058	N	-	0.041	0.041	N	-
Nitrate (as N)	mg/L	0.005	0.025	0.157	0.0736	Y	18%	0.0881	0.0882	Y	0%	0.0729	0.0730	Y	0%	0.0517	0.0521	Y	0%	0.0910	0.0896	Y	0%
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	0.157	0.077	<DL	-	<0.050	<0.050	<DL	-	0.069	0.050	N	-
Total Nitrogen	mg/L	0.01	0.05	0.140	0.070	Y	17%	0.070	0.060	Y	4%	0.230	0.150	Y	11%	0.070	0.050	Y	8%	0.160	0.140	Y	3%
Orthophosphate (as P)-Dissolved	mg/L	0.05	0.25	<0.0010	<0.0010	<DL	-	0.0032	0.0023	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0012	<0.0010	N	-
Phosphorus (as P)-Total Dissolved	mg/L	0.002	0.01	<0.0020	<0.0020	<DL	-	0.0029	0.0030	N	-	0.0021	<0.0020	N	-	<0.0020	<0.0020	<DL	-	0.0025	<0.0020	N	-
Phosphorus (as P)-Total	mg/L	0.002	0.01	0.0054	0.0031	N	-	0.0038	0.0035	N	-	0.0065	0.0039	N	-	0.0056	0.0071	N	-	0.092	0.0860	Y	2%
Sulphate (SO_4)	mg/L	0.5	2.5	17.3	13.3	Y	7%	46.0	46.0	Y	0%	18.9	18.9	Y	0%	20.1	19.9	Y	0%	5.65	5.67	Y	0%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Cyanide, Total	mg/L	0.001	0.005	0.0012	0.0019	N	-	0.0019	0.0020	N	-	0.0016	<0.0010	N	-	0.0019	0.0011	N	-	<0.0010	<0.0010	<DL	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	1.92	1.81	N	-	2.24	2.25	N	-	2.11	1.76	N	-	2.00	1.84	N	-	3.69	3.82	Y	1%
Total Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	0.0416	0.0606	Y	9%	0.0083	0.0068	N	-	0.0315	0.0309	Y	0%	0.0896	0.0760	Y	4%	1.21	1.08	Y	3%
Antimony (Sb)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00016	<0.00010	N	-	<0.00010	<0.00010	<DL	-	0.00012	0.00011	N	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00015	0.00013	Y	4%	<0.00010	<0.00010	<DL	-	0.00014	0.00013	N	-	0.00018	0.00016	N	-	0.00072	0.00059	Y	5%
Barium (Ba)	mg/L	0.00005	0.00025	0.0696	0.0638	Y	2%	0.190	0.189	Y	0%	0.0672	0.0696	Y	1%	0.0781	0.0801	Y	1%	0.0773	0.0717	Y	2%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	0.015	0.014	N	-	<0.010	<0.010	<DL	-	0.014	0.012	N	-	0.011	0.014	N	-	0.011	0.010	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000016	0.000018	N	-	<0.000010	<0.000010	<DL	-	<0.000050	<0.000040	<DL	-	0.000018	0.000019	N	-	0.000100	0.000096	Y	1%
Calcium (Ca)	mg/L	0.02000	0.1	47.8	46.4	Y	1%	48.5	47.8	Y	0%	46.6	46.8	Y	0%	49.8	50.9	Y	1%	39.6	38.2	Y	1%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00037	0.00041	N	-	<0.00010	<0.00010	<DL	-	0.00030	0.00027	N	-	0.00023	0.00027	N	-	0.00210	0.00170	Y	5%
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00075	0.00067	Y	3%
Copper (Cu)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00259	0.00190	Y	8%	<0.00050	<0.00050	<DL	-	0.00214	0.00253	Y	4%
Iron (Fe)	mg/L	0.03000	0.15	0.123	0.138	N	-	0.070	0.073	N	-	0.174	0.166	Y	1%	0.318	0.286	Y	3%	1.84	1.57	Y	4%
Lead (Pb)	mg/L	0.00005	0.00025	0.000070	0.000078	N	-	<0.000050	<0.000050	<DL	-	0.000150	0.000126	N	-	0.000072	0.000071	N	-	0.00104	0.000903	Y	4%
Lithium (Li)	mg/L	0.00050	0.0025	0.00500	0.00475	Y	1%	0.00426	0.00427	Y	0%	0.00667	0.00619	Y	2%	0.00682	0.00686	Y	0%	0.00322	0.00295	Y	2%
Magnesium (Mg)	mg/L	0.00500	0.025	12.6	11.5	Y	2%	13.5	13.5	Y	0%	12.6	13.4	Y	2%	13.2	13.5	Y	1%	10.4	9.97	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00759	0.00777	Y	1%	0.0115	0.0117	Y	0%	0.00991	0.00990	Y	0%	0.0134	0.0134	Y	0%	0.0445	0.0407	Y	2%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				M20-04				M20-03				MR3				MR6				MR3			
Date Sampled		2012 DL		24-Jan-12		>5x DL?		21-Feb-12		>5x DL?		20-Mar-12		>5x DL?		17-Apr-12		>5x DL?		16-May-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1108712-10	L1108712-11	Y/N/<DL	RPD	L1117841-4	L1117841-10	Y/N/<DL	RPD	L1127031-9	L1127031-10	Y/N/<DL	RPD	L1137305-12	L1137305-16	Y/N/<DL	RPD	L1148502-9	L1148502-15	Y/N/<DL	RPD
Total Metals (*cont'd*)																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000905	0.000862	Y	1%	0.000390	0.000407	Y	1%	0.000914	0.000836	Y	2%	0.000805	0.000848	Y	1%	0.000683	0.000649	Y	1%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00053	<0.00050	N	-	<0.00050	<0.00050	<DL	-	0.00064	0.00062	N	-	0.00055	0.00053	N	-	0.00295	0.00269	Y	2%
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.444	0.415	Y	2%	0.494	0.496	Y	0%	0.635	0.585	Y	2%	0.533	0.536	Y	0%	0.720	0.640	Y	3%
Selenium (Se)	mg/L	0.00010	0.0005	0.00027	0.00023	N	-	0.00097	0.00090	Y	2%	0.00022	0.00023	N	-	0.00047	0.00027	N	-	0.00026	0.00026	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.68	1.71	Y	0%	1.90	1.89	Y	0%	1.62	1.63	Y	0%	1.65	1.66	Y	0%	3.25	3.24	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	N	-	<0.000010	0.000040	N	-	<0.000010	<0.000010	<DL	-	0.000019	0.000015	N	-
Sodium (Na)	mg/L	0.20000	1	2.1	<2.0	Y	-	9.4	9.4	Y	-	3.0	2.7	Y	3%	2.6	2.6	Y	0%	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.150	0.143	Y	1%	0.153	0.152	Y	0%	0.156	0.162	Y	1%	0.159	0.162	Y	0%	0.0875	0.0845	Y	1%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	0.000044	0.000034	N	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	0.026	0.030	N	-
Uranium (U)	mg/L	0.00001	0.00005	0.000352	0.000303	Y	4%	0.000493	0.000496	Y	0%	0.000316	0.000306	Y	1%	0.000335	0.000344	Y	1%	0.000283	0.000278	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0047	0.0037	N	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0056	0.0040	N	-	<0.0030	<0.0030	<DL	-	0.0193	0.0206	Y	2%	<0.0030	<0.0030	<DL	-	0.0106	0.0092	N	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	<0.0030	0.0035	N	-	<0.0030	<0.0030	<DL	-	0.0039	0.0047	N	-	<0.0030	<0.0030	<DL	-	0.0100	0.0113	N	-
Antimony (Sb)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	0.00011	<0.00010	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00014	0.00011	N	-	0.00011	0.00010	N	-	0.00010	0.00012	N	-	0.00012	0.00013	N	-	0.00011	0.00012	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0642	0.0594	Y	2%	0.193	0.190	Y	0%	0.0617	0.0643	Y	1%	0.0757	0.0759	Y	0%	0.0546	0.0546	Y	0%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	0.010	<0.010	N	-	<0.010	<0.010	<DL	-	0.011	0.011	N	-	0.010	<0.010	N	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000011	0.000011	N	-	0.000014	0.000013	N	-	0.000062	0.000026	Y	20%	<0.000010	0.000011	N	-	0.000013	0.000013	N	-
Calcium (Ca)	mg/L	0.02000	0.1	47.1	44.5	Y	1%	49.7	52.8	Y	2%	45.6	49.8	Y	2%	47.5	47.9	Y	0%	34.6	35.3	Y	1%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00010	0.00013	N	-	<0.00010	<0.00010	<DL	-	0.00014	0.00013	N	-	<0.00010	<0.00010	<DL	-	0.00029	0.00012	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00094	<0.00050	N	-	<0.00050	0.00066	<DL	-	0.00303	0.00260	Y	4%	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	<0.030	<0.030	<DL	-	0.032	<0.030	<DL	-	<0.030	<0.030	<DL	-	0.044	0.044	N	-	0.051	0.032	N	-
Lead (Pb)	mg/L	0.00005	0.00025	0.000087	<0.000050	N	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00507	0.00464	Y	2%	0.00452	0.00487	Y	2%	0.00706	0.00693	Y	0%	0.00675	0.00703	Y	1%	0.00198	0.00207	N	-
Magnesium (Mg)	mg/L	0.00500	0.025	12.5	11.1	Y	3%	13.6	13.7	Y	0%	12.3	12.8	Y	1%	12.9	12.9	Y	0%	8.94	8.78	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00603	0.00590	Y	1%	0.0110	0.0109	Y	0%	0.00970	0.00932	Y	1%	0.00957	0.00973	Y	0%	0.00536	0.00519	Y	1%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000845	0.000795	Y	2%	0.000394	0.000403	Y	1%	0.000857	0.000862	Y	0%	0.000786	0.000768	Y	1%	0.000574	0.000533	Y	2%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00053	<0.00050	N	-	<0.00050	<0.00050	<DL	-	0.00074	0.00068	N	-	<0.00050	0.00050	N	-	0.00064	<0.00050	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.453	0.415	Y	2%	0.525	0.524	Y	0%	0.725	0.654	Y	3%	0.502	0.502	Y	0%	0.323	0.328	Y	0%
Selenium (Se)	mg/L	0.00010	0.0005	0.00028	0.00024	N	-	0.00101	0.00108	Y	2%	0.00026	0.00029	N	-	0.00033	0.00031	N	-	0.00021	0.00019	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.59	1.60	Y	0%	1.90	1.94	Y	1%	1.58	1.58	Y	0%	1.49	1.50	Y	0%	1.23	1.24	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	3.6	2.0	Y	14%	9.7	10.3	Y	2%	4.7	4.2	Y	3%	3.3	3.3	Y	0%	<2.0	<2.0	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.148	0.140	Y	1%	0.156	0.168	Y	2%	0.155	0.170	Y	2%	0.152	0.151	Y	0%	0.0793	0.0804	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000306	0.000292	Y	1%	0.000493	0.000508	Y	1%	0.000288	0.000296	Y	1%	0.000306	0.000306	Y	0%	0.000203	0.000204	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0074	0.0056	N	-	<0.0030	<0.0030	<DL	-	0.0313	0.0238	Y	7%	<0.0030	<0.0030	<DL	-	<0.0030	0.0040	<DL	-

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 samples which was analyzed by CARO Analytical Services

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR3				MR3				MR-REF				MR4				M20-03			
Date Sampled		2012 DL		28-May-12		>5x DL?		5-Jun-12		>5x DL?		12-Jun-12		>5x DL?		21-Jun-12		>5x DL?		26-Jun-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1154387-4	L1154387-8	Y/N/<DL	RPD	L1157872-4	L1157872-6	Y/N/<DL	RPD	L1162268-2	L1162268-9	Y/N/<DL	RPD	L1166580-4	L1166580-9	Y/N/<DL	RPD	L1169751-4	L1169751-20	Y/N/<DL	RPD
Physical Tests																							
Colour, True	CU	5	25	11.2	11.4	N	-	8.0	8.1	N	-	10.0	9.2	N	-	8.8	8.6	N	-	17.2	17.4	N	-
Conductivity	µS/cm	2	10	194	195	Y	0%	197	197	Y	0%	163	163	Y	0%	164	162	Y	0%	278	279	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	100	101	Y	0%	102	96.5	Y	1%	87.1	87.6	Y	0%	88.8	90.5	Y	0%	127	122	Y	1%
pH	pH	0.01	0.05	8.25	8.26	Y	0%	8.30	8.28	Y	0%	8.21	8.21	Y	0%	8.27	8.19	Y	0%	8.23	8.25	Y	0%
Total Suspended Solids	mg/L	1	5	103	99.3	Y	1%	20.0	18.7	Y	2%	25.7	23.0	Y	3%	41.3	40.7	Y	0%	6.6	9.3	Y	8%
Total Dissolved Solids	mg/L	10	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.1	0.5	40.7	33.1	Y	5%	13.8	12.6	Y	2%	14.6	14.1	Y	1%	36.7	35.2	Y	1%	4.73	4.64	Y	0%
Anions and Nutrients																							
Acidity (as $CaCO_3$)	mg/L	1	5	1.2	<1.0	N	-	<1.0	1.7	N	-	1.3	1.3	N	-	1.3	2.5	N	-	2.6	1.8	N	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	102	100	Y	0%	101	97.5	Y	1%	85.5	88.4	Y	1%	89.4	88.1	Y	0%	97.5	102	Y	1%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	102	100	Y	0%	101	97.5	Y	1%	85.5	88.4	Y	1%	89.4	88.1	Y	0%	97.5	102	Y	1%
Ammonia (as N)	mg/L	0.005	0.025	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-
Fluoride (F)	mg/L	0.02	0.1	0.033	0.032	N	-	0.033	0.034	N	-	0.026	0.027	N	-	0.034	0.034	N	-	0.086	0.086	N	-
Nitrate (as N)	mg/L	0.005	0.025	0.0802	0.0822	Y	1%	0.0702	0.0709	Y	0%	0.0573	0.0562	Y	0%	0.0506	0.0494	Y	1%	0.111	0.109	Y	0%
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	0.0012	<0.0010	N	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	<0.050	0.068	N	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	0.088	0.051	N	-
Total Nitrogen	mg/L	0.01	0.05	0.130	0.150	Y	4%	0.110	0.100	Y	2%	0.070	0.070	Y	0%	0.080	0.070	Y	3%	0.200	0.160	Y	6%
Orthophosphate (as P)-Dissolved	mg/L	0.05	0.25	0.0012	<0.0010	N	-	<0.0010	<0.0010	<DL	-	0.0010	<0.0010	N	-	<0.0010	<0.0010	<DL	-	0.0030	0.0019	N	-
Phosphorus (as P)-Total Dissolved	mg/L	0.002	0.01	0.0021	<0.0020	N	-	<0.0020	<0.0020	<DL	-	<0.0020	<0.0020	<DL	-	0.0028	0.0029	N	-	0.0038	0.0041	N	-
Phosphorus (as P)-Total	mg/L	0.002	0.01	0.094	0.095	Y	0%	0.0300	0.0209	Y	9%	0.0240	0.0350	Y	9%	0.0421	0.0447	Y	1%	0.0115	0.0112	Y	1%
Sulphate (SO_4)	mg/L	0.5	2.5	5.04	5.06	Y	0%	5.74	5.64	Y	0%	3.50	3.49	Y	0%	7.02	6.85	Y	1%	51.1	51.1	Y	0%
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Cyanide, Total	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Organic Carbon																							
Total Organic Carbon	mg/L	0.5	2.5	4.03	4.77	Y	4%	2.90	3.43	Y	4%	2.36	2.44	N	-	2.87	2.91	Y	0%	4.62	4.52	Y	1%
Total Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	1.41	1.29	Y	2%	0.413	0.464	Y	3%	0.459	0.440	Y	1%	0.437	0.991	Y	19%	0.135	0.149	Y	2%
Antimony (Sb)	mg/L	0.00010	0.0005	0.00011	0.00011	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00082	0.00080	Y	1%	0.00025	0.00029	N	-	0.00028	0.00029	N	-	0.00031	0.00044	N	-	0.00018	0.00019	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0615	0.0619	Y	0%	0.0410	0.0423	Y	1%	0.0312	0.0319	Y	1%	0.0492	0.0570	Y	4%	0.122	0.130	Y	2%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000100	0.000114	Y	3%	0.000031	0.000029	N	-	0.000035	0.000037	N	-	0.000053	0.000064	Y	5%	0.000022	0.000037	N	-
Calcium (Ca)	mg/L	0.02000	0.1	33.4	33.7	Y	0%	29.3	29.2	Y	0%	26.5	27.0	Y	0%	27.7	24.2	Y	3%	29.4	30.2	Y	1%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00216	0.00207	Y	1%	0.00070	0.00082	Y	4%	0.00084	0.00080	Y	1%	0.00079	0.00177	Y	19%	0.00032	0.00038	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	0.00088	0.00092	Y	1%	0.00020	0.00022	N	-	0.00026	0.00027	N	-	0.00034	0.00047	N	-	0.00011	0.00011	N	-
Copper (Cu)	mg/L	0.00050	0.0025	0.00226	0.00231	N	-	0.00075	0.00076	N	-	0.00079	0.00081	N	-	0.00104	0.00131	N	-	0.00065	0.00068	N	-
Iron (Fe)	mg/L	0.03000	0.15	2.16	2.10	Y	1%	0.509	0.540	Y	1%	0.575	0.613	Y	2%	0.627	1.10	Y	14%	0.232	0.254	Y	2%
Lead (Pb)	mg/L	0.00005	0.00025	0.00113	0.00111	Y	0%	0.000260	0.000283	Y	2%	0.000326	0.000332	Y	0%	0.000540	0.000541	Y	0%	0.000113	0.000118	N	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00283	0.00300	Y	1%	0.00164	0.00170	Y	1%	0.00158	0.00145	Y	2%	0.00181	0.00212	Y	4%	0.00582	0.00591	Y	0%
Magnesium (Mg)	mg/L	0.00500	0.025	9.00	9.02	Y	0%	7.22	7.15	Y	0%	6.26	6.38	Y	0%	6.48	7.04	Y	2%	10.7	10.9	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0495	0.0486	Y	0%	0.0125	0.0130	Y	1%	0.0152	0.0158	Y	1%	0.0207	0.0235	Y	3%	0.0118	0.0120	Y	0%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				MR3				MR3				MR-REF				MR4				M20-03			
Date Sampled		2012 DL		28-May-12		>5x DL?		5-Jun-12		>5x DL?		12-Jun-12		>5x DL?		21-Jun-12		>5x DL?		26-Jun-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1154387-4	L1154387-8	Y/N/<DL	RPD	L1157872-4	L1157872-6	Y/N/<DL	RPD	L1162268-2	L1162268-9	Y/N/<DL	RPD	L1166580-4	L1166580-9	Y/N/<DL	RPD	L1169751-4	L1169751-20	Y/N/<DL	RPD
Total Metals (*cont'd*)																							
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000603	0.000612	Y	0%	0.000484	0.000521	Y	2%	0.000490	0.000479	Y	1%	0.000449	0.000451	Y	0%	0.000493	0.000515	Y	1%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00335	<0.0035	Y	-	0.00104	0.00108	N	-	0.00102	0.00108	N	-	0.00142	0.00230	N	-	0.00121	0.00115	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.709	0.672	Y	1%	0.407	0.417	Y	1%	0.371	0.368	Y	0%	0.392	0.595	Y	10%	0.548	0.538	Y	0%
Selenium (Se)	mg/L	0.00010	0.0005	0.00026	0.00028	N	-	0.00012	0.00017	N	-	0.00014	0.00014	N	-	0.00028	0.00032	N	-	0.00303	0.00309	N	-
Silicon (Si)	mg/L	0.05000	0.25	3.42	3.20	Y	2%	1.76	2.10	Y	4%	1.72	1.76	Y	1%	1.77	3.52	Y	17%	1.88	1.91	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	0.000019	0.000022	N	-	<0.000010	<0.000010	<DL	-	<0.000010	0.000062	Y	-	<0.000010	0.000012	N	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	7.7	7.9	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.0660	0.0667	Y	0%	0.0592	0.0612	Y	1%	0.0493	0.0497	Y	0%	0.0619	0.0541	Y	3%	0.167	0.168	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	0.000044	0.000045	N	-	0.000013	0.000016	N	-	0.000016	0.000017	N	-	0.000017	0.000023	N	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	0.030	0.029	N	-	0.011	0.019	N	-	0.010	0.014	N	-	0.011	0.045	N	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000233	0.000238	Y	1%	0.000156	0.000171	Y	2%	0.000149	0.000158	Y	1%	0.000197	0.000189	Y	1%	0.000475	0.000485	Y	1%
Vanadium (V)	mg/L	0.00100	0.005	0.0054	0.0050	Y	2%	0.0016	0.0018	N	-	0.0020	0.0020	N	-	0.0018	0.0038	N	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0108	0.0113	N	-	0.0041	0.0040	N	-	0.0042	0.0036	N	-	0.0044	0.0061	N	-	<0.0030	<0.0030	<DL	-
Dissolved Metals																							
Aluminum (Al)	mg/L	0.00300	0.015	0.0119	0.0123	N	-	0.0154	0.0140	Y	2%	0.0157	0.0185	Y	4%	0.0341	0.0331	Y	1%	0.0180	0.0185	Y	1%
Antimony (Sb)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00011	0.00011	N	-	0.00011	<0.00010	N	-	<0.00010	<0.00010	<DL	-	0.00011	<0.00010	N	-	0.00011	0.00011	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0397	0.0401	Y	0%	0.0369	0.0357	Y	1%	0.0262	0.0263	Y	0%	0.0390	0.0388	Y	0%	0.120	0.124	Y	1%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000011	0.000012	N	-	<0.000010	<0.000010	<DL	-	0.000012	0.000011	N	-	0.000016	0.000010	N	-	0.000013	0.000019	N	-
Calcium (Ca)	mg/L	0.02000	0.1	28.9	28.7	Y	0%	29.1	27.6	Y	1%	25.2	25.3	Y	0%	25.5	26.2	Y	1%	32.3	30.9	Y	1%
Chromium (Cr)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	0.00010	0.00011	N	-	0.00011	0.00010	N	-	0.00016	0.00014	N	-	0.00012	<0.00010	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00105	0.00117	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	0.030	<0.030	N	-	0.049	0.048	N	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00139	0.00137	N	-	0.00127	0.00129	N	-	0.00092	0.00094	N	-	0.00151	0.00162	N	-	0.00664	0.00598	Y	3%
Magnesium (Mg)	mg/L	0.00500	0.025	6.85	7.10	Y	1%	7.13	6.73	Y	1%	5.88	5.90	Y	0%	6.09	6.06	Y	0%	11.2	10.9	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00518	0.00521	Y	0%	0.00199	0.00199	Y	0%	0.00200	0.00198	Y	0%	0.00250	0.00248	Y	0%	0.00809	0.00802	Y	0%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.000435	0.000432	Y	0%	0.000454	0.000449	Y	0%	0.000432	0.000431	Y	0%	0.000465	0.000453	Y	1%	0.000524	0.000493	Y	2%
Nickel (Ni)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00052	0.00057	N	-	0.00101	0.00098	N	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.269	0.280	Y	1%	0.247	0.240	N	-	0.203	0.205	N	-	0.246	0.238	N	-	0.535	0.551	Y	1%
Selenium (Se)	mg/L	0.00010	0.0005	0.00019	0.00019	N	-	0.00017	0.00018	N	-	0.00011	0.00013	N	-	0.00031	0.00031	N	-	0.00327	0.00322	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.09	1.12	Y	1%	1.07	1.05	Y	0%	0.909	0.928	Y	1%	1.04	1.06	Y	0%	1.78	1.74	Y	1%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	9.0	9.2	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.0572	0.0569	Y	0%	0.0581	0.0572	Y	0%	0.0471	0.0475	Y	0%	0.0589	0.0598	Y	0%	0.182	0.171	Y	2%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000158	0.000151	Y	1%	0.000137	0.000136	Y	0%	0.000118	0.000121	Y	1%	0.000149	0.000151	Y	0%	0.000460	0.000437	Y	1%
Vanadium (V)	mg/L	0.00100	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 samples which was analyzed by CARO Analytical Services

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				REFST				MR3				MR6				MR7				MR3				MR3			
Date Sampled		2012 DL		4-Jul-12		>5x DL?		23-Jul-12		>5x DL?		21-Aug-12		>5x DL?		22-Oct-12		>5x DL?		28-Nov-12		>5x DL?		18-Dec-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1174000-1	L1174000-9	Y/N/<DL	RPD	L1184612-9	L1184612-20	Y/N/<DL	RPD	L1197851-17	L1197851-18	Y/N/<DL	RPD	L1228768-10	L1228768-14	Y/N/<DL	RPD	L1243937-9	L1243937-17	Y/N/<DL	RPD	L1251738-4	L1251738-13	Y/N/<DL	RPD
Physical Tests																											
Colour, True	CU	5	25	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-	<5.0	<5.0	<DL	-
Conductivity	µS/cm	2	10	228	226	Y	0%	146	147	Y	0%	187	186	Y	0%	207	210	Y	0%	256	256	Y	0%	281	285	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	122	119	Y	1%	71.1	73.9	Y	1%	91.3	95.0	Y	1%	111	111	Y	0%	138	138	Y	0%	147	150	Y	1%
pH	pH	0.01	0.05	8.29	8.33	Y	0%	8.22	8.10	Y	0%	8.29	8.24	Y	0%	8.20	8.10	Y	0%	8.17	8.09	Y	0%	8.09	8.20	Y	0%
Total Suspended Solids	mg/L	1	5	3.1	<3.0	N	-	8.4	12.4	Y	10%	6.7	4.0	Y	13%	<3.0	<3.0	<DL	-	<3.0	<3.0	<DL	-	<3.0	<3.0	<DL	-
Total Dissolved Solids	mg/L	10	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.1	0.5	1.86	1.48	Y	6%	4.32	5.46	Y	6%	3.87	3.63	Y	2%	1.13	1.35	Y	4%	1.39	1.39	Y	0%	2.18	2.05	Y	2%
Anions and Nutrients																											
Acidity (as $CaCO_3$)	mg/L	1	5	<1.0	<1.0	N	-	1.6	1.4	N	-	1.0	1.2	N	-	<1.0	1.5	N	-	1.5	1.2	N	-	2.9	1.8	N	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1	5	114	111	Y	1%	76.9	74.8	Y	1%	94.5	95.2	Y	0%	106	105	Y	0%	131	135	Y	1%	143	139	Y	1%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1	5	<2.0	4.6	N	-	<2.0	<2.0	N	-	<2.0	<2.0	N	-	<1.0	<1.0	N	-	<2.0	<2.0	N	-	<2.0	<2.0	N	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1	5	<2.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<1.0	<1.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	1	5	114	116	Y	0%	76.9	74.8	Y	1%	94.5	95.2	Y	0%	106	105	Y	0%	131	135	Y	1%	143	139	Y	1%
Ammonia (as N)	mg/L	0.005	0.025	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-	<0.0050	<0.0050	<DL	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.1	0.5	<0.50	<0.50	<DL	-	<0.50	<0.50	<DL	-	0.63	0.63	Y	0%	0.68	0.68	Y	0%	1.09	1.09	Y	0%	1.39	1.38	Y	0%
Fluoride (F)	mg/L	0.02	0.1	0.043	0.042	N	-	0.026	0.026	N	-	0.036	0.036	N	-	0.037	0.037	N	-	0.044	0.042	N	-	0.050	0.050	N	-
Nitrate (as N)	mg/L	0.005	0.025	0.0176	0.0164	N	-	0.0126	0.0139	N	-	0.0098	0.0096	N	-	0.0364	0.0371	Y	0%	0.0704	0.0708	Y	0%	0.0862	0.0809	Y	2%
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05	0.25	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	0.060	0.052	N	-	0.064	<0.050	N	-
Total Nitrogen	mg/L	0.01	0.05	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	<0.050	<0.050	<DL	-	0.070	0.070	<DL	-	-	-	-	-	0.124	0.126	-	-
Orthophosphate (as P)-Dissolved	mg/L	0.05	0.25	0.0069	0.0071	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Phosphorus (as P)-Total Dissolved	mg/L	0.002	0.01	0.0069	0.0080	N	-	0.0024	0.0022	N	-	<0.0020	<0.0020	<DL	-	<0.0020	<0.0020	<DL	-	<0.0020	<0.0020	<DL	-	<0.0020	<0.0020	<DL	-
Phosphorus (as P)-Total	mg/L	0.002	0.01	0.0121	0.0193	Y	11%	0.0047	0.0071	N	-	0.0052	0.0037	N	-	0.0040	0.0021	N	-	0.0023	0.0038	N	-	0.0032	0.0034	N	-
Sulphate (SO_4)	mg/L	0.5	2.5	13.0	13.0	Y	0%	5.57	5.38	Y	1%	9.61	9.61	Y	0%	11.5	11.5	Y	0%	14.1	14.1	Y	0%	16.8	16.8	Y	0%
Cyanides																											
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Cyanide, Total	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Organic Carbon																											
Total Organic Carbon	mg/L	0.5	2.5	1.30	1.25	N	-	1.09	1.19	N	-	1.00	0.94	N	-	1.46	1.45	N	-	1.11	1.12	N	-	0.92	1.15	N	-
Total Metals																											
Aluminum (Al)	mg/L	0.00300	0.015	0.0412	0.0406	Y	0%	0.266	0.0071	Y	47%	0.0985	0.0982	Y	0%	0.0454	0.0524	Y	4%	0.0328	0.0339	Y	1%	0.0450	0.0430	Y	1%
Antimony (Sb)	mg/L	0.00010	0.0005	0.00013	0.00012	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00020	0.00023	N	-	0.00021	0.00012	N	-	0.00018	0.00019	N	-	0.00014	0.00013	N	-	0.00018	0.00022	N	-	0.00014	0.00018	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0237	0.0239	Y	0%	0.0301	0.0279	Y	2%	0.0422	0.0402	Y	1%	0.0408	0.0418	Y	1%	0.0552	0.0552	Y	0%	0.0592	0.0589	Y	0%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	0.011	0.011	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000038	0.000041	N	-	0.000022	<0.000010	N	-	0.000012	0.000010	N	-	0.000011	0.000010	N	-	<0.000010	0.000011	N	-	0.000014	0.000012	N	-
Calcium (Ca)	mg/L	0.02000	0.1	38.6	37.2	Y	1%	22.4	20.8	Y	2%	26.9	28.6	Y	2%	32.1	32.1	Y	0%	40.2	39.6	Y	0%	43.8	43.3	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00028	0.00032	N	-	0.00051	0.00018	Y	24%	0.00023	0.00023	N	-	0.00013	0.00013	N	-	0.00011	0.00015	N	-	0.00017	0.00016	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	0.00013	<0.00010	N	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	0.00059	0.00056	N	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	0.00051	N	-
Iron (Fe)	mg/L	0.03000	0.15	0.057	0.076	N	-	0.336	<0.030	Y	-	0.210	0.202	Y	1%	0.112	0.120	N	-	0.100	0.097	N	-	0.142	0.185	N	-
Lead (Pb)	mg/L	0.00005	0.00025	0.000063	<0.000050	Y	-	0.000242	<0.000050	N	-	0.000107	0.000101	N	-	<0.000050	0.000053	N	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00077	0.00087	Y	3%	0.00153	0.00102	N	-	0.00289	0.00308	Y	2%	0.00311	0.00309	Y	0%	0.00483	0.00478	Y	0%	0.00633	0.00631	Y	0%
Magnesium (Mg)	mg/L	0.00500	0.025	7.50	7.46	Y	0%	5.06	5.06	Y	0%	6.64	6.69	Y	0%	8.09	8.31	Y	1%	10.6	10.4	Y	0%	10.9	11.0	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.00140	0.00451	Y	26%	0.0119	0.00266	Y	32%	0.00856	0.00812	Y	1%	0.00628	0.00614	Y	1%	0.00552	0.00557	Y	0%	0.00709	0.00704	Y	0%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-

Appendix 1-3. Stream Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010 to 2012

Sample ID				REFST				MR3				MR6				MR7				MR3				MR3			
Date Sampled		2012 DL		4-Jul-12		>5x DL?		23-Jul-12		>5x DL?		21-Aug-12		>5x DL?		22-Oct-12		>5x DL?		28-Nov-12		>5x DL?		18-Dec-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L1174000-1	L1174000-9	Y/N/<DL	RPD	L1184612-9	L1184612-20	Y/N/<DL	RPD	L1197851-17	L1197851-18	Y/N/<DL	RPD	L1228768-10	L1228768-14	Y/N/<DL	RPD	L1243937-9	L1243937-17	Y/N/<DL	RPD	L1251738-4	L1251738-13	Y/N/<DL	RPD
Total Metals (*cont'd*)																											
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.00345	0.00338	Y	1%	0.000456	0.000438	Y	1%	0.000582	0.000565	Y	1%	0.000606	0.000586	Y	1%	0.000770	0.000758	Y	0%	0.000837	0.000861	Y	1%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00067	0.00068	N	-	0.00061	<0.00050	N	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.230	0.226	N	-	0.290	0.201	Y	9%	0.326	0.316	Y	1%	0.306	0.315	Y	1%	0.400	0.395	Y	0%	0.455	0.444	Y	1%
Selenium (Se)	mg/L	0.00010	0.0005	0.00053	0.00053	Y	0%	0.00011	<0.00010	N	-	0.00013	0.00011	N	-	0.00016	0.00017	N	-	0.00019	0.00020	N	-	0.00020	0.00022	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.11	1.10	Y	0%	1.26	0.765	Y	12%	1.13	1.13	Y	0%	1.18	1.17	Y	0%	1.40	1.41	Y	0%	1.60	1.57	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	2.1	2.2	Y	1%
Strontium (Sr)	mg/L	0.00010	0.0005	0.140	0.142	Y	0%	0.0563	0.0534	Y	1%	0.0781	0.0782	Y	0%	0.0916	0.0893	Y	1%	0.133	0.130	Y	1%	0.148	0.147	Y	0%
Thallium (Tl)	mg/L	0.00001	0.00005	0.000016	0.000015	N	-	0.000013	<0.000010	N	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000452	0.000438	Y	1%	0.000141	0.000116	Y	5%	0.000176	0.000181	Y	1%	0.000203	0.000198	Y	1%	0.000264	0.000255	Y	1%	0.000278	0.000277	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	0.0025	0.0024	N	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	0.0031	0.0031	N	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-
Dissolved Metals																											
Aluminum (Al)	mg/L	0.00300	0.015	<0.0030	0.0036	N	-	0.0062	0.0831	N	-	0.0040	0.0035	N	-	0.0047	0.0050	N	-	<0.0030	0.0032	N	-	<0.0030	<0.0030	<DL	-
Antimony (Sb)	mg/L	0.00010	0.0005	0.00011	0.00011	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.00010	0.0005	0.00016	0.00015	N	-	<0.00010	0.00013	N	-	0.00014	0.00012	N	-	<0.00010	<0.00010	<DL	-	<0.00010	0.00010	N	-	0.00012	0.00011	N	-
Barium (Ba)	mg/L	0.00005	0.00025	0.0225	0.0230	Y	1%	0.0260	0.0304	Y	4%	0.0390	0.0400	Y	1%	0.0404	0.0410	Y	0%	0.0516	0.0527	Y	1%	0.0563	0.0575	Y	1%
Beryllium (Be)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Bismuth (Bi)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	0.011	0.010	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000019	0.000018	N	-	<0.000010	0.000018	N	-	0.000014	<0.000010	N	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	0.000011	N	-
Calcium (Ca)	mg/L	0.02000	0.1	36.8	35.7	Y	1%	20.0	21.5	Y	2%	25.8	27.1	Y	1%	31.4	31.2	Y	0%	38.5	38.2	Y	0%	41.5	42.3	Y	0%
Chromium (Cr)	mg/L	0.00010	0.0005	0.00021	0.00020	N	-	<0.00010	0.00012	N	-	<0.00010	<0.00010	<DL	-	0.00012	0.00012	N	-	<0.00010	<0.00010	<DL	-	0.00020	<0.00010	N	-
Cobalt (Co)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.00050	0.0025	<0.00050	<0.00050	<DL	-	0.00061	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	0.00080	0.00073	<DL	-	0.00065	0.00068	<DL	-
Iron (Fe)	mg/L	0.03000	0.15	<0.030	<0.030	<DL	-	<0.030	0.169	<DL	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-	<0.030	<0.030	<DL	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.000050	<0.000050	<DL	-	<0.000050	0.000148	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	<0.000050	<0.000050	<DL	-	0.000107	<0.000050	<DL	-
Lithium (Li)	mg/L	0.00050	0.0025	0.00102	0.00079	N	-	0.00120	0.00148	N	-	0.00304	0.00309	Y	0%	0.00315	0.00307	Y	1%	0.00493	0.00480	Y	1%	0.00619	0.00622	Y	0%
Magnesium (Mg)	mg/L	0.00500	0.025	7.24	7.16	Y	0%	5.14	4.93	Y	1%	6.54	6.67	Y	0%	7.90	8.09	Y	1%	10.2	10.3	Y	0%	10.6	10.9	Y	1%
Manganese (Mn)	mg/L	0.00005	0.00025	0.000342	0.000792	Y	20%	0.00294	0.00830	Y	24%	0.00373	0.00379	Y	0%	0.00404	0.00401	Y	0%	0.00502	0.00524	Y	1%	0.00657	0.00662	Y	0%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.00313	0.00301	Y	1%	0.000410	0.000353	Y	4%	0.000556	0.000549	Y	0%	0.000583	0.000579	Y	0%	0.000711	0.000699	Y	0%	0.000793	0.000801	Y	0%
Nickel (Ni)	mg/L	0.00050	0.0025	0.00056	0.00059	N	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-	<0.00050	<0.00050	<DL	-
Phosphorus (P)	mg/L	0.20000	1	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05000	0.25	0.203	0.222	N	-	0.202	0.211	N	-	0.304	0.306	Y	0%	0.278	0.293	Y	1%	0.400	0.411	Y	1%	0.481	0.450	Y	2%
Selenium (Se)	mg/L	0.00010	0.0005	0.00055	0.00054	Y	0%	0.00010	0.00010	N	-	0.00013	0.00011	N	-	0.00016	0.00017	N	-	0.00021	0.00020	N	-	0.00021	0.00023	N	-
Silicon (Si)	mg/L	0.05000	0.25	1.01	1.02	Y	0%	0.789	0.990	Y	6%	0.965	0.965	Y	0%	1.08	1.07	Y	0%	1.34	1.39	Y	1%	1.53	1.52	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	0.20000	1	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	<2.0	<2.0	<DL	-	2.9	2.8	<DL	-	3.3	3.4	<DL	-
Strontium (Sr)	mg/L	0.00010	0.0005	0.134	0.131	Y	1%	0.0514	0.0525	Y	1%	0.0759	0.0780	Y	1%	0.0867	0.0845	Y	1%	0.128	0.125	Y	1%	0.139	0.143	Y	1%
Thallium (Tl)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-	<0.000010	<0.000010	<DL	-
Tin (Sn)	mg/L	0.00010	0.0005	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01000	0.05	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000276	0.000345	Y	6%	0.000108	0.000129	Y	4%	0.000162	0.000163	Y	0%	0.000183	0.000180	Y	0%	0.000231	0.000228	Y	0%	0.000245	0.000247	Y	0%
Vanadium (V)	mg/L	0.00100	0.005	0.0019	0.0019	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.00300	0.015	<0.0030	0.0039	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	<0.0030	<0.0030	<DL	-	0.0059	<0.0030	<DL	-	0.0035	<0.0030	<DL	-

Notes:

All parameters analyzed by ALS Environmental, except the January 2011 samples which was analyzed by CARO Analytical Services

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 2-1

Toxicity Testing on the Samples MR5 and MR-REF: Final Toxicity Test Report

Rescan™
Engineers and Scientists

Nautilus Environmental

Toxicity Testing on the samples MR5 and MR-REF
Project #0791-002-02-19

Final Toxicity Test Report

Report date: October 6, 2010

Submitted to:

RESCAN ENVIRONMENTAL SERVICES LTD.
Vancouver, BC

Burnaby Laboratory
8664 Commerce Court
Burnaby, BC
V5A 4N7

Nautilus Environmental

WO #: 10310-314

Mr. Mark Whelly
Rescan Environmental Services Ltd.
6th Floor, 1111 W. Hastings Street
Vancouver, BC
V6E 2J3

October 6, 2010

Mr. Whelly:

Re: Toxicity testing on samples MR5 and MR-REF (both collected on August 16, 2010)

Nautilus Environmental is pleased to provide you with the results of the toxicity tests conducted on the above samples, received on August 17, 2010. Testing was conducted following Environment Canada methods. All test acceptability criteria specified by Environment Canada protocols were met. A summary of the test methods and results are provided in the following report.

Please feel free to contact the undersigned at 604-420-8773 should you have any questions or require any additional information.

Nautilus Environmental

A. Tang

Armando Tang, B.Sc., R.P.Bio.
Laboratory Manager

TABLE OF CONTENTS

Page

TABLE OF CONTENTS i

1.0 INTRODUCTION 1

2.0 METHODS 1

2.1 *Ceriodaphnia dubia* survival and reproduction test 1

2.2 7-d *Lemna minor* growth inhibition test 2

2.3 72-h *Pseudokirchneriella subcapitata* growth inhibition test 3

2.4 96-h LC50 *Oncorhynchus mykiss* test 4

2.5 48-h LC50 *Daphnia magna* test 4

2.6 Quality Assurance/Quality Control (QA/QC) 5

3.0 RESULTS 11

3.1 *Ceriodaphnia dubia* survival and reproduction test 11

3.2 7-d *Lemna minor* growth inhibition test 11

3.3 72-h *Pseudokirchneriella subcapitata* growth inhibition test 11

3.4 96-h LC50 *Oncorhynchus mykiss* test 11

3.5 48-h LC50 *Daphnia magna* test 11

3.6 Quality Assurance/Quality Control 12

4.0 REFERENCES 18

LIST OF TABLES

Table 1. Summary of test conditions for the *Ceriodaphnia dubia* survival and reproduction test 6

Table 2. Summary of test conditions for the *Lemna minor* growth inhibition test 7

Table 3. Summary of test conditions for the *Pseudokirchneriella subcapitata* growth inhibition test. 8

Table 4. Summary of test conditions for the 96-h rainbow trout LC50 test. 9

Table 5. Summary of test conditions for the 48-h *Daphnia magna* LC50 test. 10

Table 6. Toxicity test results for the *Ceriodaphnia dubia* survival and reproduction test. 13

Table 7. Toxicity test results for the *Lemna minor* growth inhibition test. 14

Table 8. Toxicity test results for the *Pseudokirchneriella subcapitata* growth inhibition test. 15

Table 9. Toxicity test results for the 96-h LC50 *Oncorhynchus mykiss* tests. 16

Table 10. Toxicity test results for the 48-h LC50 *Daphnia magna* tests. 16

Table 11. Reference toxicant test results. 17

TABLE OF CONTENTS

Page

LIST OF APPENDICES

APPENDIX A *Ceriodaphnia dubia* Toxicity Test Data
APPENDIX B *Lemna minor* Toxicity Test Data
APPENDIX C *Pseudokirchneriella subcapitata* Test Data
APPENDIX D *Oncorhynchus mykiss* Test Data
APPENDIX E *Daphnia magna* Test Data
APPENDIX F Chain of Custody Forms

1.0 INTRODUCTION

Nautilus Environmental (Burnaby, BC) conducted toxicity tests for Rescan Environmental Services Ltd. on samples identified as MR5 and MR-REF, both collected on August 16, 2010. The samples were delivered to the Nautilus Environmental Laboratory in Burnaby, BC on August 17, 2010. The samples were transported in four 20-L collapsible containers in coolers containing ice packs and were stored at 4°C in the dark prior to testing. The following sublethal toxicity tests were conducted on all samples:

- *Ceriodaphnia dubia* survival and reproduction
- 7-d *Lemna minor* growth inhibition
- 72-h *Pseudokirchneriella subcapitata* (formerly identified as *Selenastrum capricornutum*) growth inhibition
- 96-h Rainbow trout *(Oncorhynchus mykiss)* LC50
- 48-h *Daphnia magna* LC50

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analysis for each test species are provided in Appendices A to E. The chain of custody form is provided in Appendix F.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 to 6 and briefly described in Sections 2.1 to 2.6. Testing was conducted according to procedures described by the Environment Canada protocols (2000a, 2000b, 2007a, 2007b and 2007c). Statistical analyses for all the tests were performed using the CETIS computer program (Tidepool Scientific Software, 2009).

2.1 *Ceriodaphnia dubia* survival and reproduction test

The chronic water flea test was conducted using *Ceriodaphnia dubia* and followed Environment Canada (2007a, EPS 1/RM/21) using a static-renewal method. The endpoints were survival and reproduction over a 7 ± 1-day exposure period. The test was conducted using seven concentrations (5, 10, 20, 40, 60, 80 and 100%) and a laboratory control. Ten replicates per concentration, each with one daphnid and 15 mL

of sample were tested. The control and dilution water was 20% Perrier water diluted with deionized water (hardness 80-100 mg/L $CaCO_3$). Test solutions were renewed daily by transferring the adult daphnid into freshly prepared solution. During renewal, the number of young produced in the previous 24 hr period were counted and recorded.

Daphnids were fed daily with a mixture of YCT and *P. subcapitata* in a 0.5:1 ratio. The test was conducted at 25 ± 1°C under a 16:8 h light:dark photoperiod. Temperature, dissolved oxygen (DO) and pH were measured daily in the old and new test solutions, and conductivity was measured daily in the new solutions. The median lethal concentration (LC50) and 95% confidence limits were calculated for survival. For the reproductive endpoint, the inhibition concentrations (IC25 and IC50) and associated 95% confidence limits were calculated. A sodium chloride reference toxicant test was conducted within 14 days of test initiation and compared to historical data to assess the health and sensitivity of *C. dubia*.

For a valid test, daphnid survival in the control must be ≥80%. Of the surviving daphnids, ≥60% must produce three broods with an average of ≥15 young within 7 ± 1 days.

2.2 7-d *Lemna minor* growth inhibition test

The *L. minor* test was conducted according to Environment Canada (2007b, EPS 1/RM/37) in a static system. The endpoints were plant growth defined by the number of fronds and the dry weight of the plants following a 7-day exposure period. Nutrients were added to the sample prior to preparing the test concentrations. The test was conducted using seven concentrations (1.5, 3.0, 6.1, 12.1, 24.3, 48.5, 97%) and a laboratory control, with four replicates per concentration and 150 mL of sample in each replicate. The control and dilution water was modified APHA media (i.e., deionized water with nutrients added).

Two healthy three-frond plants were placed in each test container at test initiation. The test was conducted at 25 ± 2°C under continuous light. Temperature was measured daily in the incubation chamber. Temperature and pH were measured at test initiation and termination. Conductivity was measured only at test initiation.

The IC25, IC50 values and associated 95% confidence limits were also calculated. A potassium chloride reference toxicant test was conducted within 14 days of test initiation and compared to historical data to assess the health and sensitivity of the duckweed.

For the test to be considered valid, the number of fronds at the end of the test must increase ≥8-fold in the control (i.e., the mean number of fronds in the control must be at least 48).

2.3 72-h *Pseudokirchneriella subcapitata* growth inhibition test

The *P. subcapitata* test was conducted according to Environment Canada (2007c, EPS 1/RM/25) in a static system. The endpoint was algal growth measured as cell yield over a 72-h exposure period. The test was conducted in a 96-well microplate using seven concentrations (1.48, 2.95, 5.9, 11.9, 23.8, 47.6, 95.2%) and a laboratory control, with four replicates per sample concentration and eight replicates for the control. Nutrients were added to the sample prior to preparing the test concentrations. The control and dilution water was deionized water with nutrients added. The test volume was 220 µL in each replicate.

Each well was inoculated with a density of approximately 10,000 algal cells/mL. The test was conducted in an incubation chamber maintained at 24 ± 2°C under continuous light. Temperature and pH were measured in each concentration at test initiation. Temperature was measured daily in the incubation chamber. Algal cells in each well were counted using a hemacytometer under a compound microscope after the 72-h exposure period. A zinc reference toxicant test was conducted within 14 days of test initiation and compared to historical data to assess the health and sensitivity of the algal culture.

For the test to be considered valid, the number of algal cells at the end of the test must increase by ≥16-fold in the control. In addition, the controls cannot exhibit a positive or negative trend when analyzed statistically using the Mann-Kendall test and the coefficient of variation of the control replicates cannot exceed 20%.

2.4 96-h LC50 *Oncorhynchus mykiss* test

The rainbow trout LC50 test was conducted using juvenile fish and followed the Environment Canada protocol (2000a, EPS 1/RM/13) in a static system. The test was conducted using five concentrations (6.25, 12.5, 25, 50 and 100%) and a laboratory control. The control and dilution water was dechlorinated municipal water. The test involved exposing ten juvenile rainbow trout (acclimated for ≥ 14 days, with wet weights of 0.3 to 2.5g) to each test concentration in glass aquaria.

The test was conducted at 15 ± 1°C under a 16:8 h light:dark photoperiod. Temperature, DO and pH were measured daily in each concentration and conductivity was measured at test initiation and termination. After 96 h, the median lethal concentration (LC50) and 95% confidence limits were calculated. A monthly sodium dodecyl sulphate reference toxicant test was conducted and compared to historical data to assess the health and sensitivity of the juvenile rainbow trout. For the test to be considered valid, rainbow trout survival must be ≥90% in the control.

2.5 48-h LC50 *Daphnia magna* test

The 48h LC50 *Daphnia magna* test was conducted according to Environment Canada (2000b, EPS 1/RM/14). The test was conducted using five concentrations (6.25, 12.5, 25, 50 and 100%) and a laboratory control. The control and dilution water was moderately-hard reconstituted water (hardness 80-100 mg/L), prepared by adding reagent-grade chemicals to deionized water. Ten *D. magna* (<24h old) were exposed in each test concentration using a 200-mL volume.

The test was conducted at 20 ± 2°C under a 16:8 h light:dark photoperiod. Temperature and survival were measured daily while DO, pH and conductivity were measured at test initiation and termination. After 48 h, the median lethal concentration (LC50) and 95% confidence limits were calculated. A sodium chloride reference toxicant test was conducted within 14 days of test initiation, and compared to historical data to assess the health and sensitivity of *D. magna*. For a valid test, *D. magna* survival must be ≥90% in the control.

2.6 Quality Assurance/Quality Control (QA/QC)

Nautilus follows a comprehensive QA/QC program to ensure that the data generated are of high quality and scientifically defensible. Our QA program is designed to ensure that all tests are performed in accordance with well-established and approved methods (e.g., Environment Canada, US EPA).

To meet these objectives, Nautilus has implemented a number of quality control procedures that include the following:

- Negative controls to ensure that appropriate testing performance criteria are met;
- Positive controls to assess the health and sensitivity of the test organisms;
- Use of appropriate species and life stage to meet the study objectives;
- Appropriate number of replicates to allow for proper statistical analyses;
- Calibration and proper maintenance of instruments to ensure accurate measurements;
- Proper documentation and recordkeeping to allow traceability of performance;
- Adequate supervision and training of staff to ensure that methods are followed;
- Proper handling and storage of samples to ensure their integrity;
- Procedures in place to address issues that may arise during testing and ensure the implementation of appropriate corrective actions; and
- Rigorous review of data by a registered professional biologist to ensure they are of good quality and scientifically defensible prior to releasing to the client.

Table 1. Summary of test conditions for the *Ceriodaphnia dubia* survival and reproduction test.

Test organism	*Ceriodaphnia dubia*
Test organism source	In-house culture
Test organism age	<24 hr old neonates produced within 12 hr
Test type	Static renewal
Test duration	7 ± 1 day
Test chamber	20 mL test tube
Test solution volume	15 mL
Test concentrations (% sample)	Seven concentrations, plus laboratory control
Number of replicates	10
Control/dilution water	20% Perrier water (hardness 80-100mg/L $CaCO_3$)
Test solution renewal	Daily
Test temperature	25 ± 1°C
Number of organisms/chamber	1
Feeding	Daily, with 0.1 ml *Pseudokirchneriella subcapitata* and 0.05 mL YCT
Light intensity	100 to 600 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	Environment Canada, 2007a, EPS 1/RM/21
Test endpoints	Survival and reproduction
Test acceptability criterion for controls	≥80% survival; ≥15 young per surviving control; ≥60% of controls producing three or more broods
Reference Toxicant	Sodium chloride

Table 2. Summary of test conditions for the *Lemna minor* growth inhibition test.

Test organism	*Lemna minor*
Test organism source	In-house culture
Test organism age	7- to 10-day old
Test type	Static
Test duration	7 days
Test chamber	250-mL glass containers
Test solution volume	150 mL
Test concentrations (% sample)	Seven concentrations, plus laboratory control
Number of replicates	4
Control/Dilution water	Deionized or distilled water with nutrients added
Test solution renewal	None
Test temperature	25 ± 2°C
Number of organisms/chamber	Two 3-frond plants
Light intensity	4000 to 5300 lux full spectrum light
Photoperiod	Continuous
Aeration	None
Test protocol	Environment Canada (2007b), EPS 1/RM/37
Test endpoint	Number of fronds and dry weight
Test acceptability criteria for controls	≥ 8-fold increase in number of fronds
Reference toxicant	Potassium chloride

Table 3. Summary of test conditions for the *Pseudokirchneriella subcapitata* growth inhibition test.

Test organism	*Pseudokirchneriella subcapitata*
Test organism source	In-house culture
Test organism age	4- to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test chamber	Microplate
Test solution volume	220 µL
Test concentrations (% sample)	Seven concentrations, plus laboratory control
Number of replicates	4 for treatments; 8 for control
Control/Dilution water	Deionized or distilled water
Test solution renewal	None
Test temperature	24 ± 2°C
Number of organisms/chamber	10,000 cells/mL
Light intensity	3600 to 4400 lux
Photoperiod	Continuous
Aeration	None
Test protocol	Environment Canada (2007c), EPS 1/RM/25
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for controls	≥ 16-fold increase in number of algal cells; no trend when analyzed with Mann-Kendall test; and CV ≤20%
Reference toxicant	Zinc

Table 4. Summary of test conditions for the 96-h rainbow trout LC50 test.

Test organism	*Oncorhynchus mykiss*
Test organism source	Commercial hatchery
Test organism age	Juveniles
Test type	Static
Test duration	96 hours
Test chamber	20 L glass aquarium
Test solution volume	10 L
Test concentrations (% sample)	Five concentrations, plus laboratory control
Number of replicates	1
Control/Dilution water	Municipal dechlorinated water
Test solution renewal	None
Test temperature	15 ± 1°C
Number of organisms/chamber	Ten
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test protocol	Environment Canada (2000a), EPS 1/RM/13
Test endpoint	96-h LC50
Test acceptability criteria for controls	Survival ≥ 90%
Reference toxicant	Sodium dodecyl sulphate

Table 5. Summary of test conditions for the 48-h *Daphnia magna* LC50 test.

Test organism	*Daphnia magna*
Test organism source	In-house culture
Test organism age	< 24 h
Test type	Static
Test duration	48 hours
Test chamber	250-mL glass beakers
Test solution volume	200 mL
Test concentrations (% sample)	Five concentrations, plus laboratory control
Number of replicates	One
Control/Dilution water	Moderately-hard reconstituted water (hardness 80-100 mg/L)
Test solution renewal	None
Test temperature	20 ± 2°C
Number of organisms/chamber	Ten
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	Environment Canada (2000b), EPS 1/RM/14
Test endpoint	48-h LC50
Test acceptability criteria for controls	Survival ≥ 90%
Reference toxicant	Sodium chloride

3.0 RESULTS

3.1 *Ceriodaphnia dubia* survival and reproduction test

Results of the *Ceriodaphnia dubia* tests are summarized in Table 6. *C. dubia* survival was between 90-100% for samples MR5 and MR-REF. The LC50 values for both samples were >100%. No effects on reproduction were observed on samples MR5 and MR-REF; the IC25 and IC50 values were >100% for both samples.

3.2 7-d *Lemna minor* growth inhibition test

Test results for this species are summarized in Table 7. No significant adverse effects were observed in the 7-d *L. minor* tests on frond growth in sample MR5. The IC25 and IC50 values for frond growth were >97 for MR5. Significant effects on frond growth were detected in sample MR-REF. The IC25 and IC50 values were 57.7 and >97%, respectively. For dry weight, no significant effects relative to the negative control were observed in either sample. The IC25 and IC50 values for both samples were >97%.

3.3 72-h *Pseudokirchneriella subcapitata* growth inhibition test

Results of the 72-h *P. subcapitata* test are provided in Table 8. *P. subcapitata* exhibited stimulatory effects on growth in all test concentrations (1.5 to 95.2%) for both samples relative to the control. The cell density IC25 and IC50 values were >95.2%. Percent algal stimulation ranged from 11.2 to 482.2% and 16.3 to 896.4% in MR5 and MR-REF, respectively.

3.4 96-h LC50 *Oncorhynchus mykiss* test

Results of the rainbow trout tests are provided in Table 9. Rainbow trout survival was 100% in all the test concentrations for samples MR5 and MR-REF. The 96-h LC50 value for the samples was >100%.

3.5 48-h LC50 *Daphnia magna* test

Effects on *D. magna* survival were observed in all test concentrations (6.25-100%) relative to the control after 48-h of test exposure in samples MR5 and MR-REF. Therefore, the 48-h LC50

values were <6.25% for both samples. Results of the 48-h LC50 *D. magna* tests are summarized in Table 10.

3.6 Quality Assurance/Quality Control

All acceptability criteria and water quality parameters remained within acceptable ranges specified in the protocols throughout the tests. The health history of the test organisms used in the exposures was acceptable and met the requirements of the Environment Canada protocol, with the exception of the *Lemna minor* test. The *L. minor* test was conducted with 6-day old fronds instead of the required 7-10 day old fronds outlined in the Environment Canada protocol to ensure that the samples were tested within the 3-day holding time. At the time of testing, the test cultures used for testing had good growth and the APHA test vessel used to evaluate the acceptability of the test cultures met the criterion of ≥ 8-fold increase in number of fronds. Therefore, the results were not likely affected by using 6-day old cultures.

The reference toxicant test results are summarized in Table 11. These results showed that the organisms used in testing were within the range of organism health and sensitivity compared to previous test organisms.

Table 6. Toxicity test results for the *Ceriodaphnia dubia* survival and reproduction test.

Concentration (% v/v)	MR5		MR-REF	
	Survival (%)	Reproduction (No. of Young/Female) Mean ± SD	Survival (%)	Reproduction (No. of Young/Female) Mean ± SD
Control	100	16.3 ± 1.5	100	16.9 ± 2.9
5	100	15.8 ± 3.6	100	17.7 ± 2.0
10	100	15.2 ± 2.8	100	16.3 ± 5.7
20	100	18.0 ± 3.5	100	16.9 ± 3.1
40	100	16.1 ± 5.1	100	17.2 ± 4.9
60	100	15.2 ± 3.4	100	17.4 ± 2.2
80	100	20.1 ± 2.5	90	17.0 ± 6.3
100	100	16.9 ± 4.3	100	19.0 ± 3.9
Test endpoint (% v/v)				
LC50 [1]	>100	--	>100	--
IC25 [1]	--	>100	--	>100
IC50 [1]	--	>100	--	>100

[1] Results relate only to the sample tested.

IC = Inhibition Concentration.
SD = Standard Deviation.

Table 7. Toxicity test results for the *Lemna minor* growth inhibition test.

Concentration (% v/v)	Mean ± SD			
	MR5		MR-REF	
	Frond Growth (No. of Fronds)	Dry Weight (mg)	Frond Growth (No. of Fronds)	Dry Weight (mg)
Control	80.2 ± 7.7	6.5 ± 0.5	81.8 ± 5.7	6.3 ± 0.5
1.5	80.5 ± 10.5	6.3 ± 1.1	70.0 ± 1.4	5.7 ± 0.4
3.0	70.5 ± 3.3	5.3 ± 0.2	70.8 ± 3.3	5.4 ± 0.2
6.1	83.2 ± 9.8	6.4 ± 0.3	73.0 ± 11.4	5.8 ± 1.0
12.1	86.8 ± 3.4	6.9 ± 0.4	73.5 ± 10.3	5.9 ± 0.6
24.2	82.2 ± 19.0	7.0 ± 1.2	71.5 ± 7.0	5.9 ± 0.4
48.5	84.2 ± 5.2	6.9 ± 1.0	61.8 ± 9.1	5.1 ± 0.7
97	65.2 ± 10.2	6.0 ± 1.1	60.0 ± 4.2	5.2 ± 0.4
Test endpoint (% v/v)				
IC25 (95% CL) [1]	>97	>97	57.7 (19.5 – 97)	>97
IC50 [1]	>97	>97	>97	>97

[1] Results relate only to the sample tested.

IC = Inhibition Concentration.
SD = Standard Deviation.
CL = Confidence Limits.

Table 8. Toxicity test results for the *Pseudokirchneriella subcapitata* growth inhibition test.

	MR5		MR-REF	
Concentration (% v/v)	**Cell Density (x 104 cells/mL) (Mean ± SD)**	**% Stimulation**	**Cell Density (x 104 cells/mL) (Mean ± SD)**	**% Stimulation**
Control	43.6 ± 4.4	0.0	41.5 ± 5.1	0.0
1.48	48.5 ± 5.2	11.2	48.2 ± 4.9	16.3
2.95	57.8 ± 6.6	32.4	49.5 ± 2.4	19.3
5.9	70.5 ± 10.3	61.6	60.5 ± 12.4	45.8
11.9	104.8 ± 13.2	140.1	100.2 ± 10.2	141.6
23.8	146.0 ± 37.1	234.7	221.8 ± 17.6	434.3
47.6	241.5 ± 27.8	453.6	262.2 ± 22.1	531.9
95.2	254.0 ± 20.7	482.2	413.5 ± 49.2	896.4
Test endpoint % (v/v)				
IC25 [1]	>95.2	--	>95.2	--
IC50 [1]	>95.2	--	>95.2	--

[1] Results relate only to the sample tested.

IC = Inhibition Concentration.
SD = Standard Deviation.

Table 9. Toxicity test results for the 96-h LC50 *Oncorhynchus mykiss* tests.

Concentration (% v/v)	% Survival	
	MR5	MR-REF
Control	100	100
6.25	100	100
12.5	100	100
25.0	100	100
50.0	100	100
100.0	100	100
Test endpoint (% v/v)		
LC50 [1]	>100	>100

[1] Results relate only to the sample tested.

LC = Lethal Concentration.

Table 10. Toxicity test results for the 48-h LC50 *Daphnia magna* tests.

Concentration (% v/v)	% Survival	
	MR5	MR-REF
Control	100	100
6.25	20	10
12.5	0	0
25.0	0	0
50.0	0	0
100.0	0	0
Test endpoint		
LC50 [1]	<6.25	<6.25

[1] Results relate only to the sample tested.

LC = Lethal Concentration.

Table 11. Reference toxicant test results.

Species	Endpoint	Historical range Mean (2 SD Range)	CV(%)	Date Setup
C. dubia	Survival (LC50): 1.5 g/L NaCl	1.9 (1.5 – 2.3)	12	August 28, 2010
	Reproduction (IC50): 1.0 g/L NaCl	1.2 (0.9 – 1.5)	14	
L. minor	No. Fronds (IC25): 3.5 g/L KCL	3.8 (2.6 – 5.4)	20	August 13, 2010
P. subcapitata	Growth (IC50): 34.3 µg/L Zn	23.1 (11.8 – 45.3)	40	August 17, 2010
O.mykiss (juvenile)	Survival (LC50): 5.3 mg/L SDS	5.2 (4.4 – 6.1)	9	August 23, 2010
D. magna	Survival (LC50): 3.9 g/L NaCl	4.0 (3.6 – 4.6)	6	August 26, 2010

4.0 REFERENCES

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Tidepool Scientific Software. 2009. CETIS comprehensive environmental toxicity information system, version 1.7D. Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Ceriodaphnia dubia* **Toxicity Test Data**

Ceriodaphnia dubia Summary Sheet

Client: Rescan
Work Order No.: 10314

Start Date/Time: Aug 17/10 @ 1200h
Set up by: JST

Sample Information:

Sample ID: MR-5
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2 x 20L

Test Organism Information:

Broodstock No.: 080510
Age of young (Day 0): <24-h (within 12-h)
Avg No. young in first 3 broods of previous 7 d: 19
Mortality (%) in previous 7 d: 0
Individual female # used ≥8 young on test day: 1, 3, 4, 5, 7, 9, 12, 14, 26, 39

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 57
Stock Solution ID: 09 NaCl
Date Initiated: Aug 24/10

7-d LC50 (95% CL): 1.5 (1.2 - 1.9) g/L NaCl
7-d IC50 (95% CL): 1.0 (0.7 - 1.2) g/L NaCl

7-d LC50 Reference Toxicant Mean (2SD Range): 1.9 (1.5 - 2.3) g/L NaCl CV (%): 12
7-d IC50 Reference Toxicant Mean (2SD Range): 1.2 (0.9 - 1.5) " " CV (%): 14

Test Results:

	Survival	Reproduction
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		>100
IC50 %(v/v) (95% CL)		>100

Reviewed by: A. Tang

Date reviewed: October 1, 2010

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Rescan
Sample ID: MR-5
Work Order #: 10314

Start Date & Time: Aug 17/10 @ 1200h
Stop Date: Aug 23/10 @ 1430h
Test Species: *Ceriodaphnia dubia*

Control Concentration (% v/v)	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	26.0	25.5	26.0	25.0	25.5	25.0	25.0	25.0	26.0		
DO (mg/L)	8.0	7.7	8.0	7.7	~~8.2~~ 7.9	7.1	8.0	6.7	~~8.2~~ 7.7	6.6	7.7	7.2		
pH	8.1	7.8	8.2	7.9	8.2	7.8	8.3	7.7	~~7.7~~ 8.2	7.7	8.2	7.9		
Cond. (µS/cm)	211	212		211		211		215		215		220		
Initials	JJ	JJ		JJ		JJ		~		~		JJ		

5 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	26.0	25.0	26.0	25.0	25.5	25.0	25.0	25.0	26.0		
DO (mg/L)	8.0	7.6	7.9	7.6	7.9	7.2	8.0	6.8	7.9	6.7	7.8	7.1		
pH	8.1	8.0	8.1	8.0	8.2	7.9	8.2	7.9	8.2	7.8	8.2	7.9		
Cond. (µS/cm)	210	209		209		209		213		215		221		
Initials	JJ	JJ		JJ		JJ		~		~		JJ		

40 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	26.0	25.0	26.0	25.5	25.5	25.5	25.0	25.0	26.0		
DO (mg/L)	8.0	7.5	7.9	7.6	8.0	7.1	8.0	6.8	7.8	6.7	7.8	7.0		
pH	8.1	8.0	8.1	8.0	8.2	7.9	8.2	7.9	8.1	7.9	8.1	7.9		
Cond. (µS/cm)	204	203		203		204		206		208		213		
Initials	JJ	JJ		JJ		JJ		~		~		JJ		

100 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	26.0	26.0	25.0	26.0	25.5	26.0	25.5	25.5	25.5	25.0	25.5	26.0		
DO (mg/L)	8.1	7.5	8.0	7.6	8.3	7.1	8.0	6.9	7.8	6.9	7.9	6.8		
pH	8.0	8.0	8.1	8.0	8.1	7.9	8.1	8.0	8.0	8.0	8.0	7.9		
Cond. (µS/cm)	193	191		195		191		194		197		201		
Initials	JJ	JJ		JJ		JJ		~		~		JJ		

	Control	100		
Hardness*	102	96		
Alkalinity*	88	90		

* mg/L as CaCO3

Analysts: AWD, JJ
Reviewed by: ART
Date reviewed: Sept 17/10

Sample Description: 1 clear

Comments: **Broodboard Used:** 080510

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Resson
Sample ID: MR-5
Work Order: 10314

Start Date & Time: Aug 17/10 @1200h
Stop Date & Time: Aug 23/10 @1430h
Set up by: JST

(%v/v)

Days	Concentration: Control										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	3	2	3	✓	✓	✓	3	✓	3	3	JST
4	✓	✓	✓	4	✓	✓	6	5	✓	✓	~
5	6	7	6	5	6	7	✓	6	6	6	~
6	6	9	6	9	8	9	8	7	6	8	JST
7											
8											
Total	15	18	15	18	14	16	17	18	15	17	JST

Days	Concentration: 5										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	✓	3	✓	✓	✓	✓	2	✓	3	✓	JST
4	3	6	4	3	3	4	6	3	✓	3	~
5	✓	✓	5	7	6	6	9	5	4	✓	~
6	7	8	11	✓	9	10	✓	9	9	10	JST
7											
8											
Total	10	17	20	10	18	20	17	17	16	13	JST

Days	Concentration: 10										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	2	3	2	✓	3	3	3	✓	2	✓	JST
4	✓	✓	6	✓	✓	3	5	3	✓	4	~
5	4	5	✓	4	5	✓	✓	5	5	4	~
6	6	8	10	6	9	10	4	10	9	9	JST
7											
8											
Total	12	16	18	10	17	16	12	18	16	17	JST

Days	Concentration: 20										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	3	4	3	✓	3	2	2	✓	✓	3	JST
4	✓	7	6	✓	✓	6	7	3	✓	✓	~
5	5	✓	✓	4	5	✓	6	7	8	5	~
6	10	12	11	7	8	10	✓	11	13	9	JST
7											
8											
Total	18	23	20	11	16	18	15	21	21	17	JST

Days	Concentration: 40										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	2	4	✓	2	✓	3	✓	✓	3	4	JST
4	✓	✓	3	✓	✓	5	8	5	✓	✓	~
5	5	6	5	8	✓	✓	8	7	7	5	~
6	9	10	9	✓	5	8	✓	9	10	11	JST
7											
8											
Total	16	20	17	10	5	16	16	21	20	20	JST

Days	Concentration: 60										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	2	✓	2	✓	2	3	2	✓	2	3	JST
4	✓	3	6	4	5	4	5	✓	4	4	~
5	4	5	9	8	8	7	9	5	✓	✓	~
6	10	8	✓	10	✓	✓	✓	7	9	2	JST
7											
8											
Total	16	16	17	22	15	14	16	12	15	9	JST

Days	Concentration: 80										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	3	3	✓	✓	3	✓	✓	✓	3	✓	JST
4	✓	5	5	3	5	4	3	3	5	3	~
5	6	✓	6	5	✓	5	7	6	✓	7	~
6	9	11	11	8	10	12	14	13	11	12	JST
7											
8											
Total	18	19	22	16	18	21	24	22	19	22	JST

Days	Concentration: 100										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JST
3	✓	✓	3	✓	2	3	2	✓	✓	2	JST
4	3	4	5	3	4	4	7	4	6	6	~
5	✓	✓	8	9	✓	✓	7	9	✓	✓	~
6	5	9	✓	8	11	11	14	11	11	12	JST
7											
8											
Total	8	13	16	20	17	18	16	24	17	20	JST

Days	Concentration:										
	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description: (1)

Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by: L. Tang

Date reviewed: September 17, 2010

CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	21-2232-3193	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 13:36	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	21-0974-0478	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	jane tsang
Start Date:	17 Aug-10 12:00	**Protocol:**	EC/EPS 1/RM/21	**Diluent:**	
Ending Date:	23 Aug-10 14:30	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	6d 2h	**Source:**		**Age:**	
Sample ID:	18-4150-8398	**Code:**	MR5-AUG10	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	36h	**Station:**	MR-5		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	>100	N/A	N/A	<1	N/A	N/A
EC10	>100	N/A	N/A	<1	N/A	N/A
EC15	>100	N/A	N/A	<1	N/A	N/A
EC20	>100	N/A	N/A	<1	N/A	N/A
EC25	>100	N/A	N/A	<1	N/A	N/A
EC40	>100	N/A	N/A	<1	N/A	N/A
EC50	>100	N/A	N/A	<1	N/A	N/A

6d Survival Rate Summary

			Calculated Variate(A/B)								
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Negative Control	10	1	1	1	0	0	0.0%	0.0%	10	10
5		10	1	1	1	0	0	0.0%	0.0%	10	10
10		10	1	1	1	0	0	0.0%	0.0%	10	10
20		10	1	1	1	0	0	0.0%	0.0%	10	10
40		10	1	1	1	0	0	0.0%	0.0%	10	10
60		10	1	1	1	0	0	0.0%	0.0%	10	10
80		10	1	1	1	0	0	0.0%	0.0%	10	10
100		10	1	1	1	0	0	0.0%	0.0%	10	10

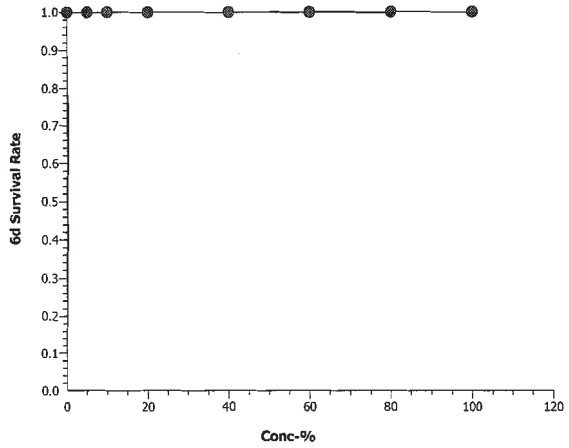
6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1	1	1	1	1	1	1	1	1	1
5		1	1	1	1	1	1	1	1	1	1
10		1	1	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1	1	1
40		1	1	1	1	1	1	1	1	1	1
60		1	1	1	1	1	1	1	1	1	1
80		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	21-2232-3193	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 13:36	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	20-3708-1645	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 13:36	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	21-0974-0478	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	jane tsang
Start Date:	17 Aug-10 12:00	**Protocol:**	EC/EPS 1/RM/21	**Diluent:**	
Ending Date:	23 Aug-10 14:30	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	6d 2h	**Source:**		**Age:**	
Sample ID:	18-4150-8398	**Code:**	MR5-AUG10	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	36h	**Station:**	MR-5		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	N/A	N/A	<1	N/A	N/A
IC10	>100	N/A	N/A	<1	N/A	N/A
IC15	>100	N/A	N/A	<1	N/A	N/A
IC20	>100	N/A	N/A	<1	N/A	N/A
IC25	>100	N/A	N/A	<1	N/A	N/A
IC40	>100	N/A	N/A	<1	N/A	N/A
IC50	>100	N/A	N/A	<1	N/A	N/A

Reproduction Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	16.3	14	18	0.2728	1.494	9.17%	0.0%
5		10	15.8	10	20	0.6656	3.645	23.07%	3.07%
10		10	15.2	10	18	0.515	2.821	18.56%	6.75%
20		10	18	11	23	0.6383	3.496	19.42%	-10.43%
40		10	16.1	5	21	0.9248	5.065	31.46%	1.23%
60		10	15.2	9	22	0.6134	3.36	22.1%	6.75%
80		10	20.1	16	24	0.4509	2.47	12.29%	-23.31%
100		10	16.9	8	24	0.7862	4.306	25.48%	-3.68%

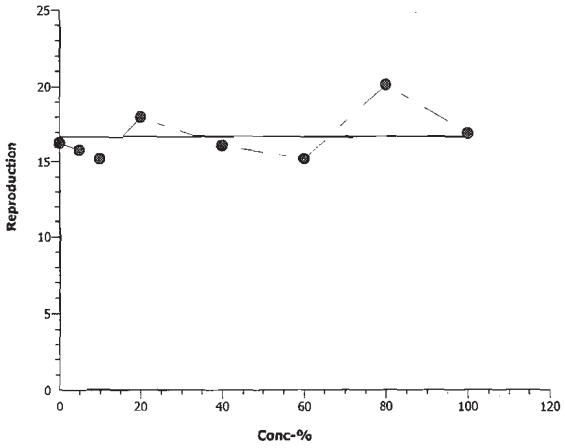
Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	15	18	15	18	14	16	17	18	15	17
5		10	17	20	10	18	20	17	17	16	13
10		12	16	18	10	17	16	12	18	16	17
20		18	23	20	11	16	18	15	21	21	17
40		16	20	17	10	5	16	16	21	20	20
60		16	16	17	22	15	14	16	12	15	9
80		18	19	22	16	18	21	24	22	19	22
100		8	13	16	20	17	18	16	24	17	20

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	20-3708-1645	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 13:36	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Ceriodaphnia dubia Summary Sheet

Client: Rescan
Work Order No.: 10314

Start Date/Time: Aug 17/10 @ 1530h
Set up by: JJT

Sample Information:

Sample ID: MR-REF
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2×20L

Test Organism Information:

Broodstock No.: 080510
Age of young (Day 0): <24hr (within 12-hr)
Avg No. young in first 3 broods of previous 7 d: 20
Mortality (%) in previous 7 d: 5
Individual female # used ≥8 young on test day: 2,4,6,7,8,11,12,14,37

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 57
Stock Solution ID: 09NaCl05
Date Initiated: Aug 24/10

7-d LC50 (95% CL): 1.5 (1.9 [1.7 - 2.3]) g/L NaCl
7-d IC50 (95% CL): 1.0 (0.7 - 1.2) g/L NaCl

7-d LC50 Reference Toxicant Mean (2SD Range): 1.9 (1.5 - 2.3) g/L NaCl CV (%): 12
7-d IC50 Reference Toxicant Mean (2SD Range): 1.2 (0.9 - 1.5) g/L NaCl CV (%): 14

Test Results:

	Survival	Reproduction
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		>100
IC50 %(v/v) (95% CL)		>100

Reviewed by: A. Terry

Date reviewed: October 1, 2010

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Rescan
Sample ID: MR-REF
Work Order #: 10314

Start Date & Time: Aug 17/10 @ 1530h
Stop Date: Aug 23/10 @ 1600h
Test Species: *Ceriodaphnia dubia*

Control Concentration (% v/v)	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	25.5	25.5	26.0	25.0	25.0	25.0	25.0	25.0	26.0		
DO (mg/L)	8.0	7.5	8.0	7.7	7.9	7.1	8.0	6.7	7.7	6.7	7.4	7.1		
pH	8.1	8.1	8.2	7.8	8.2	7.9	8.3	7.7	8.2	7.6	8.2	8.0		
Cond. (µS/cm)	211	212		211		211		216		215		219		
Initials	JJT	JJT		JJT		JJT		~		~		JJT		

5 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	26.0	25.0	26.0	25.0	25.0	25.0	25.0	25.0	26.0		
DO (mg/L)	8.0	7.4	7.9	7.7	7.9	7.1	8.0	6.8	7.8	6.8	7.8	7.0		
pH	8.1	8.1	8.2	7.9	8.2	7.9	8.2	7.7	8.2	7.8	8.2	8.0		
Cond. (µS/cm)	209	209		209		209		213		211		218		
Initials	JJT	JJT		JJT		JJT		~		~		JJT		

40 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.5	26.0	25.0	26.0	25.0	26.0	25.5	25.0	25.5	25.0	25.0	26.0		
DO (mg/L)	8.0	7.4	7.9	7.6	8.0	7.0	8.0	6.8	7.8	6.7	7.9	7.0		
pH	8.1	8.1	8.1	8.0	8.2	7.9	8.2	7.8	8.1	7.9	8.1	8.0		
Cond. (µS/cm)	197	198		198		198		199		202		207		
Initials	JJT	JJT		JJT		JJT		~		~		JJT		

100 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	26.0	26.0	25.0	26.0	25.0	26.0	25.5	25.0	25.5	25.0	25.5	26.0		
DO (mg/L)	8.1	7.4	8.0	7.6	8.3	7.1	8.0	6.9	7.8	6.7	7.9	6.9		
pH	8.0	8.1	8.0	8.0	8.1	7.9	8.1	7.8	8.0	8.0	8.1	8.0		
Cond. (µS/cm)	177	179		176		179		179		178		184		
Initials	JJT	JJT		JJT		JJT		~		~		JJT		

	Control	100		
Hardness*	102	86		
Alkalinity*	88	86		

* mg/L as CaCO3

Analysts: AWD, JJT
Reviewed by: ~~RPT~~
Date reviewed: ~~Sept 16~~ 17/Sept 10

Sample Description: 1) clear

Comments: **Broodboard Used:** 080510

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Rescan
Sample ID: MR-REF
Work Order: 10314

Start Date & Time: Aug 17/10 @ 1530h
Stop Date & Time: Aug 23/10 @ 1600h
Set up by: JJT

(%v/v)

Days	Concentration: Control										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	3	✓	✓	✓	3	✓	2	✓	✓	✓	JJT
4	✓	2	3	3	✓	4	✓	4	3	3	~
5	6	6	6	7	5	7	6	✓	6	5	~
6	8	9	8	7	11	12	9	8	7	6	JJT
7											
8											
Total	17	17	17	17	Aug 9	23	17	12	16	14	JJT

Days	Concentration: 5										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	4	✓	✓	3	2	✓	4	✓	3	✓	JJT
4	✓	3	✓	7	✓	3	3	3	✓	4	~
5	6	6	7	✓	7	✓	✓	7	8	5	~
6	8	8	11	10	7	11	10	9	10	8	JJT
7											
8										7	
Total	18	17	18	20	16	14	17	19	21	19	JJT

Days	Concentration: 10										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	4	✓	✓	✓	3	✓	✓	2	4	✓	JJT
4	✓	3	4	✓	✓	4	✓	6	✓	5	~
5	8	✓	✓	5	8	5	✓	6	7	7	~
6	11	6	9	4	12	10	11	✓	10	9	JJT
7											
8											
Total	23	9	13	9	23	19	11	14	21	21	JJT

Days	Concentration: 20										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	3	✓	3	✓	3	✓	✓	2	✓	✓	JJT
4	✓	✓	✓	3	✓	3	4	6	5	6	~
5	7	6	6	5	5	6	6	✓	6	6	~
6	12	8	9	6	8	11	10	9	5	✓	JJT
7											
8											
Total	22	14	18	14	16	20	20	17	16	12	JJT

Days	Concentration: 40										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	2	✓	✓	✓	✓	✓	✓	3	4	✓	JJT
4	✓	4	✓	3	✓	5	3	6	✓	4	~
5	6	7	6	6	7	7	✓	✓	6	✓	~
6	10	13	11	11	11	✓	12	12	10	3	JJT
7											
8											
Total	18	24	17	20	18	12	15	21	20	7	JJT

Days	Concentration: 60										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	2	3	✓	✓	3	✓	✓	✓	2	3	JJT
4	✓	✓	3	4	✓	3	3	3	✓	✓	~
5	4	7	✓	6	6	6	5	4	4	5	~
6	8	11	11	8	9	11	9	10	11	10	JJT
7											
8											
Total	14	21	14	18	18	20	17	17	17	18	JJT

Days	Concentration: 80										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	3	✓	✓	✓	3	✓	✓	3	✓	✓	JJT
4	✓	3	✓	✓	✓	3	3	7	✓	✓	~
5	4	7	7	6	6	5	4	8	7	✓	~
6	11	12	13	10	12	12	12	✓	9	X	JJT
7											
8											
Total	18	22	20	16	21	20	19	18	16	0X	JJT

Days	Concentration: 100										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	2	✓	✓	✓	3	✓	✓	✓	✓	✓	JJT
4	✓	3	3	3	✓	3	5	4	✓	✓	~
5	6	7	9	6	7	5	✓	10	7	6	~
6	10	6	13	13	14	13	9	✓	12	11	JJT
7											
8	~										
Total	19	16	25	22	24	21	14	14	19	17	JJT

Days	Concentration:										
	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description:
Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by: A. Tang

Date reviewed: October 1, 2010

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	11-5655-5762	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 15:16	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	11-8177-4317	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	jane tsang
Start Date:	17 Aug-10 15:30	**Protocol:**	EC/EPS 1/RM/21	**Diluent:**	
Ending Date:	23 Aug-10 16:00	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	6d 0h	**Source:**		**Age:**	
Sample ID:	15-2112-4189	**Code:**	MRREF-AUG10	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	16 Aug-10	**Source:**	Rescan		
Sample Age:	40h	**Station:**	MR-REF		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	100	66.05	N/A	1	N/A	1.514
EC10	>100	N/A	N/A	<1	N/A	N/A
EC15	>100	N/A	N/A	<1	N/A	N/A
EC20	>100	N/A	N/A	<1	N/A	N/A
EC25	>100	N/A	N/A	<1	N/A	N/A
EC40	>100	N/A	N/A	<1	N/A	N/A
EC50	>100	N/A	N/A	<1	N/A	N/A

6d Survival Rate Summary

			Calculated Variate(A/B)								
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Negative Control	10	1	1	1	0	0	0.0%	0.0%	10	10
5		10	1	1	1	0	0	0.0%	0.0%	10	10
10		10	1	1	1	0	0	0.0%	0.0%	10	10
20		10	1	1	1	0	0	0.0%	0.0%	10	10
40		10	1	1	1	0	0	0.0%	0.0%	10	10
60		10	1	1	1	0	0	0.0%	0.0%	10	10
80		10	0.9	0	1	0.05774	0.3162	35.14%	10.0%	9	10
100		10	1	1	1	0	0	0.0%	0.0%	10	10

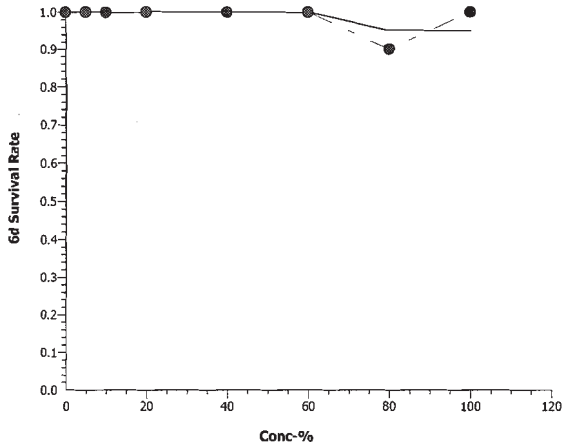
6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1	1	1	1	1	1	1	1	1	1
5		1	1	1	1	1	1	1	1	1	1
10		1	1	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1	1	1
40		1	1	1	1	1	1	1	1	1	1
60		1	1	1	1	1	1	1	1	1	1
80		1	1	1	1	1	1	1	1	1	0
100		1	1	1	1	1	1	1	1	1	1

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	11-5655-5762	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	24 Aug-10 15:16	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	17-9594-9117	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	01 Oct-10 13:56	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	11-8177-4317	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	jane tsang
Start Date:	17 Aug-10 15:30	**Protocol:**	EC/EPS 1/RM/21	**Diluent:**	
Ending Date:	23 Aug-10 16:00	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	6d 0h	**Source:**		**Age:**	
Sample ID:	15-2112-4189	**Code:**	MRREF-AUG10	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	16 Aug-10	**Source:**	Rescan		
Sample Age:	40h	**Station:**	MR-REF		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	N/A	N/A	<1	N/A	N/A
IC10	>100	N/A	N/A	<1	N/A	N/A
IC15	>100	N/A	N/A	<1	N/A	N/A
IC20	>100	N/A	N/A	<1	N/A	N/A
IC25	>100	N/A	N/A	<1	N/A	N/A
IC40	>100	N/A	N/A	<1	N/A	N/A
IC50	>100	N/A	N/A	<1	N/A	N/A

Reproduction Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	16.9	12	23	0.52669	2.8848	17.07%	0.0%
5		10	17.7	14	21	0.36566	2.0028	11.32%	-4.73%
10		10	16.3	9	23	1.0401	5.697	34.95%	3.55%
20		10	16.9	12	22	0.57381	3.1429	18.6%	0.0%
40		10	17.2	7	24	0.88944	4.8717	28.32%	-1.78%
60		10	17.4	14	21	0.40552	2.2211	12.77%	-2.96%
80		10	17	0	22	1.1483	6.2893	37.0%	-0.59%
100		10	19	14	25	0.71492	3.9158	20.61%	-12.43%

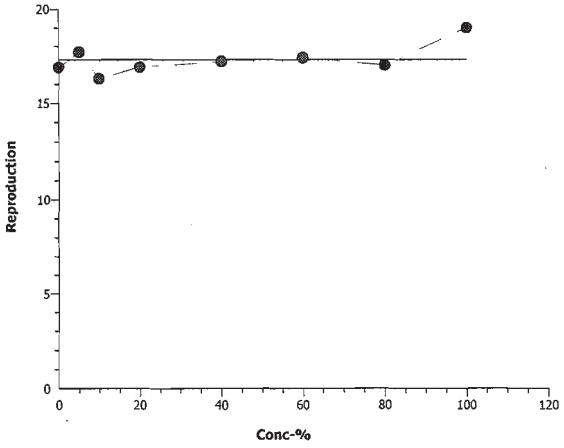
Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	17	17	17	17	19	23	17	12	16	14
5		18	17	18	20	16	14	17	19	21	17
10		23	9	13	9	23	19	11	14	21	21
20		22	14	18	14	16	20	20	17	16	12
40		18	24	17	20	18	12	15	21	20	7
60		14	21	14	18	18	20	17	17	17	18
80		18	22	20	16	21	20	19	18	16	0
100		18	16	25	22	24	21	14	14	19	17

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis ID:	17-9594-9117	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	01 Oct-10 13:56	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Client: Rescan

W.O.#: 10314

Hardness and Alkalinity Datasheet

	Alkalinity						Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity ($mg/LCaCO_3$)		Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness ($mg/L\ CaCO_3$)	Technician
Control-081510	Aug 16/10	50	4.5	4.6	JJT 88		50	5.1	102	JJT
MR#5	Aug 23/10	50	4.6	4.7	90		50	4.8	96	JJT
MR-REF	Aug 23/10	50	4.4	4.5	86		50	4.3	86	JJT

Notes:

Reviewed by: A. Tong

Date Reviewed: September 20, 2010

APPENDIX B - *Lemna minor* Toxicity Test Data

Lemna minor Summary Sheet

Client: Rescan
Work Order No.: 10313

Start Date: Aug 18/10
Set up by: JJT

Sample Information:

Sample ID: MR5
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2x2 L

Test Organism Information:

Culture Date: Aug 12/10
Age of culture (Day 0): 6 days
>8X growth in APHA?: Yes (20X fronds)
on Day ~~7~~ 10

KCl Reference Toxicant Results:

Reference Toxicant ID: LM ~~50~~ 55 AT
Date Initiated: Aug 13/10

7-d No. of Fronds IC50 (95% CL): 3.5 (2.7 - 4.6) ~~g/L~~ g/L KCl

7-d No. Fronds IC50 Reference Toxicant Mean (2 SD Range): 3.8 (2.6 - 5.4) g/L KCl CV (%): 19.5

		Number of Fronds	Dry Weight
Test Results:	IC25 %(v/v) (95% CL)	> 97	> 97
	IC50 %(v/v) (95% CL)	> 97	> 97

Reviewed by: L. Teng

Date reviewed: September 20, 2010

Plant Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Rescan

Setup by: JJT

Sample ID: MR/5 5/A

Test Date: Aug 18/10

Work Order No.: 10313

Test Species: Lemna minor

Culture Source: UTCC #490

Test Culture Age: 6 days

> 8X Growth? (Y/N): Yes 27 fronds on day 6A

Light Intensity Range: 4000 - 4250

Date Measured: Aug 18/10

Day	0	1	2	3	4	5	6	7
Shelf Temp (°C)	25.0	26.0	25.5	25.5	25.5	26.0	26.0	25.5
Initials	~	JJT	~	~	~	JJT	JJT	JJT

Sample Characteristics

Aeration? 20 min

Temperature (°C)	25.5	25.0
DO (mg/L)	8.0	7.6
pH	8.1	8.1
Conductivity (µS)	191	1195

Concentration % (v/v)	Temperature (°C)		pH		Conductivity (µS)
	Day 0	Day 7	Day 0	Day 7	0 h
Control	24.0	26.5	8.4	8.8	819
1.5	24.0	26.5	8.3	8.7	822
3.05	24.0	26.5	8.2	9.0	829
6.1	24.5	26.5	8.2	8.9	835
12.1	24.5	26.5	8.2	8.8	~~880~~ 880
24.2	24.5	26.5	8.1	8.8	890
48.5	25.0	26.5	8.1	8.9	899
97	25.0	26.5	8.1	9.1	1195
Initials	~	JJT	~	JJT	~

Thermometer: Big Jumbo Thermometer Cond. Meter: C-1 pH meter: pH-1

Sample Description: clear

Comments:

Reviewed: A. Tang Date Reviewed: September 20, 2010

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: Rescan
Sample ID: MR~~5~~ M
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10
Test set up by: JJT

Concentration % (v/v)	Rep	No. of fronds Day 0	No. of fronds Day 7	Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
Control	A	6	83										JJT
	B		97										
	C		79										
	D		86										
1.5	A		81										
	B		101										
	C		77										
	D		87										
3.05	A		81										
	B		76										
	C		73										
	D		76										
6.1	A		82										
	B		95										
	C		100										
	D		80										
12.1	A		93										
	B		96										
	C		94										
	D		88										
24.2	A		112										
	B		75										
	C		95										
	D		71										

Comments:

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: Rescan
Sample ID: mE35
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10
Test set up by: JST

Concentration % (v/v)	Rep	No. of fronds		Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
		Day 0	Day 7										
48.5	A	6	94										JST
	B		94										
	C		83										
	D		90										
97	A		75										
	B		76										
	C		78										
	D		56										
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												

Comments:

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

7-d *Lemna minor* Weight Data Sheet

Client: Research
Sample ID: ME35
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10

Concentration % (w/v)	Rep	BLUE Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
Control	A	1	~~1316~~ 1317.03	1323.58	
	B	2	1318.90	1326.04	
	C	3	1321.13	1326.99	
	D	4	1320.11	1326.51	
1.5	A	5	1324.39	1331.03	
	B	6	1314.28	1321.92	
	C	7	1321.03	1326.17	
	D	8	1319.92	1325.77	
3.05	A	9	1320.08	1325.57	
	B	10	1316.83	1321.93	
	C	11	1313.99	1319.32	
	D	12	1319.58	1324.71	
6.1	A	13	1315.05	1321.47	
	B	14	1314.17	1320.85	
	C	15	1319.93	1326.51	
	D	16	1312.07	1318.08	
12.1	A	17	1309.64	1316.15	
	B	18	1315.84	1322.91	
	C	19	1315.48	1322.79	
	D	20	1311.24	1317.90	
24.2	A	21	1320.91	1329.59	
	B	22	1317.31	1323.40	
	C	23	1318.38	1325.62	
	D	24	1321.94	1327.98	
48.5	A	25	1313.52	1321.05	
	B	26	1316.02	1323.91	
	C	27	1317.91	1323.52	
	D	28	1312.94	1319.65	

Comments: Reweighed #3 1326.91 #31 1325.39
#13 1321.41

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

7-d *Lemna minor* Weight Data Sheet

Client: Resca
Sample ID: MRS
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10

Concentration (% v/v)	Rep	BLUE Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
97	A	29	1314.13	1320.21	
	B	30	1313.31	~~1325.35~~ 1319.98	
	C	31	1318.52	1325.40	
	D	32	1314.52	1319.07	
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Comments:

Reviewed by: A. Terg

Date Reviewed: September 20, 2010

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	02-7557-8760	**Endpoint:**	Total Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	27 Aug-10 12:08	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	19-5442-6695	**Test Type:**	Lemna Growth	**Analyst:**	andy diewald
Start Date:	18 Aug-10	**Protocol:**	EC/EPS 1/RM/37	**Diluent:**	
Ending Date:	25 Aug-10	**Species:**	Lemna minor	**Brine:**	
Duration:	7d 0h	**Source:**	UTCC #490	**Age:**	
Sample ID:	13-3344-8330	**Code:**	4F7ACE8A	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	48h	**Station:**	MR5		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	79.97	N/A	N/A	1.25	N/A	N/A
IC10	>97	N/A	N/A	<1.031	N/A	N/A
IC15	>97	N/A	N/A	<1.031	N/A	N/A
IC20	>97	N/A	N/A	<1.031	N/A	N/A
IC25	>97	N/A	N/A	<1.031	N/A	N/A
IC40	>97	N/A	N/A	<1.031	N/A	N/A
IC50	>97	N/A	N/A	<1.031	N/A	N/A

Total Dry Weight-mg Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	4	6.487	5.86	7.14	0.0961	0.5263	8.11%	0.0%
1.5		4	6.318	5.14	7.64	0.196	1.074	16.99%	2.62%
3.05		4	5.263	5.1	5.49	0.03337	0.1828	3.47%	18.88%
6.1		4	6.422	6.01	6.68	0.05387	0.2951	4.6%	1.0%
12.1		4	6.888	6.51	7.31	0.06718	0.3679	5.34%	-6.17%
24.2		4	7.012	6.04	8.68	0.2268	1.242	17.71%	-8.09%
48.5		4	6.943	5.61	7.89	0.1844	1.01	14.55%	-7.01%
97		4	6.042	4.54	6.88	0.1931	1.057	17.5%	6.86%

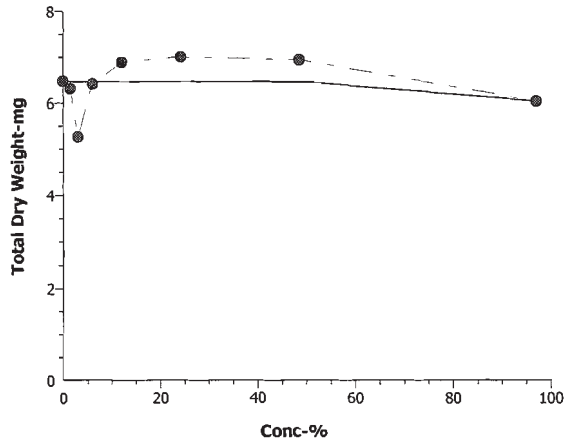
Total Dry Weight-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Negative Control	6.55	7.14	5.86	6.4
1.5		6.64	7.64	5.14	5.85
3.05		5.49	5.1	5.33	5.13
6.1		6.42	6.68	6.58	6.01
12.1		6.51	7.07	7.31	6.66
24.2		8.68	6.09	7.24	6.04
48.5		7.53	7.89	5.61	6.74
97		6.08	6.67	6.88	4.54

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	02-7557-8760	**Endpoint:**	Total Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	27 Aug-10 12:08	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	16-7548-2011	**Endpoint:**	Frond Count	**CETIS Version:**	CETISv1.7.0
Analyzed:	26 Aug-10 11:09	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	19-5442-6695	**Test Type:**	Lemna Growth	**Analyst:**	andy diewald
Start Date:	18 Aug-10	**Protocol:**	EC/EPS 1/RM/37	**Diluent:**	
Ending Date:	25 Aug-10	**Species:**	Lemna minor	**Brine:**	
Duration:	7d 0h	**Source:**	UTCC #490	**Age:**	
Sample ID:	13-3344-8330	**Code:**	4F7ACE8A	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	48h	**Station:**	MR5		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Extreme Value	Grubbs Extreme Value	2.732	2.938	0.1178	No Outliers Detected

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	57.95	N/A	72.83	1.726	1.373	N/A
IC10	69.2	36.66	109.9	1.445	0.9103	2.728
IC15	82.6	44.28	N/A	1.211	N/A	2.258
IC20	>97	N/A	N/A	<1.031	N/A	N/A
IC25	>97	N/A	N/A	<1.031	N/A	N/A
IC40	>97	N/A	N/A	<1.031	N/A	N/A
IC50	>97	N/A	N/A	<1.031	N/A	N/A

Frond Count Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	4	80.25	73	91	1.409	7.719	9.62%	0.0%
1.5		4	80.5	71	95	1.918	10.5	13.05%	-0.31%
3.05		4	70.5	67	75	0.6055	3.317	4.7%	12.15%
6.1		4	83.25	74	94	1.785	9.777	11.74%	-3.74%
12.1		4	86.75	82	90	0.6214	3.403	3.92%	-8.1%
24.2		4	82.25	65	106	3.469	19	23.1%	-2.49%
48.5		4	84.25	77	88	0.9472	5.188	6.16%	-4.98%
97		4	65.25	50	72	1.87	10.24	15.7%	18.69%

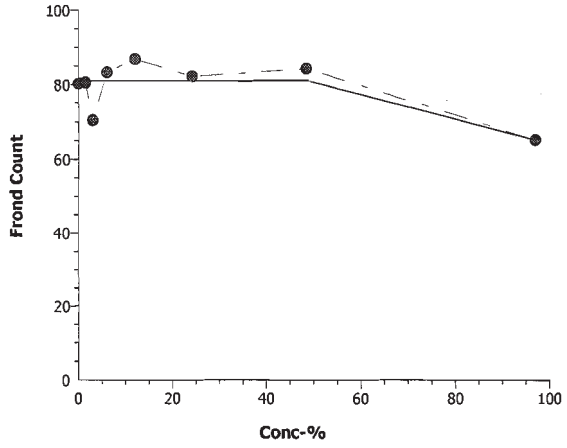
Frond Count Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Negative Control	77	91	73	80
1.5		75	95	71	81
3.05		75	70	67	70
6.1		76	89	94	74
12.1		87	90	88	82
24.2		106	69	89	65
48.5		88	88	77	84
97		69	70	72	50

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	16-7548-2011	**Endpoint:**	Frond Count	**CETIS Version:**	CETISv1.7.0
Analyzed:	26 Aug-10 11:09	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Analyst:_____ QA Sept 20/10

Lemna minor Summary Sheet

Client: Rescan
Work Order No.: 10313
Start Date: Aug 18/10
Set up by: JST

Sample Information:

Sample ID: MR-REF
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2+2 L

Test Organism Information:

Culture Date: Aug 12/10
Age of culture (Day 0): 6 days
>8X growth in APHA?: Yes (7X fronds on Day 7 to 7)

KCl Reference Toxicant Results:

Reference Toxicant ID: LM AT 55
Date Initiated: Aug 13/10

7-d No. of Fronds IC50 (95% CL): 3.5 (2.7 - 4.6) g/L KCl

7-d No. Fronds IC50 Reference Toxicant Mean (2 SD Range): 3.8 (2.6 - 5.4) g/L KCl CV (%): 19.5

		Number of Fronds	Dry Weight
Test Results:	IC25 %(v/v) (95% CL)	57.7 (19.5 - 100)	>97
	IC50 %(v/v) (95% CL)	>97	>97

Reviewed by: A. Tang
Date reviewed: September 20, 2010

Plant Growth Inhibition Toxicity Test
Water Quality Measurements

Client: Rescon | Setup by: JJT

Sample ID: MR-REF | Test Date: Aug 18/10

Work Order No.: 10313 | Test Species: Lemna minor

Culture Source: ~~6 days~~ UTCC #490

Test Culture Age: 6 days | > 8X Growth? (Y/N): Yes 27 fronds on day #6A

Light Intensity Range: 4000 - 4250 | Date Measured: Aug 18/10

Day	0	1	2	3	4	5	6	7
Shelf Temp (°C)	25.5	26.0	25.5	25.5	25.5	26.0	26.0	25.5
Initials	~	JJT	~	~	~	JJT	JJT	JJT

Sample Characteristics | Aeration? 20 min

Temperature (°C)	25.5	24.6
DO (mg/L)	8.0	8.1
pH	8.0	8.1
Conductivity (µS)	179	953

Concentration % (v/v)	Temperature (°C)		pH		Conductivity (µS)
	Day 0	Day 7	Day 0	Day 7	0 h
Control	24.0	26.5	8.4	8.6	818
1.5	24.0	26.5	8.3	8.8	~~825~~
3.05	24.0	26.5	8.3	9.0	~~838~~ 827
6.1	24.0	26.5	8.2	9.4	833
12.1	24.6	26.5	8.2	9.2	850
24.2	24.6	26.5	8.1	9.2	875
48.5	24.6	26.5	8.1	9.4	933
97	24.6	26.5	8.1	9.3	953
Initials	~	JJT	~	JJT	~

Thermometer: Big Jumbo Thermometer | Cond. Meter: C-1 | pH meter: pH-1

Sample Description: Clear

Comments:

Reviewed: A. Tang | Date Reviewed: September 20, 2010

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ReScan
Sample ID: MR-REF
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10
Test set up by: JST

Concentration % (v/v)	Rep	No. of fronds Day 0	No. of fronds Day 7	Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
Control	A	6	85										JST
	B		81										
	C		93										
	D		92										
1.5	A		76										
	B		77										
	C		77						✓				
	D		74										
3.05	A		81										
	B		73										
	C		77										
	D		76										
6.1	A		85										
	B		92										
	C		71										
	D		68										
12.1	A		78										
	B		93										
	C		68										
	D		79										
24.2	A		81										
	B		77										
	C		84										
	D		68										

Comments:

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: Rescan
Sample ID: MR-EEF
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10
Test set up by: JST

Concentration % (v/v)	Rep	No. of fronds Day 0	No. of fronds Day 7	Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
48.5	A	6	62										JST
	B		75										
	C		76										
	D		58										
97	A		70										
	B		69										
	C		61										
	D		64										
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												

Comments:

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

7-d *Lemna minor* Weight Data Sheet

Client: Rescan
Sample ID: MR-REF
Work Order #: 10313

Start Date: Aug 16/10
Termination Date: Aug 25/10

Concentration % (v/v)	Rep	GREEN Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
Control	A	1	1293.03	1299.63	
	B	2	1297.09	1302.70	
	C	3	1294.00	1300.70	
	D	4	1298.46	1304.81	
1.5	A	5	1294.73	1300.56	
	B	6	1298.08	1303.21	
	C	7	1297.56	1303.31	
	D	8	1291.13	1297.19	
3.05	A	9	~~1300.06~~ 1282.94	1288.08	
	B	10	1300.06	1305.55	
	C	11	1297.13	1302.63	
	D	12	1293.78	1299.31	
6.1	A	13	1295.78	1302.15	
	B	14	1296.00	1302.91	
	C	15	1298.75	~~1299.7~~ 1303.95	
	D	16	1295.20	1299.99	
12.1	A	17	1297.57	1303.64	
	B	18	1298.19	1304.91	
	C	19	1295.43	1300.70	
	D	20	1297.88	1303.47	
24.2	A	21	1291.48	1297.40	
	B	22	1295.57	1301.59	
	C	23	1295.30	1301.52	
	D	24	1291.29	1296.55	
48.5	A	25	1288.02	1292.65	
	B	26	1294.86	1300.56	
	C	27	1297.26	1302.95	
	D	28	1292.35	1296.63	

Comments: Reweighed # 1 1299.73 # 29: 1299.13
14 1302.97

Reviewed by: A. Tang

Date Reviewed: September 20, 2010

7-d *Lemna minor* Weight Data Sheet

Client: Rescan
Sample ID: MR-REF
Work Order #: 10313

Start Date: Aug 18/10
Termination Date: Aug 25/10

Concentration (%)	Rep	Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
97	A	29	1293.46	1299.15	^
	B	30	1294.38	1299.55	|
	C	31	1292.42	1297.07	|
	D	32	1293.24	1298.37	✓
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Comments:

Reviewed by: L. Teng

Date Reviewed: September 20, 2010

CETIS Analytical Report

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	08-5961-4879	**Endpoint:**	Total Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	27 Aug-10 12:02	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	01-2741-5639	**Test Type:**	Lemna Growth	**Analyst:**	andy diewald
Start Date:	18 Aug-10	**Protocol:**	EC/EPS 1/RM/37	**Diluent:**	
Ending Date:	25 Aug-10	**Species:**	Lemna minor	**Brine:**	
Duration:	7d 0h	**Source:**	UTCC #490	**Age:**	
Sample ID:	03-5609-0139	**Code:**	1539811B	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	48h	**Station:**	MR-REF		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	0.6518	0.1968	46.38	153.4	2.156	508.2
IC10	25.75	N/A	71.52	3.883	1.398	N/A
IC15	36.71	N/A	N/A	2.724	N/A	N/A
IC20	>97	N/A	N/A	<1.031	N/A	N/A
IC25	>97	N/A	N/A	<1.031	N/A	N/A
IC40	>97	N/A	N/A	<1.031	N/A	N/A
IC50	>97	N/A	N/A	<1.031	N/A	N/A

Total Dry Weight-mg Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	4	6.315	5.61	6.7	0.08992	0.4925	7.8%	0.0%
1.5		4	5.693	5.13	6.06	0.07254	0.3973	6.98%	9.86%
3.05		4	5.415	5.14	5.53	0.03362	0.1841	3.4%	14.25%
6.1		4	5.818	4.79	6.91	0.1806	0.9893	17.0%	7.88%
12.1		4	5.913	5.27	6.72	0.1152	0.6309	10.67%	6.37%
24.2		4	5.855	5.26	6.22	0.07592	0.4158	7.1%	7.28%
48.5		4	5.075	4.28	5.7	0.1333	0.73	14.38%	19.64%
97		4	5.16	4.65	5.69	0.07762	0.4251	8.24%	18.29%

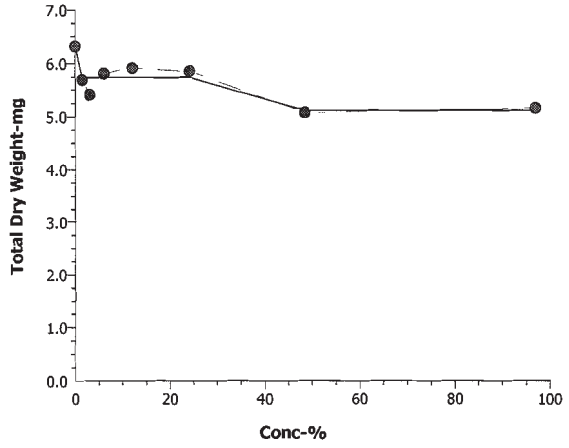
Total Dry Weight-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Negative Control	6.6	5.61	6.7	6.35
1.5		5.83	5.13	5.75	6.06
3.05		5.14	5.49	5.5	5.53
6.1		6.37	6.91	5.2	4.79
12.1		6.07	6.72	5.27	5.59
24.2		5.92	6.02	6.22	5.26
48.5		4.63	5.7	5.69	4.28
97		5.69	5.17	4.65	5.13

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	08-5961-4879	**Endpoint:**	Total Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	27 Aug-10 12:02	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	17-8746-1052	**Endpoint:**	Frond Count	**CETIS Version:**	CETISv1.7.0
Analyzed:	26 Aug-10 11:27	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	01-2741-5639	**Test Type:**	Lemna Growth	**Analyst:**	andy diewald
Start Date:	18 Aug-10	**Protocol:**	EC/EPS 1/RM/37	**Diluent:**	
Ending Date:	25 Aug-10	**Species:**	Lemna minor	**Brine:**	
Duration:	7d 0h	**Source:**	UTCC #490	**Age:**	
Sample ID:	03-5609-0139	**Code:**	1539811B	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Water Sample	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	48h	**Station:**	MR-REF		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Extreme Value	Grubbs Extreme Value	2.091	2.938	0.9977	No Outliers Detected

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	0.4577	0.2367	1.965	218.5	50.9	422.4
IC10	1.125	0.5112	45.61	88.89	2.192	195.6
IC15	27.97	N/A	52.21	3.575	1.915	N/A
IC20	37.45	12.63	105.8	2.671	0.9451	7.919
IC25	57.72	19.51	N/A	1.733	N/A	5.126
IC40	>97	N/A	N/A	<1.031	N/A	N/A
IC50	>97	N/A	N/A	<1.031	N/A	N/A

Frond Count Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	4	81.75	75	87	1.047	5.737	7.02%	0.0%
1.5		4	70	68	71	0.2582	1.414	2.02%	14.37%
3.05		4	70.75	67	75	0.6032	3.304	4.67%	13.46%
6.1		4	73	62	86	2.082	11.4	15.62%	10.7%
12.1		4	73.5	62	87	1.877	10.28	13.99%	10.09%
24.2		4	71.5	62	78	1.269	6.952	9.72%	12.54%
48.5		4	61.75	52	70	1.662	9.106	14.75%	24.46%
97		4	60	55	64	0.7746	4.243	7.07%	26.61%

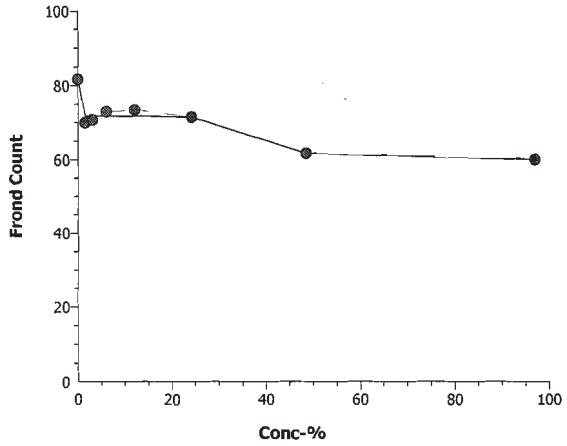
Frond Count Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Negative Control	79	75	87	86
1.5		70	71	71	68
3.05		75	67	71	70
6.1		79	86	65	62
12.1		72	87	62	73
24.2		75	71	78	62
48.5		56	69	70	52
97		64	63	55	58

Lemna Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	17-8746-1052	**Endpoint:**	Frond Count	**CETIS Version:**	CETISv1.7.0
Analyzed:	26 Aug-10 11:27	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



APPENDIX C - ***Pseudokirchneriella subcapitata*** **Toxicity Test Data**

Pseudokirchneriella subcapitata Summary Sheet

Client: Rescan
Work Order No.: 10312
Start Date: August 17, 2010
Set up by: ECC

Sample Information:

Sample ID: MR5
Sample Date: Aug. 16, 2010
Date Received: Aug. 17, 2010
Sample Volume: 2 x 20L

Test Organism Information:

Culture Date: August 12, 2010
Age of culture (Day 0): 5 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC61
Stock Solution ID: 10Zn01
Date Initiated: August 17, 2010

72-h IC50 (95% CL): 34.3 (32.4 - 36.3) µg/L Zn

72-h IC50 Reference Toxicant Mean and Range: 23.3 (11.8 - 45.7) µg/L Zn CV (%): 40%

Test Results:

	Algal Growth
IC25 %(v/v) (95% CL)	> 95.2
IC50 %(v/v) (95% CL)	> 95.2

Reviewed by: A. Terg
Date reviewed: September 17, 2010

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Rescan **Setup by:** ECC

Sample ID: MRS **Test Date/Time:** August 17, 2010 1300h

Work Order No.: 10312 **Test Species:** *Pseudokirchneriella subcapitata*

Culture Date: Aug. 12, 2010 **Age of Culture:** 5d **Culture Health:** Good

Culture Count: 1 811 2 794 **Average:** 802.5 **Culture Cell Density (c1):** 802.5 x 10⁴

$$v1 = \frac{220{,}000 \text{ cells/ml} \times 100 \text{ ml}}{(c1)\ 802.5 \times 10^4 \text{ cells/ml}} = 2.7 \text{ mL}$$

Time Zero Counts: 1 21 2 23 **Average:** 22 x 10⁴

No. of Cells/mL: 22 x 10⁴ **Initial Density:** # cells/mL ÷ 220 µL x 10 µL = 10,000

Concentration	Water Quality Measurements					Microplates rotated 2X per day?			
	pH	Temp (°C)							
% (v/v)	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.8	24.0	25.5	26.0	25.5	✓	✓	✓	✓
1.5	6.9	24.0	25.5	26.0	25.5	✓	✓	✓	✓
3.0	7.1	24.0	25.5	26.0	25.5	✓	✓	✓	✓
5.9	7.1	24.0	25.5	26.0	25.5	✓	✓	✓	✓
11.9	7.2	24.5	25.5	26.0	25.5	✓	✓	✓	✓
23.8	7.5	25.0	25.5	26.0	25.5	✓	✓	✓	✓
47.6	7.7	25.0	25.5	26.0	25.5	✓	✓	✓	✓
95.2	8.0	25.5	25.5	26.0	25.5	✓	✓	✓	✓
Initials									

Initial control pH: Well 1: 6.8 Well 2: 6.8

Final control pH: Well 1: 6.5 Well 2: 6.5

Light intensity (lux): 3700 **Date measured:** Aug. 17, 2010

Sample Description: Clear, colourless

Comments:

Reviewed: A. Teng **Date reviewed:** September 17, 2010

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: Rescan
Start Date/Time: August 17, 2010 1300h
Work Order #: 10312
Termination Date: August 20, 2010
Sample ID: MR5
Test set up by: ECC

%(v/v)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	42					
	B	38					
	C	49					
	D	50					
	E	40					
	F	46					
	G	47	49				
	H	44					
1.5	A	43					
	B	52					
	C	55					
	D	48					
3.0	A	62					
	B	51					
	C	56					
	D	66					
5.9	A	76					
	B	85	82				
	C	68					
	D	59					
11.9	A	103					
	B	106					
	C	123					
	D	91					
23.8	A	133					
	B	99	103				
	C	174					
	D	180					
47.6	A	276					
	B	225					
	C	215					
	D	254					
95.2	A	265					
	B	278					
	C	231					
	D	246					

Comments:

Reviewed by: A. Tang
Date Reviewed: September 17, 2010

***Pseudokirchneriella subcapitata* Algal Counts**

Client:	Rescan	Start Date/Time:	17-Aug-10 @1300h		
WO#:	10312	Termination Date:	20-Aug-10		
Sample ID:	MR5				
		Initial Cell Density:	10000 cell/mL		220000
					0.22
					0.01

Concentration % v/v	Rep	Count 1 (x 10^4)	Count 2 (x 10^4)	Count 3 (x 10^4)	Count 4 (x 10^4)	Mean (x 10^4)	Cell Yield (x 10^4) cell/mL		10000
Control	A	42				42	41.0	mean	43.6
	B	38				38	37.0	SD	4.373214
	C	49				49	48.0	CV	10.02456
	D	50				50	49.0		
	E	40				40	39.0		
	F	46				46	45.0		
	G	47	49			48	47.0		
	H	44				44	43.0		
1.48	A	43				43	42.0		
	B	52				52	51.0		
	C	55				55	54.0		
	D	48				48	47.0		
2.95	A	62				62	61.0		
	B	51				51	50.0		
	C	56				56	55.0		
	D	66				66	65.0		
5.9	A	76				76	75.0		
	B	85	82			83.5	82.5		
	C	68				68	67.0		
	D	59				59	58.0		
11.9	A	103				103	102.0		
	B	106				106	105.0		
	C	123				123	122.0		
	D	91				91	90.0		
23.8	A	133				133	132.0		
	B	99	103			101	100.0		
	C	174				174	173.0		
	D	180				180	179.0		
47.6	A	276				276	275.0		
	B	225				225	224.0		
	C	215				215	214.0		
	D	254				254	253.0		
95.2	A	265				265	264.0		
	B	278				278	277.0		
	C	231				231	230.0		
	D	246				246	245.0		

ART
Sept 17/10

CETIS Analytical Report

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	05-7350-3073	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.7.0
Analyzed:	23 Aug-10 14:31	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	13-5110-4070	**Test Type:**	Cell Growth	**Analyst:**	
Start Date:	17 Aug-10	**Protocol:**	EC/EPS 1/RM/25	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	20 Aug-10	**Species:**	Pseudokirchneriella subcapitata	**Brine:**	
Duration:	72h	**Source:**	In-House Culture	**Age:**	5 d
Sample ID:	00-5704-1063	**Code:**	MR5	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	24h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Control Trend	Mann-Kendall Trend	4		0.7195	Non-significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC10	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC15	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC20	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC25	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC40	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC50	>95.2	N/A	N/A	<1.0504	N/A	N/A

Cell Density Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	8	43.625	37	49	0.79844	4.3732	10.03%	0.0%
1.5		4	48.5	42	54	0.94868	5.1962	10.71%	+11.18%
3		4	57.75	50	65	1.2053	6.6018	11.43%	+32.38%
5.9		4	70.5	58	82	1.8886	10.344	14.67%	+61.61%
11.9		4	104.75	90	122	2.41	13.2	12.6%	+140.11%
23.8		4	146	100	179	6.7741	37.103	25.41%	+234.67%
47.6		4	241.5	214	275	5.0739	27.791	11.51%	+453.58%
95.2		4	254	230	277	3.7801	20.704	8.15%	+482.24%

% Stimulation

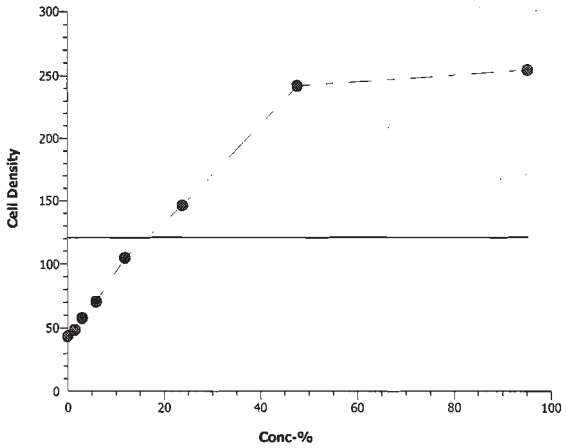
Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	41	37	48	49	39	45	47	43
1.5		42	51	54	47				
3		61	50	55	65				
5.9		75	82	67	58				
11.9		102	105	122	90				
23.8		132	100	173	179				
47.6		275	224	214	253				
95.2		264	277	230	245				

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	05-7350-3073	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.7.0
Analyzed:	23 Aug-10 14:31	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Analyst:_____ QA: 17/10

Pseudokirchneriella subcapitata Summary Sheet

Client: Rescan
Work Order No.: 10312
Start Date: August 17, 2010
Set up by: ECC

Sample Information:

Sample ID: ~~MREF~~ REF
Sample Date: Aug. 16, 2010
Date Received: Aug. 17, 2010
Sample Volume: 2 x 2 L

Test Organism Information:

Culture Date: August 12, 2010
Age of culture (Day 0): 5 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC61
Stock Solution ID: 10Zn01
Date Initiated: August 17, 2010

72-h IC50 (95% CL): 34.3 (32.4 - 36.3) µg/L Zn

72-h IC50 Reference Toxicant Mean and Range: ~~23.3~~ 45.3, 11.8 - ~~8.4~~ 45.3 µg/L Zn CV (%): 40%

Test Results:

	Algal Growth
IC25 %(v/v) (95% CL)	> 95.2
IC50 %(v/v) (95% CL)	> 95.2

Reviewed by: A. Tang
Date reviewed: September 17, 2010

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Rescan **Setup by:** ECC

Sample ID: MR REF **Test Date/Time:** August 17, 2010 1300h

Work Order No.: 10312 **Test Species:** *Pseudokirchneriella subcapitata*

Culture Date: Aug. 12, 2010 **Age of Culture:** 5 d **Culture Health:** Good

Culture Count: 1 811 2 794 **Average:** 8025 **Culture Cell Density (c1):** 802.5 X10⁴

$$v1 = \frac{220{,}000 \text{ cells/ml} \times 100 \text{ ml}}{(c1)\ 802.5 \times 10^4 \text{ cells/ml}} = 2.7 \text{ mL}$$

Time Zero Counts: 1 21 2 23 **Average:** 22 x 10⁴

No. of Cells/mL: 22 x 10⁴ **Initial Density:** # cells/mL ÷ 220 µL x 10 µL = 10,000

Concentration	Water Quality Measurements					Microplates rotated 2X per day?			
	pH	Temp (°C)							
% (v/v)	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.8	24.0	25.5	26.0	25.5	✓	✓	✓	✓
1.5	6.8	24.0	25.5	26.0	25.5	✓	✓	✓	✓
3.0	6.8	24.0	25.5	26.0	25.5	✓	✓	✓	✓
5.9	6.8	24.0	25.5	26.0	25.5	✓	✓	✓	✓
11.9	6.9	24.0	25.5	26.0	25.5	✓	✓	✓	✓
23.8	7.2	24.5	25.5	26.0	25.5	✓	✓	✓	✓
47.6	7.4	25.0	25.5	26.0	25.5	✓	✓	✓	✓
95.2	7.8	25.5	25.5	26.0	25.5	✓	✓	✓	✓
Initials									

Initial control pH: Well 1: 6.8 Well 2: 6.8

Final control pH: Well 1: 6.5 Well 2: 6.5

Light intensity (lux): 3610 **Date measured:** Aug. 17, 2010

Sample Description: Clear, colourless

Comments:

Reviewed: A. Tang **Date reviewed:** September 17, 2010

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: Rescan | Start Date/Time: August 17, 2010 1300h

Work Order #: 10312 | Termination Date: August 20, 2010

Sample ID: ~~MREF-EFF~~ | Test set up by: ECC

%(v/v)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	39	43				
	B	41					
	C	46					
	D	35					
	E	47					
	F	51	48				
	G	36					
	H	45					
1.5	A	42					
	B	51					
	C	53					
	D	50	51				
3.0	A	49					
	B	52					
	C	47	49				
	D	53					
5.9	A	56					
	B	65					
	C	48					
	D	78	76				
11.9	A	115					
	B	97					
	C	102					
	D	89	94				
23.8	A	248					
	B	213					
	C	221					
	D	198	220				
47.6	A	283					
	B	232					
	C	265					
	D	273					
95.2	A	455					
	B	368					
	C	376					
	D	459					

Comments:

Reviewed by: A. Teng | Date Reviewed: September 17, 2010

***Pseudokirchneriella subcapitata* Algal Counts**

Client:	Rescan	Start Date/Time:	17-Aug-10 @1300h
WO#:	10312	Termination Date:	20-Aug-10
Sample ID:	MREF - REF		
		Initial Cell Density:	10000 cell/mL

									220000
									0.22
									0.01
Concentration % v/v	Rep	Count 1 (x 10^4)	Count 2 (x 10^4)	Count 3 (x 10^4)	Count 4 (x 10^4)	Mean (x 10^4)	Cell Yield (x 10^4) cell/mL		10000
Control	A	39	43			41	40.0	mean	41.6
	B	41				41	40.0	SD	5.219726
	C	46				46	45.0	CV	12.55874
	D	35				35	34.0		
	E	47				47	46.0		
	F	51	48			49.5	48.5		
	G	36				36	35.0		
	H	45				45	44.0		
1.48	A	42				42	41.0		
	B	51				51	50.0		
	C	53				53	52.0		
	D	50	51			50.5	49.5		
2.95	A	49				49	48.0		
	B	52				52	51.0		
	C	47	49			48	47.0		
	D	53				53	52.0		
5.9	A	56				56	55.0		
	B	65				65	64.0		
	C	48				48	47.0		
	D	78	76			77	76.0		
11.9	A	115				115	114.0		
	B	97				97	96.0		
	C	102				102	101.0		
	D	89	94			91.5	90.5		
23.8	A	248				248	247.0		
	B	213				213	212.0		
	C	221				221	220.0		
	D	198	220			209	208.0		
47.6	A	283				283	282.0		
	B	232				232	231.0		
	C	265				265	264.0		
	D	273				273	272.0		
95.2	A	455				455	454.0		
	B	368				368	367.0		
	C	376				376	375.0		
	D	459				459	458.0		

ART
Sept 17/10

CETIS Analytical Report

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	19-3573-7456	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.7.0
Analyzed:	23 Aug-10 14:27	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	10-9607-5822	**Test Type:**	Cell Growth	**Analyst:**	
Start Date:	17 Aug-10	**Protocol:**	EC/EPS 1/RM/25	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	20 Aug-10	**Species:**	Pseudokirchneriella subcapitata	**Brine:**	
Duration:	72h	**Source:**	In-House Culture	**Age:**	5 d
Sample ID:	19-2680-7539	**Code:**	MRF EEF	**Client:**	Rescan
Sample Date:	16 Aug-10	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Aug-10	**Source:**	Rescan		
Sample Age:	24h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	57951	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Control Trend	Mann-Kendall Trend	6		0.5484	Non-significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC10	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC15	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC20	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC25	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC40	>95.2	N/A	N/A	<1.0504	N/A	N/A
IC50	>95.2	N/A	N/A	<1.0504	N/A	N/A

Cell Density Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	8	41.5	34	48	0.93605	5.127	12.35%	0.0%
1.5		4	48.25	41	52	0.89907	4.9244	10.21%	+16.27%
3		4	49.5	47	52	0.43461	2.3805	4.81%	+19.28%
5.9		4	60.5	47	76	2.273	12.45	20.58%	+45.78%
11.9		4	100.25	90	114	1.8641	10.21	10.19%	+141.57%
23.8		4	221.75	208	247	3.2055	17.557	7.92%	+434.34%
47.6		4	262.25	231	282	4.0342	22.096	8.43%	+531.93%
95.2		4	413.5	367	458	8.9846	49.21	11.9%	+896.39%

do stimulation

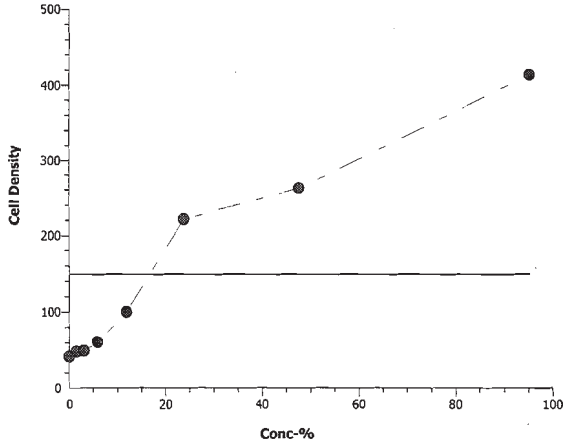
Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	40	40	45	34	46	48	35	44
1.5		41	50	52	50				
3		48	51	47	52				
5.9		55	64	47	76				
11.9		114	96	101	90				
23.8		247	212	220	208				
47.6		282	231	264	272				
95.2		454	367	375	458				

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	19-3573-7456	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.7.0
Analyzed:	23 Aug-10 14:27	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Analyst:_____ QA: ART Sept 17/10

APPENDIX D – *Oncorhynchus mykiss* Toxicity Test Data

Rainbow Trout Summary Sheet

Client: Rescan

Start Date/Time: Aug 19/10 @ 1545h

Work Order No.: 10310

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: MRS
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2x20L
Other: —

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 10
Alkalinity (mg/L $CaCO_3$): 8

Test Organism Information:

Batch No.: 061610
Source: Trout Lake Lodge
No. Fish/Volume (L): 10/10L
Loading Density: 0.35
Mean Length ± SD (mm): 35 ± 3 Range: 28-38
Mean Weight ± SD (g): 0.35 ± 0.05 Range: 0.25-0.42

SDS Reference Toxicant Results:

Reference Toxicant ID: RT62
Stock Solution ID: 10508
Date Initiated: Aug 23/10
96-h LC50 (95% CL): 5.3 (4.3-6.6)

Reference Toxicant Mean (2SD Range): 5.2 (4.4-6.1)
Reference Toxicant CV (%): 8.5

Test Results: The 96-h LC50 > 100 %(v/v)

Reviewed by: A. Tang

Date reviewed: September 17, 2010

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Rescan
Sample I.D. MRS
W.O. # 10310
RBT Batch #: 061610
Date Collected/Time: Aug 16 /10 @ n/a
Date Setup/Time: Aug 19/10 @ 1545
Sample Setup By: JAB

D.O. meter: DO-1
pH meter: pH-1
Cond. Meter: C-1

Number Fish/Volume: 10/10L
7-d % Mortality: 0%
Total Pre-aeration Time (mins): 30 min
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.0		14.5
pH	7.9		7.9
D.O. (mg/L)	9.4		9.6
Cond. (µS/cm)	196		194

Concentration % (v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control				10	10	10	10	14.5	14.6	14.6	14.5	14.0	9.8	10.0	9.9	10.0	10.0	6.9	6.9	6.9	6.9	7.1	30	33
6.25				10	10	10	10	14.5	14.5	14.6	14.5	14.0	9.8	10.1	10.0	10.1	10.1	7.3	7.3	7.2	7.1	7.2	43	44
12.5				10	10	10	10	14.5	14.5	14.6	14.5	14.0	9.8	10.2	10.1	10.2	10.0	7.4	7.5	7.4	7.3	7.3	51	51
25				10	10	10	10	14.5	14.6	14.5	14.5	14.0	9.7	10.4	10.2	9.9	10.2	7.5	7.5	7.6	7.5	7.5	71	70
50				10	10	10	10	14.5	14.6	14.5	14.5	14.0	9.6	10.0	10.0	10.0	10.0	7.6	7.7	7.9	7.9	7.7	111	107
100				10	10	10	10	14.5	14.5	14.6	14.5	14.0	9.6	10.1	9.9	10.2	10.0	7.9	7.8	8.0	8.1	7.9	194	178 194
Initials				~	~	~	JAB	SKM	~	~	~	JAB	SKM	~	~	~	JLT	SKM	~	~	~	JAB	SKM	JLT

Sample Description/Comments: Clear, Colorless

Fish Description at 96? Fish appear ok

Other Observations:

Reviewed by: A. Tang

Date Reviewed: September 17, 2010

Rainbow Trout Summary Sheet

Client: Rescan

Start Date/Time: Aug 19/10 @ 1545h

Work Order No.: 10310

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: MR Ref
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2x20L
Other:

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 10
Alkalinity (mg/L $CaCO_3$): 8

Test Organism Information:

Batch No.: 061610
Source: Trout Lake Lodge
No. Fish/Volume (L): 10/10L
Loading Density: 0.33
Mean Length ± SD (mm): 33 ± 3 Range: 28-37
Mean Weight ± SD (g): 0.33 ± 0.04 Range: 0.27-0.39

SDS Reference Toxicant Results:

Reference Toxicant ID: RT62
Stock Solution ID: 10508
Date Initiated: Aug 23/10
96-h LC50 (95% CL): 5.3 (4.3-6.6)

Reference Toxicant Mean (2SD Range): 5.2 (4.4-6.1)
Reference Toxicant CV (%): 8.5

Test Results: The 96-h LC50 > 100 % (v/v)

Reviewed by: A. Teng

Date reviewed: September 17, 2010

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Rescan
Sample I.D. MR Ref
W.O. # 10310
RBT Batch #: 06/610
Date Collected/Time: Aug 16/10 @ n/a
Date Setup/Time: Aug 19/10 @ 1545h
Sample Setup By: JAB

D.O. meter: DO-1
pH meter: pH-1
Cond. Meter: C-1

Number Fish/Volume: 10/10L
7-d % Mortality: 0%
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.5		14.5
pH	7.9		7.9
D.O. (mg/L)	9.3		9.5
Cond. (µS/cm)	174		174

Concentration % (v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control				10	10	10	10	14.5	14.5	14.6	14.6	14.0	9.8	10.0	9.9	10.0	10.0	6.9	6.9	6.9	6.9	7.1	30	46 DNS 33
6.25				10	10	10	10	14.5	14.5	14.6	14.5	14.0	9.8	9.9	10.0	10.1	10.1	7.2	7.5	7.2	7.1	7.2	41	53 46
12.5				10	10	10	10	14.5	14.5	14.5	14.5	14.0	9.8	10.0	10.0	10.0	10.2	7.2	7.4	7.9	7.9	7.3	48	53
25				10	10	10	10	14.5	14.5	14.5	14.5	14.0	9.7	9.9	9.9	10.0	10.3	7.3	7.5	7.6	7.5	7.4	68	74
50				10	10	10	10	14.5	14.5	14.5	14.5	14.0	9.6	9.9	10.0	9.9	10.2	7.6	7.5	7.9	7.9	7.8	7.103 SKm	115
100				10	10	10	10	14.5	14.5	14.5	14.5	14.0	9.5	10.0	10.0	10.0	10.3	7.9	7.7	8.1	8.2	7.9	174	194
Initials				~	~	~	JAB	SKm	~	~	~	JAB	SKm	~	~	~	JLT	SKm	~	~	~	JAB	SKm	JAB

Sample Description/Comments: Clear, Colorless

Fish Description at 96? fish appear ok

Other Observations:

Reviewed by: A. Tang

Date Reviewed: September 17, 2010

APPENDIX E – *Daphnia magna* Toxicity Test Data

Daphnia magna Summary Sheet

Client: Rescan
Work Order No.: 10311

Start Date/Time: Aug 18/10 @ 1230h
Test Species: *D.magna*
Set up by: JJT

Sample Information:

Sample ID: MR5
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2 x 20L

Test Organism Information:

Broodstock No.: 072810A
Age of young (Day 0): <24 hour
Avg No. young per brood in previous 7 d: 15
Mortality (%) in previous 7 d: 0
Days to first brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: Dm 61
Stock Solution ID: 09 NaCl
Date Initiated: ~~Aug 26/10~~
48-h LC50 (95% CL): 3.9 (3.2 - 4.9) g/L NaCl

Reference Toxicant Mean (2SD Range): 4.0 (3.6 - 4.6) g/L NaCl
Reference Toxicant CV (%): 6

Test Results: The 48 hour LC50 is ~~2.4% v/v.~~ < 6.25 % (J/J)

Reviewed by: A. Tang

Date reviewed: September 17, 2010

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: Pescan
Sample ID: MR25
Work Order No.: 10311

Start Date/Time: Aug 18 / 10 @ 1230h
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: JJT

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

Concentration % (v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (µS/cm) 0	Conductivity (µS/cm) 48
control	A	10	10	0	22.0	20.0	20.0	8.3		6.4	7.9		8.2	354	361
	B														
	C														
	D														
6.25	A	10	2	0	22.0	20.0	20.0	8.4		6.3	8.0		8.1	342	365
	B														
	C														
	D														
12.5	A	4	0	0	22.0	20.0	20.0	8.5		6.4	8.0		8.1	330	354
	B														
	C														
	D														
25	A	6	0	0	21.5	20.0	20.0	8.5		6.3	8.0		8.0	312	333
	B														
	C														
	D														
50	A	3	0	0	21.5	20.0	20.0	8.6		6.3	8.0		8.0	279	300
	B														
	C														
	D														
100	A	1	0	0	21.0	20.0	20.0	8.9		6.3	8.0		8.0	191	208
	B														
	C														
	D														
Technician Initials		~	~	~	JJT	~	~	JJT		K	JJT		K	JJT	~

	Hardness*	Alkalinity*
Conc.	*(mg/L as CaCo3)	
Control (MHW)	96	72
Highest conc.	96	90

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	21.0		
DO (mg/L)	8.9		
pH	JJT 7.9 8.0		
Cond (µS/cm)	191		

Sample Description: clear

Comments: Batch#: 0726A 7-d previous # young/brood: 15 Day of 1st Brood: 9 Previous 7-d % Mortality: 0

Reviewed by: A. Tang Date reviewed: September 17, 2010

Daphnia magna Summary Sheet

Client: Rescan
Work Order No.: 10311

Start Date/Time: Aug 18/10 @ 1235h
Test Species: *D.magna*
Set up by: JJT

Sample Information:

Sample ID: MR-REF
Sample Date: Aug 16/10
Date Received: Aug 17/10
Sample Volume: 2x20L

Test Organism Information:

Broodstock No.: 072810A
Age of young (Day 0): <24h
Avg No. young per brood in previous 7 d: 15
Mortality (%) in previous 7 d: 0
Days to first brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: DM 61
Stock Solution ID: 09NaCS
Date Initiated: Aug 26/10
48-h LC50 (95% CL): 3.9 (3.2 - 4.9) g/L NaCl

Reference Toxicant Mean (2SD Range): 4.0 (3.6 - 4.6) g/L NaCl
Reference Toxicant CV (%): 6

Test Results: The 48 hour LC50 is ~~20%~~ < 6.25 % (v/v)

Reviewed by: A. Teng

Date reviewed: September 17, 2010

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: Pescon
Sample ID: MR-REF
Work Order No.: 10311

Start Date/Time: Aug 18 /10 @1235h
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: JJT

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

Concentration % (v/v)	Rep	Number of Live Organisms 24	48	No. Immobilized 48	Temperature (°C) 0	24	48	Dissolved oxygen (mg/L) 0	24	48	pH 0	24	48	Conductivity (µS/cm) 0	48
control	A	10	10	0	22.0	20.2	20.2	8.3		8.2	7.9		8.2	354	383
	B														
	C														
	D														
6.25	A	10	1	0	22.0	20.0	20.2	8.4		8.1	8.0		8.1	342	352
	B														
	C														
	D														
12.5	A	7	0	0	22.0	20.0	20.2	8.4		8.1	8.0		8.2	331	345
	B														
	C														
	D														
25	A	6	0	0	22.0	20.0	20.2	8.4		8.0	8.0		8.2	308	328
	B														
	C														
	D														
50	A	6	0	0	22.0	20.0	20.2	8.5		8.0	8.0		8.2	270	286
	B														
	C														
	D														
100	A	1	0	0	21.0	20.0	20.2	8.7		8.0	8.0		8.2	175	187
	B														
	C														
	D														
Technician Initials		~	~	~	JJT	~	M	JJT			JJT		JJT	JJT	M

	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Conc.		
Control (MHW)	96	72
Highest conc.	86	86

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	21.0		
DO (mg/L)	8.7		
pH	8.0		
Cond (µS/cm)	175		

Sample Description: clear

Comments: Batch#: ~~07810A~~ 7-d previous # young/brood: 15 Day of 1st Brood: 9 Previous 7-d % Mortality: 0

Reviewed by: A. Teng Date reviewed: September 17, 2010

Client: Rescan

W.O.#: 10311

Hardness and Alkalinity Datasheet

	Alkalinity						Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity ($mg/LCaCO_3$)		Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness ($mg/L\ CaCO_3$)	Technician
(Control (MHW)-081310	Aug 16/10	50	3.7	3.8	72		50	4.8	96	JJT
MR-5	Aug 23/10	50	4.6	4.7	90		50	4.8	96	JJT
MR-REF	Aug 23/10	50	4.4	4.5	86		50	4.3	86	JJT

Notes:

Reviewed by: L. Teng

Date Reviewed: September 17, 2010

APPENDIX F – Chain of Custody Forms

Nautilus Environmental

Chain of Custody

☐ **CALIFORNIA**
5550 Morehouse Drive • Suite 150
San Diego, California 92121
Phone 858.587.7333
Fax 858.587.3961

☐ **WASHINGTON**
5009 Pacific Highway East • Suite 2
Tacoma, Washington 98424
Phone 253.922.4296
Fax 253.922.5814

☐ **BRITISH COLUMBIA**
8664 Commerce Court
Burnaby, British Columbia, Canada V5A 4N3
Phone 604.420.8773
Fax 604.357.1361

Date _____ **Page** _____ **of** _____

Sample Collection by: Pam Reece (RESCAN).

Report to: MARK WHELLY
Company RESCAN ENVIRONMENTAL.
Address 600 - 1111 W HASTINGS STREET
City VANCOUVER State BC Zip V6E 2J3
Contact MARK WHELLY
Phone/Email 604-689-9460 #3408 mwhelly@rescan.com

Invoice to: RESCAN Accounting.
Company (SAME AS LEFT)
Address
City State Zip
Contact
Phone/Email Project #0791-002-02-19

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: Acute Rainbow trout flyLC50	Acute Daphnia magna LC50	Chronic P. subcapitata test	Chronic L. minor test	Chronic C. dubia test	RECEIPT TEMPERATURE (°C)
NR5	Aug 16/10 ①		water	20L carboy	2	STREAM WATER	X	X	X	X	X	17°
MR-REF	Aug 16/10 ①		WATER	—"—	2	STREAM WATER	X	X	X	X	X	
							WO #10310	WO #10311	WO #10312	WO #10313	WO #10314	

PROJECT INFORMATION
CLIENT
P.O. NO.
SHIPPED VIA:

SAMPLE RECEIPT
TOTAL NO. OF CONTAINERS 4 of 4
REC'D GOOD CONDITION ✓
MATCHES TEST SCHEDULE ✓

SPECIAL INSTRUCTIONS/COMMENTS:
① Information from carboy containers.

RELINQUISHED BY (CLIENT)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RELINQUISHED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
per JAB
(Signature) 0945 (Time)
(Printed Name) John T. Aug 17/10 (Date)
Nautilus Environmental Log-in No: Nautilus Env.

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

Appendix 3-1

Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Rescan™
Engineers and Scientists

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF				MR4			
Replicate		1	2	3	PAH-1	1	2	3	PAH-1
Date Sampled		15-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10
Lab Sample ID	Units	L921662-15	L921662-16	L921662-17	L921662-21	L921662-4	L921662-5	L921662-6	L921662-7
Physical Tests									
Moisture	%	32.0	32.7	31.4	34.0	37.5	35.6	34.3	35.3
Particle Size									
Gravel (>2mm)	%	3.82	1.12	7.18	-	<0.10	<0.10	-	-
Sand (2.0mm - 0.063mm)	%	90.2	93.0	83.6	-	89.8	89.4	-	-
Silt (0.063mm - 4µm)	%	5.81	5.69	9.10	-	10.1	10.5	-	-
Clay (<4µm)	%	0.15	0.18	<0.10	-	0.16	0.11	-	-
Leachable Nutrients									
Total Nitrogen	%	0.051	0.070	0.071	-	0.069	0.058	0.072	-
Organic Carbon									
Total Organic Carbon	%	0.83	0.91	1.05	-	0.78	0.79	0.80	-
Plant Available Nutrients									
Available Phosphate	mg/kg	<2.0	<2.0	<2.0	-	4.4	<2.0	<2.0	-
Available Sulfate	mg/kg	7.2	8.2	5.3	-	14.1	13.0	24.1	-
Metals									
Aluminum (Al)	mg/kg	5570	5480	6210	-	4850	4640	4560	-
Antimony (Sb)	mg/kg	0.53	0.49	0.52	-	<0.10	0.42	0.46	-
Arsenic (As)	mg/kg	6.02	5.75	6.22	-	5.55	4.87	4.70	-
Barium (Ba)	mg/kg	246	154	180	-	353	268	308	-
Beryllium (Be)	mg/kg	0.47	0.51	0.58	-	0.41	0.38	0.36	-
Bismuth (Bi)	mg/kg	0.11	0.12	0.12	-	0.11	<0.10	<0.10	-
Cadmium (Cd)	mg/kg	0.642	0.643	0.755	-	0.520	0.572	0.479	-
Calcium (Ca)	mg/kg	60800	58200	60800	-	36200	48800	37700	-
Chromium (Cr)	mg/kg	62.1	37.0	18.7	-	25.0	19.0	29.0	-
Cobalt (Co)	mg/kg	5.73	5.64	5.88	-	5.63	5.40	4.88	-
Copper (Cu)	mg/kg	14.3	14.0	14.9	-	14.8	12.4	12.1	-
Iron (Fe)	mg/kg	16100	15000	16000	-	14000	13000	12100	-
Lead (Pb)	mg/kg	8.24	8.30	8.91	-	8.59	7.40	7.15	-
Magnesium (Mg)	mg/kg	23000	20900	21800	-	14500	19500	15300	-
Manganese (Mn)	mg/kg	225	225	241	-	226	237	205	-
Mercury (Hg)	mg/kg	0.0254	0.0246	0.0270	-	0.0401	0.0277	0.0348	-
Molybdenum (Mo)	mg/kg	2.32	2.11	1.99	-	1.04	1.22	1.32	-
Nickel (Ni)	mg/kg	48.2	35.7	26.4	-	29.5	24.0	28.9	-
Phosphorus (P)	mg/kg	1640	1430	1630	-	1080	1300	1010	-
Potassium (K)	mg/kg	1230	1180	1330	-	860	840	850	-
Selenium (Se)	mg/kg	0.52	0.48	0.56	-	0.46	0.43	0.43	-
Silver (Ag)	mg/kg	0.141	0.139	0.144	-	0.189	0.134	0.151	-
Sodium (Na)	mg/kg	110	100	130	-	<100	<100	<100	-
Strontium (Sr)	mg/kg	78.6	76.6	80.7	-	54.6	61.4	53.8	-
Sulfur (S)-Total	mg/kg	900	600	600	-	900	700	800	-
Thallium (Tl)	mg/kg	0.18	0.18	0.19	-	0.15	0.16	0.15	-
Tin (Sn)	mg/kg	14.6	6.90	2.40	-	1.96	2.33	10.9	-

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-REF				MR4			
Replicate		1	2	3	PAH-1	1	2	3	PAH-1
Date Sampled		15-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10
Lab Sample ID	Units	L921662-15	L921662-16	L921662-17	L921662-21	L921662-4	L921662-5	L921662-6	L921662-7
Metals (*cont'd*)									
Titanium (Ti)	mg/kg	45.5	15.1	15.5	-	9.5	10.7	22.7	-
Uranium (U)	mg/kg	1.54	1.14	1.24	-	0.837	0.959	0.805	-
Vanadium (V)	mg/kg	33.7	31.0	35.2	-	20.2	22.7	21.1	-
Zinc (Zn)	mg/kg	90.1	88.1	92.5	-	88.1	71.7	74.9	-
Hydrocarbons									
EPH10-19	mg/kg	-	-	-	<200	-	-	-	<200
EPH19-32	mg/kg	-	-	-	<200	-	-	-	<200
LEPH	mg/kg	-	-	-	<200	-	-	-	<200
HEPH	mg/kg	-	-	-	<200	-	-	-	<200
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	mg/kg	-	-	-	<0.0050	-	-	-	<0.0050
Acenaphthylene	mg/kg	-	-	-	<0.0050	-	-	-	<0.0050
Anthracene	mg/kg	-	-	-	<0.0040	-	-	-	<0.0040
Benz(a)anthracene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Benzo(a)pyrene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Benzo(b)fluoranthene	mg/kg	-	-	-	0.035	-	-	-	0.012
Benzo(g,h,i)perylene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Benzo(k)fluoranthene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Chrysene	mg/kg	-	-	-	<0.040	-	-	-	<0.020
Dibenz(a,h)anthracene	mg/kg	-	-	-	<0.0050	-	-	-	<0.0050
Fluoranthene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Fluorene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
2-Methylnaphthalene	mg/kg	-	-	-	0.052	-	-	-	0.067
Naphthalene	mg/kg	-	-	-	0.034	-	-	-	0.020
Phenanthrene	mg/kg	-	-	-	0.112	-	-	-	0.086
Pyrene	mg/kg	-	-	-	<0.010	-	-	-	<0.010
Total PAHs	mg/kg	-	-	-	0.232	-	-	-	0.185
Surrogate: d10-Acenaphthene (SS)	%	-	-	-	121	-	-	-	73
Surrogate: d12-Chrysene (SS)	%	-	-	-	122	-	-	-	83
Surrogate: d8-Naphthalene (SS)	%	-	-	-	120	-	-	-	72
Surrogate: d10-Phenanthrene (SS)	%	-	-	-	126	-	-	-	79

Notes:

All parameters analyzed by ALS Environmental

< indicate the value was less than the detection limit

Dashes indicate parameter not analyzed

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6				M20-04			REFST		
Replicate		1	2	3	PAH-1	1	2	3	1	2	3
Date Sampled		16-Aug-10	16-Aug-10	16-Aug-10	16-Aug-10	15-Aug-10	15-Aug-10	15-Aug-10	16-Aug-10	16-Aug-10	16-Aug-10
Lab Sample ID	Units	L921662-8	L921662-9	L921662-10	L921662-11	L921662-12	L921662-13	L921662-14	L921662-18	L921662-19	L921662-20
Physical Tests											
Moisture	%	39.9	40.5	34.0	33.7	35.6	26.5	44.8	43.4	29.7	44.8
Particle Size											
Gravel (>2mm)	%	<0.10	<0.10	<0.10	-	-	-	-	-	2.78	-
Sand (2.0mm - 0.063mm)	%	74.0	56.9	80.3	-	-	-	-	-	71.1	-
Silt (0.063mm - 4µm)	%	25.7	42.4	19.5	-	-	-	-	-	25.9	-
Clay (<4µm)	%	0.34	0.80	0.19	-	-	-	-	-	0.24	-
Leachable Nutrients											
Total Nitrogen	%	0.089	0.146	0.057	-	0.106	0.138	0.114	0.222	0.185	0.189
Organic Carbon											
Total Organic Carbon	%	1.55	3.11	0.82	-	1.32	1.37	1.34	3.20	2.47	2.38
Plant Available Nutrients											
Available Phosphate	mg/kg	<2.0	<4.0	<2.7	-	<4.7	22.0	<4.0	<4.7	<8.0	<4.2
Available Sulfate	mg/kg	14.6	18.2	17.2	-	72.9	39.5	77.1	-	50.3	-
Metals											
Aluminum (Al)	mg/kg	5160	5290	4550	-	5780	5540	6140	4470	4710	4250
Antimony (Sb)	mg/kg	0.44	0.44	0.39	-	0.60	0.59	0.66	1.00	1.11	0.97
Arsenic (As)	mg/kg	4.41	4.37	4.23	-	5.56	5.87	5.95	8.21	7.98	8.10
Barium (Ba)	mg/kg	214	201	223	-	493	480	544	166	175	139
Beryllium (Be)	mg/kg	0.38	0.40	0.36	-	0.42	0.43	0.45	0.45	0.47	0.47
Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	-	0.11	0.12	0.12	0.12	0.12	0.12
Cadmium (Cd)	mg/kg	0.519	0.608	0.424	-	0.669	0.733	0.741	2.46	2.53	2.71
Calcium (Ca)	mg/kg	42500	41400	44800	-	38800	38700	43000	65300	65200	61200
Chromium (Cr)	mg/kg	18.1	19.8	36.2	-	61.9	51.4	39.9	23.9	18.3	34.7
Cobalt (Co)	mg/kg	5.03	5.05	4.60	-	7.07	7.38	7.71	5.62	6.21	5.64
Copper (Cu)	mg/kg	11.1	11.3	10.2	-	15.9	16.0	16.4	16.6	16.2	16.5
Iron (Fe)	mg/kg	12100	12000	11200	-	15100	15600	16200	15500	15200	15400
Lead (Pb)	mg/kg	6.84	7.05	6.26	-	9.13	9.12	9.53	9.73	9.90	9.84
Magnesium (Mg)	mg/kg	17200	16500	18000	-	12700	12500	13700	15200	15500	14000
Manganese (Mn)	mg/kg	243	285	192	-	288	292	316	202	231	191
Mercury (Hg)	mg/kg	0.0327	0.0419	0.0256	-	0.0514	0.0507	0.0496	0.0434	0.0448	0.0395
Molybdenum (Mo)	mg/kg	1.21	1.27	1.37	-	2.18	2.15	1.81	4.64	4.49	5.10
Nickel (Ni)	mg/kg	22.2	23.6	32.0	-	54.7	47.2	41.0	37.3	34.6	45.9
Phosphorus (P)	mg/kg	1080	986	1110	-	867	893	943	1680	1800	1540
Potassium (K)	mg/kg	960	980	880	-	1160	1010	1170	1210	1310	1120
Selenium (Se)	mg/kg	0.43	0.45	0.36	-	0.90	0.82	0.86	1.59	1.67	1.60
Silver (Ag)	mg/kg	0.130	0.139	0.117	-	0.213	0.212	0.228	0.210	0.209	0.204
Sodium (Na)	mg/kg	<100	<100	<100	-	100	<100	<100	110	110	110
Strontium (Sr)	mg/kg	54.7	55.0	57.7	-	68.1	67.3	72.9	113	115	110
Sulfur (S)-Total	mg/kg	700	900	600	-	1300	1500	1500	1600	1800	1900
Thallium (Tl)	mg/kg	0.17	0.18	0.14	-	0.16	0.15	0.17	0.52	0.58	0.52
Tin (Sn)	mg/kg	0.97	1.16	5.41	-	5.10	6.22	5.72	4.47	1.06	4.30

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR6				M20-04			REFST		
Replicate		1	2	3	PAH-1	1	2	3	1	2	3
Date Sampled		16-AUG-10	16-AUG-10	16-AUG-10	16-AUG-10	15-AUG-10	15-AUG-10	15-AUG-10	16-AUG-10	16-AUG-10	16-AUG-10
Lab Sample ID	Units	L921662-8	L921662-9	L921662-10	L921662-11	L921662-12	L921662-13	L921662-14	L921662-18	L921662-19	L921662-20
Metals (*cont'd*)											
Titanium (Ti)	mg/kg	22.5	21.6	21.1	-	45.1	40.2	51.8	14.4	19.3	8.7
Uranium (U)	mg/kg	0.853	0.818	0.882	-	0.755	0.740	0.797	1.56	1.59	1.44
Vanadium (V)	mg/kg	25.8	26.2	23.2	-	23.9	22.4	25.3	71.3	77.9	64.4
Zinc (Zn)	mg/kg	64.2	65.5	64.2	-	111	94.9	100	135	140	152
Hydrocarbons											
EPH10-19	mg/kg	-	-	-	<200	-	-	-	-	-	-
EPH19-32	mg/kg	-	-	-	<200	-	-	-	-	-	-
LEPH	mg/kg	-	-	-	<200	-	-	-	-	-	-
HEPH	mg/kg	-	-	-	<200	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	mg/kg	-	-	-	<0.0050	-	-	-	-	-	-
Acenaphthylene	mg/kg	-	-	-	<0.0050	-	-	-	-	-	-
Anthracene	mg/kg	-	-	-	<0.0040	-	-	-	-	-	-
Benz(a)anthracene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	-	-	-	0.013	-	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Chrysene	mg/kg	-	-	-	<0.015	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	-	-	-	<0.0050	-	-	-	-	-	-
Fluoranthene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Fluorene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
2-Methylnaphthalene	mg/kg	-	-	-	0.026	-	-	-	-	-	-
Naphthalene	mg/kg	-	-	-	0.013	-	-	-	-	-	-
Phenanthrene	mg/kg	-	-	-	0.045	-	-	-	-	-	-
Pyrene	mg/kg	-	-	-	<0.010	-	-	-	-	-	-
Total PAHs	mg/kg	-	-	-	0.096	-	-	-	-	-	-
Surrogate: d10-Acenaphthene (SS)	%	-	-	-	85	-	-	-	-	-	-
Surrogate: d12-Chrysene (SS)	%	-	-	-	93	-	-	-	-	-	-
Surrogate: d8-Naphthalene (SS)	%	-	-	-	84	-	-	-	-	-	-
Surrogate: d10-Phenanthrene (SS)	%	-	-	-	89	-	-	-	-	-	-

Notes:

All parameters analyzed by ALS Environmental

< indicate the value was less than the detection limited indicated

Dashes indicate parameter not analyzed

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-9	MR-4	M20-03		M20-05						M20-04
Replicate		1	1	1A	1B	1A	1B	2	3	4	5	1
Date Sampled		25-Aug-11	25-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	25-Aug-11
Lab Sample ID	Units	BJ9412	BJ9413	BJ9414	BJ9415	BJ9417	BJ9418	BJ9419	BJ9420	BJ9421	BJ9422	BJ9416
Physical Tests												
Moisture	%	31	22	37	36	30	31	35	27	32	30	45
Particle Size												
Gravel (>2mm)	%	<2.0	2	<2.0	4	4	3	<2.0	12	6	6	12
Sand (2.0mm - 0.063mm)	%	68	84	79	74	36	24	44	46	40	49	74
Silt (0.063mm - 4µm)	%	26	12	14	16	18	22	18	14	14	13	11
Clay (<4µm)	%	6	3	6	6	43	51	37	29	40	32	4
Metals												
Aluminum (Al)	mg/kg	6880	5650	5620	5990	12600	12600	11900	13100	14100	12400	4650
Antimony (Sb)	mg/kg	0.5	0.5	0.5	0.5	0.6	0.8	0.8	0.9	0.8	0.8	0.5
Arsenic (As)	mg/kg	5.3	4.9	5.3	5.4	7.6	7.0	7.2	7.6	7.3	6.6	5.1
Barium (Ba)	mg/kg	154	241	355	368	405	393	391	377	392	422	443
Beryllium (Be)	mg/kg	0.4	<0.4	0.5	0.5	1.0	0.9	0.8	0.8	0.7	0.8	<0.4
Bismuth (Bi)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1
Cadmium (Cd)	mg/kg	0.76	0.76	0.82	0.83	1.20	1.23	1.15	1.20	1.19	1.20	0.63
Calcium (Ca)	mg/kg	54400	44100	6940	6770	62700	60300	60200	64600	67700	63400	41700
Chromium (Cr)	mg/kg	13	11	10	11	21	22	21	22	24	22	10
Cobalt (Co)	mg/kg	6.5	5.8	5.6	5.6	10.8	10.5	10.5	10.9	11.4	10.7	5.6
Copper (Cu)	mg/kg	15.6	14.8	15.1	16.1	28.6	28.2	27.1	28.8	29.1	27.7	12.7
Iron (Fe)	mg/kg	15600	14600	15000	14900	23800	23000	23200	23800	24900	23400	13900
Lead (Pb)	mg/kg	8.8	8.3	8.5	8.5	12.6	13.0	12.1	13.1	13.0	12.7	7.6
Lithium (Li)	mg/kg	12	10	8	8	18	19	17	18	21	18	7
Magnesium (Mg)	mg/kg	21300	17800	3250	3270	18300	18400	18300	19300	19000	18800	14500
Manganese (Mn)	mg/kg	304	253	320	315	419	409	422	431	443	427	244
Mercury (Hg)	mg/kg	<0.05	<0.05	0.05	0.07	0.06	0.07	0.08	0.07	0.07	0.08	<0.05
Molybdenum (Mo)	mg/kg	1.4	1.2	1.1	1.1	1.9	2.0	1.9	2.1	2.1	1.9	0.9
Nickel (Ni)	mg/kg	22.6	21.2	21.8	22.4	40.1	39.7	38.5	40.6	41.2	39.4	19.1
Phosphorus (P)	mg/kg	1080	980	808	804	959	956	977	1000	986	994	888
Potassium (K)	mg/kg	1110	848	773	833	2400	2410	2300	2450	2800	2340	734
Selenium (Se)	mg/kg	1.1	1.1	1.0	1.2	1.2	0.9	1.1	1.5	1.3	1.3	0.6
Silver (Ag)	mg/kg	0.11	0.13	0.17	0.19	0.21	0.23	0.22	0.23	0.23	0.23	0.13
Sodium (Na)	mg/kg	<100	<100	<100	<100	114	119	109	115	120	114	<100
Strontium (Sr)	mg/kg	61.7	53.6	28.5	29.1	89.6	87.3	85.6	90.5	92.8	90.0	59.0
Thallium (Tl)	mg/kg	0.19	0.17	0.12	0.11	0.18	0.19	0.18	0.19	0.17	0.17	0.10
Tin (Sn)	mg/kg	0.5	0.4	0.3	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Titanium (Ti)	mg/kg	13	8	4	11	12	16	22	38	34	20	41
Uranium (U)	mg/kg	0.89	0.82	0.64	0.68	1.02	1.04	0.99	1.08	1.07	1.10	0.72
Vanadium (V)	mg/kg	32	25	22	23	47	48	47	50	53	47	21
Zinc (Zn)	mg/kg	78	73	82	84	117	116	114	118	117	115	69
Zirconium (Zr)	mg/kg	0.7	0.6	<0.5	<0.5	2.9	3.1	3.3	3.6	3.2	3.3	1.4

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR-9	MR-4	M20-03		M20-05						M20-04
Replicate		1	1	1A	1B	1A	1B	2	3	4	5	1
Date Sampled		25-Aug-11	25-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	25-Aug-11
Lab Sample ID	Units	BJ9412	BJ9413	BJ9414	BJ9415	BJ9417	BJ9418	BJ9419	BJ9420	BJ9421	BJ9422	BJ9416
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthylene	mg/kg	<0.005	<0.005	<0.007	<0.005	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.005
Anthracene	mg/kg	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Benzo(a)anthracene	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b&j)fluoranthene	mg/kg	<0.02	0.02	<0.02	<0.02	0.06	0.06	0.07	0.07	0.06	0.05	0.02
Benzo(g,h,i)perylene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chrysene	mg/kg	0.03	0.05	0.05	0.04	0.13	0.14	0.15	0.15	0.14	0.12	0.06
Dibenz(a,h)anthracene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	mg/kg	<0.02	<0.02	<0.02	<0.02	0.03	0.03	0.04	0.04	0.03	0.03	<0.02
Fluorene	mg/kg	<0.02	<0.02	<0.02	<0.02	0.07	0.07	0.08	0.07	0.07	0.06	<0.02
Indeno(1,2,3-cd)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Methylnaphthalene	mg/kg	0.05	0.10	0.29	0.24	0.29	0.31	0.43	0.34	0.31	0.30	0.15
Naphthalene	mg/kg	0.03	0.03	0.17	0.13	0.07	0.07	0.10	0.07	0.07	0.08	0.03
Phenanthrene	mg/kg	0.07	0.10	0.18	0.12	0.33	0.34	0.39	0.36	0.34	0.31	0.13
Pyrene	mg/kg	<0.02	<0.02	<0.02	<0.02	0.05	0.05	0.06	0.06	0.05	0.05	<0.02
Total PAH	mg/kg	0.18	0.29	0.69	0.53	0.96	1.0	1.3	1.1	1.0	0.94	0.36
Low Molecular Weight PAHs	mg/kg	0.15	0.23	0.64	0.50	0.75	0.78	1.0	0.84	0.78	0.74	0.31
High Molecular Weight PAHs	mg/kg	<0.05	0.05	0.05	<0.05	0.21	0.22	0.25	0.25	0.22	0.20	0.06
Surrogate: d10-Anthracene (SS)	%	90	95	88	90	78	84	85	83	75	80	95
Surrogate: d8-Acenaphthylene (SS)	%	89	96	90	90	80	85	91	83	80	84	95
Surrogate: d8-Naphthalene (SS)	%	97	93	102	88	94	94	97	93	92	95	95
Surrogate: d14-Terphenyl (SS)	%	97	101	96	97	85	87	98	95	83	90	103

Notes:

All parameters analyzed by Maxxam Analytics

< indicate the value was less than the detection limit

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR3					MR7B	MR6	M20-06	M17-02	M19-01				M19-02
Replicate		1	2	3	4	5	1	1	1	1	1A	1B	2A	2B	1
Date Sampled		29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	30-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
Lab Sample ID	Units	EK8330	EK8331	EK8332	EK8333	EK8334	EK8336	EK8335	EK8348	EK8337	EK8339	EK8340	EK8341	EK8347	EK8338
Physical Tests															
Moisture	%	32	38	30	33	47	37	32	36	41	38	37	28	37	31
Particle Size															
Gravel (>2mm)	%	<2.0	<2.0	<2.0	5.6	<2.0	<2.0	<2.0	<2.0	2.9	3.3	3.3	<2.0	<2.0	4.8
Sand (2.0mm - 0.063mm)	%	64	62	72	58	45	54	74	42	50	73	74	77	80	52
Silt (0.063mm - 4µm)	%	31	30	24	31	45	39	24	44	34	20	18	19	18	26
Clay (<4µm)	%	5.0	7.7	3.6	5.6	11	7.2	<2.0	12	13	3.9	4.0	4.0	2.4	17
Polycyclic Aromatic Hydrocarbons															
Acenaphthene	mg/kg	0.00062	<0.0025	0.0010	0.00075	<0.0025	0.00071	0.00055	<0.0025	<0.0025	<0.00050	<0.0025	0.00069	0.00052	0.00068
Acenaphthylene	mg/kg	<0.0023	<0.0031	<0.0023	<0.0018	<0.0038	<0.0024	<0.0024	<0.012	<0.0056	<0.0016	<0.0025	<0.0011	<0.0015	<0.0022
Anthracene	mg/kg	<0.0010	<0.0050	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010
Benzo(a)anthracene	mg/kg	0.0032	<0.0050	0.0035	0.0024	0.0055	0.0038	0.0037	0.0059	0.0076	0.0022	<0.0050	0.0018	0.0021	0.0033
Benzo(a)pyrene	mg/kg	0.0013	<0.0050	0.0013	<0.0010	<0.0050	0.0014	0.0012	<0.0050	<0.0050	0.0016	<0.0050	0.0012	0.0016	0.0026
Benzo(b&j)fluoranthene	mg/kg	0.023	0.029	0.022	0.018	0.033	0.026	0.021	0.04	0.03	0.012	0.013	0.011	0.012	0.014
Benzo(g,h,i)perylene	mg/kg	0.0040	<0.010	0.0036	0.0030	<0.010	0.0044	0.0038	0.013	0.011	0.0053	<0.010	0.0048	0.0075	0.0070
Benzo(k)fluoranthene	mg/kg	<0.0010	<0.0050	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010
Chrysene	mg/kg	0.041	0.056	0.041	0.031	0.061	0.047	0.039	0.11	0.065	0.025	0.028	0.022	0.026	0.029
Dibenz(a,h)anthracene	mg/kg	0.0031	0.0037	0.0030	0.0024	0.0044	0.0033	0.0028	0.0061	0.0061	0.0019	<0.0025	0.0017	0.0024	0.0026
Fluoranthene	mg/kg	0.0090	0.012	0.0082	0.0060	0.013	0.0088	0.0077	0.019	0.012	0.0053	0.0054	0.0041	0.0049	0.0067
Fluorene	mg/kg	0.0068	0.0068	0.0066	0.0057	0.0083	0.0087	0.0058	0.038	0.019	0.0067	0.0057	0.0036	0.0053	0.010
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0020	<0.010	<0.0020	<0.0020	<0.010	<0.0020	<0.0020	<0.010	<0.010	<0.0020	<0.010	<0.0020	<0.0020	<0.0020
2-Methylnaphthalene	mg/kg	0.071	0.1	0.077	0.057	0.13	0.079	0.089	0.44	0.27	0.060	0.058	0.040	0.051	0.10
Naphthalene	mg/kg	0.038	0.057	0.045	0.033	0.074	0.043	0.058	0.087	0.091	0.031	0.028	0.021	0.026	0.045
Phenanthrene	mg/kg	0.088	0.14	0.090	0.066	0.14	0.095	0.095	0.33	0.16	0.054	0.059	0.042	0.052	0.081
Pyrene	mg/kg	0.016	0.023	0.015	0.011	0.023	0.015	0.013	0.031	0.021	0.013	0.016	0.0086	0.015	0.012
Total PAH	mg/kg	0.28	0.40	0.29	0.22	0.46	0.31	0.31	1.1	0.65	0.20	0.20	0.15	0.19	0.29
Low Molecular Weight PAHs	mg/kg	0.20	0.30	0.22	0.16	0.36	0.23	0.25	0.89	0.53	0.15	0.15	0.11	0.14	0.24
High Molecular Weight PAHs	mg/kg	0.073	0.096	0.072	0.053	0.11	0.079	0.067	0.17	0.11	0.050	0.049	0.040	0.052	0.057
Surrogate: d10-Anthracene (SS)	%	75	89	77	76	94	77	74	94	90	78	99	74	77	77
Surrogate: d8-Acenaphthylene (SS)	%	71	79	72	73	86	73	70	82	80	72	87	71	73	74
Surrogate: d8-Naphthalene (SS)	%	71	80	75	74	88	73	70	78	78	72	88	71	75	73
Surrogate: d14-Terphenyl (SS)	%	79	91	81	79	99	82	78	91	91	82	97	77	79	81

Notes:

All parameters analyzed by Maxxam Analytics

< indicate the value was less than the detection limit

Appendix 3-1. Stream Sediment Quality Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9	MR3					MR4		MR7B	MR6	M20-04	M20-06	M17-02	M19-01				M19-02
Replicate		1	1	2	3	4	5	1A	1B	1	1	1	1	1	1A	1B	2A	2B	1
Date Sampled		31-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	28-Aug-12	30-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
Lab Sample ID	Units	EK8769	EK8760	EK8761	EK8762	EK8763	EK8764	EK8765	EK8766	EK8768	EK8767	EK8797	EK8798	EK8770	EK8793	EK8794	EK8795	EK8796	EK8771
Organic Carbon																			
Total Organic Carbon	%	1.8	1.6	2.2	2.1	2.1	2.0	2.1	1.8	2.1	2.0	1.4	2.0	2.2	2.6	2.5	2.7	2.4	2.6
Total Metals																			
Aluminum (Al)	mg/kg	6680	5420	5810	7110	7610	7240	6440	6360	6510	6520	5060	7580	7670	6250	6870	5770	5180	8170
Antimony (Sb)	mg/kg	0.46	0.35	0.39	0.46	0.50	0.44	0.48	0.44	0.43	0.39	0.49	0.62	0.45	0.28	0.28	0.26	0.23	0.46
Arsenic (As)	mg/kg	4.31	3.68	3.52	4.39	4.38	4.14	4.47	4.39	4.20	4.19	4.44	5.47	3.83	3.28	3.06	3.17	2.79	3.61
Barium (Ba)	mg/kg	134	133	135	130	131	131	184	193	134	137	393	457	321	199	196	177	157	221
Beryllium (Be)	mg/kg	<0.40	0.41	0.43	<0.40	<0.40	0.48	<0.40	0.45	<0.40	0.44	<0.40	0.43	<0.40	<0.40	<0.40	<0.40	<0.40	0.51
Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	0.11	0.11	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.11	<0.10	<0.10	<0.10	<0.10	0.12
Cadmium (Cd)	mg/kg	0.895	0.649	0.839	0.937	0.956	0.847	0.840	0.836	0.765	0.798	0.685	0.879	0.673	0.518	0.470	0.526	0.446	0.736
Calcium (Ca)	mg/kg	50400	45500	46500	47500	48400	46900	46200	46300	48300	47800	34000	48100	30900	16700	15300	13700	13400	27100
Chromium (Cr)	mg/kg	12.1	10.9	11.4	13.6	13.6	14.2	12.1	12.1	11.5	11.7	9.3	13.4	13.5	10.3	11.2	9.7	8.7	13.4
Cobalt (Co)	mg/kg	5.94	5.09	5.28	6.43	6.63	6.41	5.89	5.92	5.77	5.56	5.75	8.42	7.49	5.51	5.36	4.66	4.17	7.54
Copper (Cu)	mg/kg	15.4	17.9	16.9	19.2	17.5	23.2	19.0	26.4	18.7	26.6	22.0	29.6	23.5	17.7	26.8	18.0	26.0	25.9
Iron (Fe)	mg/kg	15300	12500	12800	15700	16700	16000	14400	14500	14800	14300	13400	17500	15500	13400	13100	12500	11600	16700
Lead (Pb)	mg/kg	8.38	6.95	7.53	9.08	9.23	9.11	8.13	8.44	8.20	7.97	7.85	10.4	9.05	7.20	7.51	6.68	5.97	9.83
Lithium (Li)	mg/kg	10.3	8.3	8.6	11.7	13.2	12.6	10.6	9.8	10.6	9.8	7.4	10.7	11.7	8.6	8.9	8.0	7.5	11.7
Magnesium (Mg)	mg/kg	18200	17200	17700	18100	18100	17800	17000	17000	17700	17500	11100	14500	10600	6850	6470	5860	5720	10700
Manganese (Mn)	mg/kg	238	208	211	266	287	276	250	240	245	226	226	336	266	290	266	194	171	267
Mercury (Hg)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.053	<0.050	0.054	<0.050	<0.050	0.064	0.072	0.058	0.050	<0.050	<0.050	0.064
Molybdenum (Mo)	mg/kg	1.35	1.17	1.14	1.31	1.31	1.28	1.16	1.20	1.12	1.15	0.98	1.31	0.90	0.50	0.52	0.56	0.52	0.90
Nickel (Ni)	mg/kg	21.4	19.4	20.1	23.5	24.4	23.9	21.3	21.8	21.2	20.4	19.1	27.0	26.4	18.2	17.7	15.5	14.1	24.6
Phosphorus (P)	mg/kg	1000	1030	1010	1000	1010	978	999	1030	986	950	770	882	766	801	770	756	700	806
Potassium (K)	mg/kg	1060	1020	1090	1140	1180	1130	1110	1070	1030	1100	948	1410	1320	836	915	783	714	1300
Selenium (Se)	mg/kg	<0.50	0.51	0.52	0.74	0.72	<0.50	0.61	0.61	0.51	0.62	0.73	1.20	0.71	<0.50	0.50	0.51	<0.50	0.79
Silver (Ag)	mg/kg	0.137	0.120	0.149	0.154	0.200	0.166	0.175	0.169	0.148	0.132	0.186	0.269	0.191	0.161	0.149	0.155	0.134	0.199
Sodium (Na)	mg/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	119	<100	<100	134	<100	<100	<100
Strontium (Sr)	mg/kg	56.7	50.7	51.2	55.6	56.9	54.7	54.3	53.9	53.9	52.5	50.4	70.3	46.0	24.6	23.5	21.8	20.0	34.2
Thallium (Tl)	mg/kg	0.178	0.153	0.166	0.212	0.210	0.191	0.168	0.166	0.179	0.167	0.112	0.186	0.175	0.102	0.110	0.091	0.090	0.176
Tin (Sn)	mg/kg	0.20	0.26	0.25	0.28	0.25	0.23	0.22	0.23	0.22	0.22	0.17	0.28	0.23	0.24	0.21	0.24	0.18	0.26
Titanium (Ti)	mg/kg	10.5	10.4	13.2	14.4	16.7	21.9	17.6	13.1	9.5	13.2	24.8	41.0	41.5	12.2	8.4	9.1	12.9	19.7
Uranium (U)	mg/kg	0.839	0.847	0.871	0.841	0.841	0.821	0.831	0.873	0.822	0.772	0.663	0.847	0.726	0.590	0.578	0.534	0.486	0.687
Vanadium (V)	mg/kg	31.0	27.1	29.1	32.8	33.7	32.8	29.0	29.6	30.2	28.6	20.4	28.5	27.8	21.9	23.1	19.7	17.9	28.4
Zinc (Zn)	mg/kg	76.6	68.4	71.4	83.4	87.6	83.6	78.6	84.1	77.6	77.2	75.2	102	89.1	64.3	66.2	60.7	61.5	91.7
Zirconium (Zr)	mg/kg	0.69	0.73	0.81	0.80	0.83	0.90	0.74	0.71	0.74	0.66	0.93	0.99	1.36	0.57	0.56	<0.50	0.55	1.05

Notes:

All parameters analyzed by Maxxam Analytics

< indicate the value was less than the detection limit

Appendix 3-2

Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

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Appendix 3-2. Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				M20-03				M20-05			
Date Sampled		2011 DL		26-Aug-11		>5x DL?		26-Aug-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	BJ9414	BJ9415	Y/N/<DL	RPD	BJ9417	BJ9418	Y/N/<DL	RPD
Physical Tests											
Moisture	%	0.3	1.5	37	36	Y	1%	30	31	Y	1%
Particle Size											
Gravel (>2mm)	%	2	10	<2.0	4	N	-	4	3	N	-
Sand (2.0mm - 0.063mm)	%	2	10	79	74	Y	2%	36	24	Y	10%
Silt (0.063mm - 4µm)	%	2	10	14	16	Y	3%	18	22	Y	5%
Clay (<4µm)	%	2	10	6	6	N	-	43	51	Y	4%
Metals											
Aluminum (Al)	mg/kg	100	500	5620	5990	Y	2%	12600	12600	Y	0%
Antimony (Sb)	mg/kg	0.1	0.5	0.5	0.5	N	-	0.6	0.8	Y	7%
Arsenic (As)	mg/kg	0.5	2.5	5.3	5.4	Y	0%	7.6	7.0	Y	2%
Barium (Ba)	mg/kg	0.1	0.5	355	368	Y	1%	405	393	Y	1%
Beryllium (Be)	mg/kg	0.4	2	0.5	0.5	N	-	1.0	0.9	Y	3%
Bismuth (Bi)	mg/kg	0.1	0.5	<0.1	<0.1	<DL	-	<0.1	<0.1	<DL	-
Cadmium (Cd)	mg/kg	0.05	0.25	0.82	0.83	Y	0%	1.20	1.23	Y	1%
Calcium (Ca)	mg/kg	100	500	6940	6770	Y	1%	62700	60300	Y	1%
Chromium (Cr)	mg/kg	1	5	10	11	Y	2%	21	22	Y	1%
Cobalt (Co)	mg/kg	0.3	1.5	5.6	5.6	Y	0%	10.8	10.5	Y	1%
Copper (Cu)	mg/kg	0.5	2.5	15.1	16.1	Y	2%	28.6	28.2	Y	0%
Iron (Fe)	mg/kg	100	500	15000	14900	Y	0%	23800	23000	Y	1%
Lead (Pb)	mg/kg	0.1	0.5	8.5	8.5	Y	0%	12.6	13.0	Y	1%
Lithium (Li)	mg/kg	5	25	8	8	N	-	18	19	N	-
Magnesium (Mg)	mg/kg	100	500	3250	3270	Y	0%	18300	18400	Y	0%
Manganese (Mn)	mg/kg	0.2	1	320	315	N	-	419	409	Y	1%
Mercury (Hg)	mg/kg	0.05	0.25	0.05	0.07	N	-	0.06	0.07	N	-
Molybdenum (Mo)	mg/kg	0.1	0.5	1.1	1.1	Y	0%	1.9	2.0	Y	1%
Nickel (Ni)	mg/kg	0.8	4	21.8	22.4	Y	1%	40.1	39.7	Y	0%
Phosphorus (P)	mg/kg	10	50	808	804	Y	0%	959	956	Y	0%
Potassium (K)	mg/kg	100	500	773	833	Y	2%	2400	2410	Y	0%
Selenium (Se)	mg/kg	0.5	2.5	1.0	1.2	N	-	1.2	0.9	N	-
Silver (Ag)	mg/kg	0.05	0.25	0.17	0.19	N	-	0.21	0.23	N	-
Sodium (Na)	mg/kg	100	500	<100	<100	<DL	-	114	119	N	-
Strontium (Sr)	mg/kg	0.1	0.5	28.5	29.1	Y	1%	89.6	87.3	Y	1%
Thallium (Tl)	mg/kg	0.05	0.25	0.12	0.11	N	-	0.18	0.19	N	-
Tin (Sn)	mg/kg	0.1	0.5	0.3	0.5	N	-	0.3	0.4	N	-
Titanium (Ti)	mg/kg	1	5	4	11	Y	23%	12	16	Y	7%
Uranium (U)	mg/kg	0.05	0.25	0.64	0.68	Y	2%	1.02	1.04	Y	0%
Vanadium (V)	mg/kg	2	10	22	23	Y	1%	47	48	Y	1%
Zinc (Zn)	mg/kg	1	5	82	84	Y	1%	117	116	Y	0%
Zirconium (Zr)	mg/kg	0.5	2.5	<0.5	<0.5	<DL	-	2.9	3.1	Y	2%

Appendix 3-2. Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				M20-03				M20-05			
Date Sampled		2011 DL		26-Aug-11		>5x DL?		26-Aug-11		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	BJ9414	BJ9415	Y/N/<DL	RPD	BJ9417	BJ9418	Y/N/<DL	RPD
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	mg/kg	0.005 - 0.02	0.025	<0.005	<0.005	<DL	-	<0.005	<0.005	<DL	-
Acenaphthylene	mg/kg	0.01	0.05	<0.007	<0.005	<DL	-	<0.01	<0.01	<DL	-
Anthracene	mg/kg	0.004	0.02	<0.004	<0.004	<DL	-	<0.004	<0.004	<DL	-
Benzo(a)anthracene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	<0.02	<0.02	<DL	-
Benzo(a)pyrene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	<0.02	<0.02	<DL	-
Benzo(b&j)fluoranthene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	0.06	0.06	N	-
Benzo(g,h,i)perylene	mg/kg	0.05	0.25	<0.05	<0.05	<DL	-	<0.05	<0.05	<DL	-
Benzo(k)fluoranthene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	<0.02	<0.02	<DL	-
Chrysene	mg/kg	0.02	0.1	0.05	0.04	N	-	0.13	0.14	Y	2%
Dibenz(a,h)anthracene	mg/kg	0.05	0.25	<0.05	<0.05	<DL	-	<0.05	<0.05	<DL	-
Fluoranthene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	0.03	0.03	N	-
Fluorene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	0.07	0.07	N	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	0.25	<0.05	<0.05	<DL	-	<0.05	<0.05	<DL	-
2-Methylnaphthalene	mg/kg	0.02	0.1	0.29	0.24	Y	5%	0.29	0.31	Y	2%
Naphthalene	mg/kg	0.01	0.05	0.17	0.13	Y	7%	0.07	0.07	Y	0%
Phenanthrene	mg/kg	0.02	0.1	0.18	0.12	Y	10%	0.33	0.34	Y	1%
Pyrene	mg/kg	0.02	0.1	<0.02	<0.02	<DL	-	0.05	0.05	N	-
Total PAH	mg/kg	0.05	0.25	0.69	0.53	Y	7%	0.96	1.0	Y	1%

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Dashes indicate RPD not calculated because values <5 DL

Shaded values indicate RPD greater than 20%

Appendix 3-2. Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				MR19-01				MR19-01			
Date Sampled		2012 DL		31-Aug-12		>5x DL?		31-Aug-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	EK8339	EK8340	Y/N/<DL	RPD	EK8341	EK8347	Y/N/<DL	RPD
Physical Tests											
Moisture	%	0.3	1.5	38	37	Y	1%	28	27	Y	1%
Particle Size											
Gravel (>2mm)	%	2	10	3.3	3.3	N	-	<2.0	<2.0	<DL	-
Sand (2.0mm - 0.063mm)	%	2	10	73	74	Y	0%	77	80	Y	1%
Silt (0.063mm - 4µm)	%	2	10	20	18	Y	3%	19	18	Y	1%
Clay (<4µm)	%	2	10	3.9	4.0	N	-	4.0	2.4	N	-
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	mg/kg	0.0005 - 0.003	0.0025	<0.00050	<0.0025	<DL	-	0.00069	0.00052	N	-
Acenaphthylene	mg/kg	0.0011 - 0.012	0.0055	<0.0016	<0.0025	<DL	-	<0.0011	<0.0015	<DL	-
Anthracene	mg/kg	0.001 - 0.005	0.005	<0.0010	<0.0050	<DL	-	<0.0010	<0.0010	<DL	-
Benzo(a)anthracene	mg/kg	0.001 - 0.005	0.005	0.0022	<0.0050	N	-	0.0018	0.0021	N	-
Benzo(a)pyrene	mg/kg	0.001 - 0.005	0.005	0.0016	<0.0050	N	-	0.0012	0.0016	N	-
Benzo(b&j)fluoranthene	mg/kg	0.001 - 0.005	0.005	0.012	0.013	Y	2%	0.011	0.012	Y	2%
Benzo(g,h,i)perylene	mg/kg	0.002 - 0.01	0.01	0.0053	<0.010	N	-	0.0048	0.0075	N	-
Benzo(k)fluoranthene	mg/kg	0.001 - 0.005	0.005	<0.0010	<0.0050	<DL	-	<0.0010	<0.0010	<DL	-
Chrysene	mg/kg	0.001 - 0.005	0.005	0.025	0.028	Y	3%	0.022	0.026	Y	4%
Dibenz(a,h)anthracene	mg/kg	0.0005 - 0.003	0.0025	0.0019	<0.0025	N	-	0.0017	0.0024	N	-
Fluoranthene	mg/kg	0.001 - 0.005	0.005	0.0053	0.0054	Y	0%	0.0041	0.0049	N	-
Fluorene	mg/kg	0.001 - 0.005	0.005	0.0067	0.0057	Y	4%	0.0036	0.0053	Y	10%
Indeno(1,2,3-cd)pyrene	mg/kg	0.002 - 0.01	0.01	<0.0020	<0.010	<DL	-	<0.0020	<0.0020	<DL	-
2-Methylnaphthalene	mg/kg	0.001 - 0.005	0.005	0.060	0.058	Y	1%	0.040	0.051	Y	6%
Naphthalene	mg/kg	0.001 - 0.005	0.005	0.031	0.028	Y	3%	0.021	0.026	Y	5%
Phenanthrene	mg/kg	0.001 - 0.005	0.005	0.054	0.059	Y	2%	0.042	0.052	Y	5%
Pyrene	mg/kg	0.001 - 0.005	0.005	0.013	0.016	Y	5%	0.0086	0.015	Y	14%
Total PAH	mg/kg	0.0011 - 0.012	0.0055	0.20	0.20	Y	0%	0.15	0.19	Y	6%

Appendix 3-2. Stream Sediment Quality Analytical Results of Field Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				MR4				M19-01				M19-01			
Date Sampled		2012 DL		29-Aug-12		>5x DL?		31-Aug-12		>5x DL?		31-Aug-12		>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	EK8765	EK8766	Y/N/<DL	RPD	EK8793	EK8794	Y/N/<DL	RPD	EK8795	EK8796	Y/N/<DL	RPD
Organic Carbon															
Total Organic Carbon	%	0.02	0.1	2.1	1.8	Y	4%	2.6	2.5	Y	1%	2.7	2.4	Y	3%
Total Metals															
Aluminum (Al)	mg/kg	100	500	6440	6360	Y	0%	6250	6870	Y	2%	5770	5180	Y	3%
Antimony (Sb)	mg/kg	0.1	0.5	0.48	0.44	N	-	0.28	0.28	N	-	0.26	0.23	N	-
Arsenic (As)	mg/kg	0.5	2.5	4.47	4.39	Y	0%	3.28	3.06	Y	2%	3.17	2.79	Y	3%
Barium (Ba)	mg/kg	0.1	0.5	184	193	Y	1%	199	196	Y	0%	177	157	Y	3%
Beryllium (Be)	mg/kg	0.4	2	<0.40	0.45	N	-	<0.40	<0.40	<DL	-	<0.40	<0.40	<DL	-
Bismuth (Bi)	mg/kg	0.1	0.5	<0.10	<0.10	<DL	-	<0.10	<0.10	<DL	-	<0.10	<0.10	<DL	-
Cadmium (Cd)	mg/kg	0.05	0.25	0.840	0.836	Y	0%	0.518	0.470	Y	2%	0.526	0.446	Y	4%
Calcium (Ca)	mg/kg	100	500	46200	46300	Y	0%	16700	15300	Y	2%	13700	13400	Y	1%
Chromium (Cr)	mg/kg	1	5	12.1	12.1	Y	0%	10.3	11.2	Y	2%	9.7	8.7	Y	3%
Cobalt (Co)	mg/kg	0.3	1.5	5.89	5.92	Y	0%	5.51	5.36	Y	1%	4.66	4.17	Y	3%
Copper (Cu)	mg/kg	0.5	2.5	19.0	26.4	Y	8%	17.7	26.8	Y	10%	18.0	26.0	Y	9%
Iron (Fe)	mg/kg	100	500	14400	14500	Y	0%	13400	13100	Y	1%	12500	11600	Y	2%
Lead (Pb)	mg/kg	0.1	0.5	8.13	8.44	Y	1%	7.20	7.51	Y	1%	6.68	5.97	Y	3%
Lithium (Li)	mg/kg	5	25	10.6	9.8	N	-	8.6	8.9	N	-	8.0	7.5	N	-
Magnesium (Mg)	mg/kg	100	500	17000	17000	Y	0%	6850	6470	Y	1%	5860	5720	Y	1%
Manganese (Mn)	mg/kg	0.2	1	250	240	Y	1%	290	266	Y	2%	194	171	Y	3%
Mercury (Hg)	mg/kg	0.05	0.25	0.053	<0.050	N	-	0.058	0.050	N	-	<0.050	<0.050	<DL	-
Molybdenum (Mo)	mg/kg	0.1	0.5	1.16	1.20	Y	1%	0.50	0.52	Y	1%	0.56	0.52	Y	2%
Nickel (Ni)	mg/kg	0.8	4	21.3	21.8	Y	1%	18.2	17.7	Y	1%	15.5	14.1	Y	2%
Phosphorus (P)	mg/kg	10	50	999	1030	Y	1%	801	770	Y	1%	756	700	Y	2%
Potassium (K)	mg/kg	100	500	1110	1070	Y	1%	836	915	Y	2%	783	714	Y	2%
Selenium (Se)	mg/kg	0.5	2.5	0.61	0.61	N	-	<0.50	0.50	N	-	0.51	<0.50	N	-
Silver (Ag)	mg/kg	0.05	0.25	0.175	0.169	N	-	0.161	0.149	N	-	0.155	0.134	N	-
Sodium (Na)	mg/kg	100	500	<100	<100	<DL	-	<100	134	N	-	<100	<100	<DL	-
Strontium (Sr)	mg/kg	0.1	0.5	54.3	53.9	Y	0%	24.6	23.5	Y	1%	21.8	20.0	Y	2%
Thallium (Tl)	mg/kg	0.05	0.25	0.168	0.166	N	-	0.102	0.110	N	-	0.091	0.090	N	-
Tin (Sn)	mg/kg	0.1	0.5	0.22	0.23	N	-	0.24	0.21	N	-	0.24	0.18	N	-
Titanium (Ti)	mg/kg	1	5	17.6	13.1	Y	7%	12.2	8.4	Y	9%	9.1	12.9	Y	9%
Uranium (U)	mg/kg	0.05	0.25	0.831	0.873	Y	1%	0.590	0.578	Y	1%	0.534	0.486	Y	2%
Vanadium (V)	mg/kg	2	10	29.0	29.6	Y	1%	21.9	23.1	Y	1%	19.7	17.9	Y	2%
Zinc (Zn)	mg/kg	1	5	78.6	84.1	Y	2%	64.3	66.2	Y	1%	60.7	61.5	Y	0%
Zirconium (Zr)	mg/kg	0.5	2.5	0.74	0.71	N	-	0.57	0.56	N	-	<0.50	0.55	N	-

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Appendix 3-3

Stream Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

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Appendix 3-3. Stream Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

Lab Sample ID	ALS ID	Analyte	Units	Replicate 1	Replicate 2	RPD	RPD Limit	Diff	Diff Limit	Qualifier
Particle Size										
L921662-8	WG1165163-1	Gravel (>2mm)	%	<0.10	<0.10	N/A	25	-	-	RPD-NA
L921662-8	WG1165163-1	Sand (2.0mm - 0.063mm)	%	74.0	73.5	-	-	0.51	6.3	J
L921662-8	WG1165163-1	Silt (0.063mm - 4µm)	%	25.7	26.1	-	-	0.41	5	J
L921662-8	WG1165163-1	Clay (<4µm)	%	0.34	0.44	-	-	0.10	5	J
Leachable Nutrients										
L921662-10	WG1165112-1	Total Nitrogen	%	0.057	0.057	-	-	0.001	0.05	J
Organic Carbon										
L921662-10	WG1165124-1	Total Organic Carbon	%	0.82	0.81	1.2	30	-	-	-
Plant Available Nutrients										
L921662-15	WG1165570-1	Available Phosphate	mg/kg	<2.0	<2.0	N/A	30	-	-	RPD-NA
Metals										
L921662-9	WG1161116-3	Mercury	mg/kg	0.0419	0.0392	-	-	0.0013	0.02	J
L921662-10	WG1165112-1	Sulphur	mg/kg	600	700	21	30	-	-	-
Hydrocarbons										
L921662-11	WG1163499-5	EPH10-19	mg/kg	<200	<200	N/A	40	-	-	RPD-NA
L921662-11	WG1163499-5	EPH19-32	mg/kg	<200	<200	N/A	40	-	-	RPD-NA
Polycyclic Aromatic Hydrocarbons										
L921662-11	WG1163499-5	Acenaphthene	mg/kg	<0.0050	<0.0050	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Acenaphthylene	mg/kg	<0.0050	<0.0050	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Anthracene	mg/kg	<0.0040	<0.0040	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Benz(a)anthracene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Benzo(a)pyrene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Benzo(b)fluoranthene	mg/kg	0.013	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Benzo(g,h,i)perylene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Benzo(k)fluoranthene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Chrysene	mg/kg	<0.015	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Dibenz(a,h)anthracene	mg/kg	<0.0050	<0.0050	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Fluoranthene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Fluorene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Indeno(1,2,3-c,d)pyrene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	2-Methylnaphthalene	mg/kg	0.026	0.018	-	-	0.008	0.04	J
L921662-11	WG1163499-5	Naphthalene	mg/kg	0.013	<0.010	N/A	50	-	-	RPD-NA
L921662-11	WG1163499-5	Phenanthrene	mg/kg	0.045	0.029	-	-	0.016	0.04	J
L921662-11	WG1163499-5	Pyrene	mg/kg	<0.010	<0.010	N/A	50	-	-	RPD-NA

Notes:

Samples analyzed by ALS Environmental

RPD = relative percent difference calculated when values were >10x DL

N/A = at least one value <DL

Diff = difference between the replicate values in concentration units, used where replicate 1 value is <10x DL

RPD-NA = relative percent difference not available due to results being less than DL

J = duplicate results and limits are expressed in terms of absolute difference

Appendix 4-1
Stream Sampling Results 2011

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HD Mining: Aquatic Life Data Report 2011

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2011 ENVIRONMENTAL EMPLOYER OF THE YEAR

EDI ENVIRONMENTAL DYNAMICS INC.

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EXECUTIVE SUMMARY

In August 2011, EDI Environmental Dynamics Inc. conducted an aquatic monitoring program on Murray River, located in northern British Columbia near Tumbler Ridge. This work involved sediment, benthic invertebrate and periphyton sampling at six sites, including three sites on M20 Creek and three sites on Murray River. The program incorporated temporal and spatial replication in a Before-After Control-Impact study design. The purpose of this program was to establish baseline conditions and monitoring sites so that sampling throughout the life cycle of the mine can detect the occurrence of impacts caused by the mine.

Sediment, benthic invertebrate and periphyton sampling methodologies were based on various field manuals from the BC and federal governments. Sediments were analyzed for particle size, metal concentration and organic content. Means and standard deviations were calculated for each site. Benthic invertebrates were identified to the family taxonomic level and a selection of abundance diversity metrics were calculated to represent community composition among sites. Periphyton was sampled and analyzed for both community composition (i.e., abundance and richness) and biomass (i.e., chlorophyll *a*).

The results are summarized and key points are presented for each component of the program: sediment, benthic invertebrates and periphtyon. Results suggest that M20 Creek has existing elevated metal concentrations. Naturally occurring sedimentation is a potential cause of these elevated values. Sites within the sampling area contained relatively high levels of Cadmium, 2-Methylnaphthalene and Phenanthrene. Site M20-05 had relatively high metals values compared to all other sites, and had its particle size composition differed with higher clay and lower sand content.

Kick sampling for benthic invertebrates was successful and the upstream site on M20 Creek had the highest abundance among sites. In one replicate at that site, 11,160 invertebrates were collected in a three minute kick sample and 89% of those organisms were in the EPT group. The EPT group is known to comprise the taxa most sensitive to pollution. The lower sample site on M20 Creek had the lowest benthic invertebrate abundance values on M20 creek. The Hilsenhoff Biotic Index indicated excellent water quality at all sites except for MR-7 where a high value indicated relatively poor water quality. Periphyton results showed that M20 Creek had the highest densities of periphyton and higher number of taxa (richness) in comparison to the Murray River sites.

In the invertebrate and periphyton data in particular, there was a high amount of variability in the data. A power analysis indicated that additional pre-impact sampling would be required in order to detect effects using ANOVA statistical analysis with the before-after control-impact sampling design. Power analysis is a statistical technique used to determine the number of samples required in order to detect an effect of a given size, at a given significance level. Recommendations are provided based on this analysis.

ACKNOWLEDGEMENTS

EDI would like to thank all who contributed to the success of this program. Special thanks to Bruce Carmichael and James Jacklin from Ministry of Environment for their advice on study design. Thank you to the various lab staff who analyzed the samples

AUTHORSHIP

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TABLE OF CONTENTS

1 INTRODUCTION 3

1.1 STUDY AREA 4

1.2 PREVIOUS STUDIES 4

2 METHODS 7

2.1 STUDY DESIGN 7

2.2 AQUATIC LIFE SAMPLING AND ANALYSIS 8

2.2.1 Aquatic Habitat 8

2.2.2 Stream Sediments 9

2.2.3 Benthic Invertebrates 10

2.2.4 Periphyton 11

3 RESULTS & DISCUSSION 13

3.1 AQUATIC HABITAT 13

3.2 STREAM SEDIMENTS 15

3.3 BENTHIC INVERTEBRATES 17

3.4 PERIPHYTON 20

4 REFERENCES 26

4.1 LITERATURE CITED 26

4.2 SPATIAL DATA 27

APPENDIX A SEDIMENT DATA

APPENDIX B PERIPHYTON DATA

APPENDIX C BENTHIC DATA

APPENDIX D HILSENHOFF BIOTIC INDEX TABLE

APPENDIX E EMAIL CORRESPONDANCE FROM MINISTRY OF ENVIRONMENT

LIST OF TABLES

Table 1. Summary of the aquatic life monitoring program, 2010 to 2011 5

Table 2. List of sites sampled in the 2011 Murray River Aquatic Life Monitoring Program 7

Table 3. Metrics used to describe benthic invertebrate abundance, diversity and community similarity. 11

Table 4. Site specific habitat data, August 2011 14

Table 5. Physical properties for sediment samples, 2011 15

Table 6. Total metal concentrations for sediment samples, 2011 16

Table 7. Semi-volatile organics for sediment samples, 2011 17

Table 8. Summary of benthic invertebrate metrics. 2011 20

Table 9. Periphyton species richness and total number of taxa in replicates for Murray River Aquatic Monitoring Sites 2011. 21

Table 10. Periphyton density for Murray River Aquatic Monitoring Sites 2011. 21

Table 11. Chlorophyll a analysis for all 2011 Murray River Aquatic Monitoring Sites 21

LIST OF FIGURES

Figure 1. Map overview of the Murray River Project Aquatic Life Monitoring Area. 6

LIST OF PHOTOS

Photo 1. Potential far field site downstream on Murray River. Sampling was not feasible due to high water. 8

Photo 2. MR-9 sample site picture shows depth and river turbidity in contexts to light penetration. 23

1 INTRODUCTION

In 2011 Environmental Dynamics Inc. (EDI) conducted an aquatic life baseline program for the HD Mining Murray River Coal Mine Project. The goal of this program was to provide sediment, benthic invertebrate and periphyton baseline data in order to monitor potential impacts of the mine and fulfill information requirements for the BC Environmental Assessment process. A scientifically defendable study was designed with the purpose of using baseline data as a reference to statistically compare data from potential impact zones throughout the mine life. The program was initiated in 2010, the study design was refined based on current mine planning in 2011, and sampling was continued in 2011.

Sampling was conducted at six locations upstream and downstream of the mine influence on two watercourses, M20 Creek and Murray River. Benthic invertebrates were sampled using the Canadian Aquatic Biomonitoring Network (CABIN) standard method with a kick net. This method was selected because a CABIN reference model for the Peace region is currently under development and is anticipated to be completed in the next several years. The CABIN system of biomonitoring uses invertebrate community data compiled from a series of unimpaired reference sites to build a statistical model which a test site is compared against. The test site is compared using multivariate statistical analysis to determine if it statistically differs from the reference condition, in which case the site is considered impaired. Since the CABIN reference model for the Peace region is not currently available, the sampling design falls back on a before-after control-impact design (Smith 2002) where upstream control sites are paired with downstream impact sites. The intention for future monitoring is to statistically compare pre-impact data to post-impact data using two-factor ANOVA.

Aquatic monitoring of stream sediments, benthic invertebrates and periphyton provides an overall indication of water quality and site productivity. Benthic invertebrates respond to a wide variety but not to all impacts; therefore, it is recommended to have a balanced approach by including multiple biological components (Rosenburg and Resh 1992). Periphyton and sediment, the two primary food sources of benthic invertebrates, collect impurities from their surrounding ecosystem either by deposition and adsorption (sediment) or absorption (periphyton). Metal ingested by benthic invertebrates is believed to be the primary cause of elevated metal levels in fish in and around contaminated sites (Biggs and Kilroy 2000; Meret 2003). As these components are highly sensitive to changes in physical, chemical and biological conditions in the aquatic environment, detecting changes downstream may be an indication of an impact upstream of that point in the watershed.

The objective of the study design is to establish sites upstream and downstream from the Project footprint so that potential impacts throughout the life cycle of the mine can be detected and quantified if they occur. The Project is a proposed underground coal mine and its footprint as known at the time of designing this program includes clearing and grubbing areas, site grading and preparation areas, access construction, surface water management infrastructures, decline portals, laydown area, waste rock area, coal stockpile conveyor, coal sample storage, coal truck loading

facility, rail load out area, water control system, fuel storage, and electrical power source. The site is nearby existing transmission, rail, and all season road infrastructures.

1.1 STUDY AREA

The Project is located in northeast British Columbia, southeast of Tumbler Ridge within the Murray River watershed. The study area covers an elevation ranging from 760 to 1,110 meters. The vegetation in the study area is dominated by Engelmann spruce and subalpine fir in the higher elevations, white and black spruce in the lower elevations and willow species in the streamside riparian areas. The monitoring program included six sites, three on the Murray River and three on M20 Creek, which is a tributary to the Murray River (Figure 1; Table 1).

1.2 PREVIOUS STUDIES

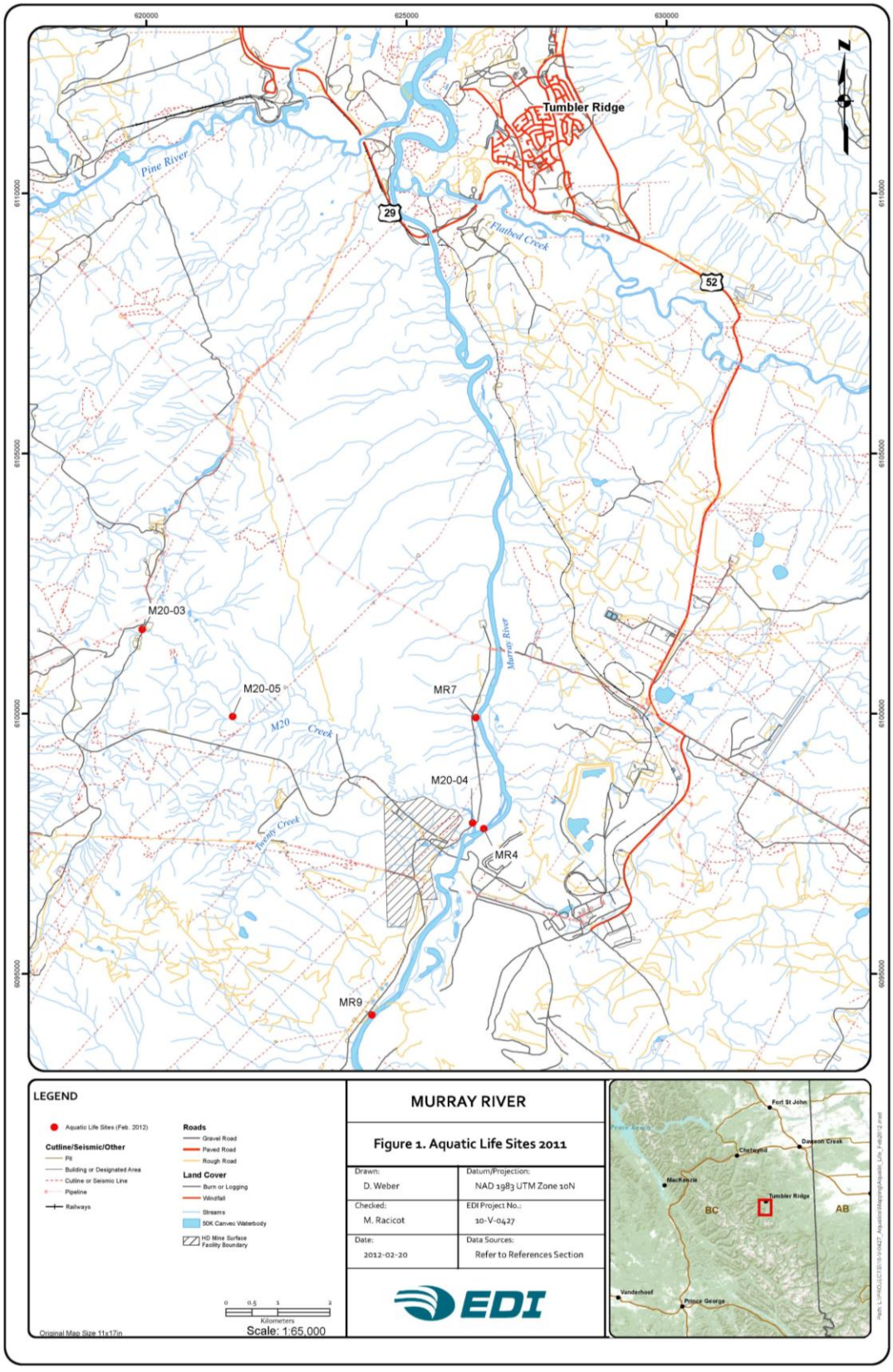
Sampling in 2010 was completed by Rescan and is summarized in a technical report (Rescan 2010). Aquatic life sampling in 2011 was completed by EDI. Similar to 2011, the 2010 program included sediment, benthic invertebrates and periphyton sample collection at six sites. An earlier aquatic monitoring program that partly coincides with the Murray River project was completed for the Herman Mine Project between 2004 and 2006 (WCCC 2007). Site names for the Murray River baseline program were changed in 2011 to match site names from the Hermann Mine baseline program. Sites M20-03 and M20-04 coincide with Hermann Mine aquatic life sites. Other sites coincide with pre-existing water quality sites, and their nomenclature was changed in 2011 to match the existing site names. Table 1 provides a summary of the sampling in the past two years for the Murray River project. The sites are listed in Table 1 in order of upstream-most to downstream-most sites on Murray River, and then upstream-most to downstream-most sites on M20 Creek.

Table 1. Summary of the aquatic life monitoring program, 2010 to 2011.

Site Name	2010 Sampling			2011 Sampling		
	Benthic Invertebrate	Periphyton	Sediment	Benthic Invertebrate	Periphyton	Sediment
MR-REF	✓	✓	✓			
MR-9				✓	✓	✓
MR-4 (Rescan 2010)[a]	✓	✓	✓			
MR-4 [b]	✓	✓	✓	✓	✓	✓
MR-7				✓	✓	
MR-6	✓	✓	✓			
M20-03				✓	✓	✓
M20-05				✓	✓	✓
M20-04 [c]	✓	✓	✓	✓	✓	✓
REFST-DS [d]	✓	✓	✓			

Notes: **a.** MR-4 (2010) was located on Murray River upstream of M20 Creek confluence and downstream of Twenty Creek confluence
b. MR-4 was previously known as MR-5 by Rescan in 2010
c. M20-04 was previously known as M20-DS by Rescan in 2010 and was the same site as Hermann Mine M20-04
d. REFST-DS is located on a tributary of the Murray River that enters the Murray upstream of MR-REF

Figure 1. Aquatic Life Sites 2011.



2 METHODS

2.1 STUDY DESIGN

In 2011, sample locations and site nomenclature were changed from the initial year of sampling in 2010 due to current mine footprint planning (Table 2). Study design and methodologies were consistent with *Water and Air Resource Protection Guidelines for Mine Proponents and Operators: Baseline Monitoring* (MOE 2009). Site selection was influenced based on the following rationale:

- Are there existing data locations used for other projects that are suitable? Building on previous data could assist in future analyses and potentially minimize the amount of sampling required.
- Are there other available data that could be built on? By reviewing the CABIN database for existing data, it was found that site M20-03 was previously sampled as a reference site.

One site that was previously sampled, MR-6 on the lower Murray River, was selected as a potential far-field impact site; however, water levels did not permit sampling and it was dropped from the 2011 sampling program (Photo 1). Review of sampling design and methodologies was provided by the Ministry of Environment - Environmental Quality Section (Appendix E).

Table 2. List of sites sampled in the 2011 Murray River Aquatic Life Monitoring Program

Site Name	UTM Coordinates	Site Description	Rationale
M20-03	10 U 619880 6101618	Upstream of mine footprint on M20 Creek	Control site for M20 drainage as it is upstream of all mine activity. This site was a CABIN reference site.
M20-05	10 U 621661 6099951	Downstream of natural sediment sources on M20 Creek	Quantify the influence of the natural occurring sediment sources in upper section of M20 creek.
M20-04	10 U 626265 6097901	Downstream of mine footprint on lower part of M20 Creek	Monitor potential impacts directly downstream resulting from mine operations.
MR-9	10 U 624311 6094181	Upper Murray River control site	Control site for Murray River upstream of all potential impacts of Murray River project.
MR-4	10 U 626493 6097797	Approx. 250m downstream of M20 confluence on Murray River	Downstream of M20 mixing zone. Isolate the influence M20 creek has on Murray River from other potential direct effects on Murray River.
MR-7	10 U 626337 6099950	Approx. 2.6 km downstream of M20 confluence on Murray River	Monitor potential impacts downstream of all potential impacts of the mine footprint.

Photo 1. Potential far field site downstream on Murray River at site MR-6. Sampling was not feasible due to high water.

2.2 AQUATIC LIFE SAMPLING AND ANALYSIS

Sampling was conducted August 24 to 26, 2011. Stream sediment, benthic invertebrate and periphyton sampling was conducted by two qualified EDI personnel. Habitat data for each site was collected based on the Canadian Aquatic Biomonitoring Network (CABIN) methods. CABIN is the national biomonitoring program developed by Environment Canada that delivers a standardized sampling protocol.

Sampling methods and field techniques for stream sediments and periphyton were based on *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emission, Waste, Wastewater, Soil, Sediment, and Biological Samples* (Clark 2003) and *Stream Periphyton Monitoring Manual* (Biggs and Kilroy 2000).

2.2.1 Aquatic Habitat

At each site, the following habitat parameters were examined, as per CABIN methodology.

- **Pebble Count and Embeddedness**: A minimum of 100 particles (i.e., pebbles) were randomly selected from the streambed. The intermediate axis of each particle was measured, as well as the depth of the substrate it was buried in (i.e., embedded).
- **Elevation**: Determined from a handheld GPS unit or topographic map (scale 1:50,000).
- **Channel morphology**: Features measured included stream gradient, wetted and bankfull width, average water depth and velocity.

2.2.2 Stream Sediments

Sediments support aquatic life by providing habitat for attached algae, rooted plants and burrowing or sediment-feeding benthic invertebrates. Fine grained sediments can also bind to some chemical contaminants (e.g., metals and organics), preferably to silts and clays. Contaminants bound to fine sediment can in turn affect the health of organisms that use sediment as their habitat (BC MOE 2009). Sediments also incorporate periodic or storm based contamination events that can be missed by regular water quality sampling.

In 2011, sediment samples were collected at five sites and were analyzed for the following parameters:

- **Particle size distribution** describes the physical properties of the sediment, including the percentage of sand, silt and clay, which highly influences the chemical and biological characteristics of sediment at the site.
- **Metals** are naturally present in all sediments; most metals tend to be associated with suspended solids which settle out in the sediments over time.
- **Polycyclic aromatic hydrocarbons (PAHs) are** a group of organic contaminants that form from the incomplete combustion of hydrocarbons, such as coal and gasoline.

Three samples were collected at each of the five sites within the active channel using a Teflon coated spoon for metals analysis and a stainless steel spoon for PAHs and particle size analysis. Submerged depositional areas were targeted where fine grained sediments were present. Each sample was a composite of scoops from several locations within depositional zones at the site. New nitrile gloves were worn at each site. The Teflon scoop was disinfected with 10% nitric acid and the steel scoop was disinfected with acetone between sites to avoid contamination. Data on sediment texture, colour, smell and presence of organic debris were recorded at each site. Field quality assurance and quality control (QA/QC) included split samples at two sites and five replicates at one site

Samples were stored in glass jars in a cool environment (4˚C) and promptly shipped to the laboratory within the specific holding period. Laboratory analysis was conducted by Maxxam Analytics in Burnaby, BC. As previously stated, samples were analyzed for physical properties (including particle size distribution), total metals (33 elements scan), and PAHs.

Results for each replicate sample were averaged for each site and compared to the Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG) and the BC Ambient Water Quality Guidelines[1] (AWQG) (BC MOE 2006) for the Protection of Aquatic Life[2]

2.2.3 Benthic Invertebrates

As sedentary, bottom-dwelling and detritus-feeding aquatic organisms, benthic invertebrates sustain exposure to stream water and sediments throughout their life cycle. Some species of benthic invertebrates are known to be intolerant to elevated concentrations of metals often associated with mining activity, allowing other more tolerant species to become dominant at contaminated sites (Maret et al. 2003). Benthic invertebrates' abundance and ease to sample due to their sedentary and relatively long-lived nature makes them one of the most commonly used to assess ecological impacts to the ecosystem.

In 2011, benthic invertebrates were sampled at six sites within the project area. At each site, riffles and glides were targeted for sampling. Sampling was conducted at water depths between 10 to 50 cm for a period of three minutes with a 400µm mesh, 30 cm diameter kick net. Substrate and debris upstream of the kick net was disturbed by kicking and turning rocks over to dislodge invertebrates. After the three minutes, the kick net was removed from the stream and all invertebrates and debris in the net and collection cup were rinsed carefully into the sample jar. Samples were preserved with a 10% buffered formalin solution, at a ratio of 1:3 parts formalin to water. A total of three sample replicates were collected at each site, moving in an upstream direction within the identified riffle or glide. Water depth and average water velocity were measured at each sample replicate location. In-situ water quality, substrate type and riparian vegetation were also recorded at each site.

Samples were sent to EcoAnalysts, Inc. for enumeration and identification to the family taxonomic level. Data from each replicate sample was analyzed based on the following metrics and mean and standard deviations were calculated for each site (Table 3). A selection of metrics was chosen to represent community composition, proportion of pollution intolerant species and overall productivity.

[1] http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html#table2

[2] http://ceqg-rcqe.ccme.ca/

Table 3. Metrics used to describe benthic invertebrate abundance, diversity and community similarity.

Metrics	Description
Total Density	The total number of individuals of all taxon categories collected at each site.
Taxa Richness	The average number of distinct taxa counted at each site. Distinct taxa include individuals identified only to order if there were no individuals identified to a lower level for that taxon (Rosenberg and Resh 1993).
EPT Richness	Measures the amount of pollution sensitive species (Ephemeroptera, Plecoptera and Trichoptera) that are present. This was calculated by counting the number of different taxa from each of these orders. High numbers typically indicate good water quality (Rosenberg and Resh 1993).
Hilsenhoff Biotic Index (HBI)	The sum of abundance weighted by assigned tolerance to organic pollution value for each taxon (Rosenberg and Resh 1993).
Ephemeroptera (%)	The abundance of Ephemeroptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Plecoptera (%)	The abundance of Plecoptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Trichoptera (%)	The abundance of Trichoptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Diptera (%)	The abundance of Diptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).

2.2.4 Periphyton

Periphyton is an essential part of a stream ecosystem. It provides food to many aquatic invertebrates and purifies water by absorbing impurities such as metals. Periphyton can be found on rock and stable substrates in creeks. It is very responsive to changes in its ecosystem. It can change in both biomass (measured in Chlorophyll a) and in taxonomic community shifts (Biggs and Kilroy 2000).

In 2011, periphyton was sampled at six sites and analyzed for total metals, taxonomy and biomass.

Samples were collected using a circular template (10 cm diameter) to isolate a uniform area on a rock or group of rocks. Periphyton was then scraped and rinsed from this area into a plastic sample jar.

The number of templates used for each sample depended on the density of periphyton and was recorded for each site. If two visual periphyton communities were present at a site (i.e. a filamentous community and brown algae on rocks), both the dominant the sub-dominant community were sampled.

Samples were then processed accordingly, based on sample type:

- **Taxonomic samples** were preserved with Lugol's solution and sent to a taxonomic laboratory (EcoAnalysts, Inc.) for identification to the lowest taxonomic level. Enumeration was completed to obtain a density of cells per site.
- **Biomass samples** were placed and stored in a cooler until filtering. Each sample was filtered using a peristaltic pump with a membrane filter of 0.45µm pore size, folded inside a larger Whatman type paper filter. A magnesium carbonate solution ($MgCO_3$) was added to the periphyton during filtering to act as a drying and stabilizing agent. Filtered samples were then wrapped in aluminium foil and kept cool (4˚C) until shipment to the laboratory (Maxxam Analytics). Chlorophyll a was analyzed as a surrogate variable for periphyton biomass.

Taxonomic and biomass results were summarized and statistics were calculated for further analysis based on EcoAnalysts Inc. methodology.

3 RESULTS & DISCUSSION

Results are summarized and discussed below for each component of the 2011 Murray River Aquatic Monitoring Program. Sediment, periphyton and benthic invertebrate raw data are provided in Appendix A, B and C, respectively.

Weather conditions during sampling on August 24 to 26, 2011 were typical for the time of the year; temperatures ranged from 14˚C to 26˚C. No precipitation was documented during sampling; however, a rain event prior to sampling resulted in higher than seasonal water levels during the sampling period. Water levels at the Murray River Water Survey Canada gauge station[3] were between 1.6 and 1.9 m during sampling in August 2011.

3.1 AQUATIC HABITAT

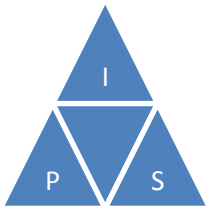
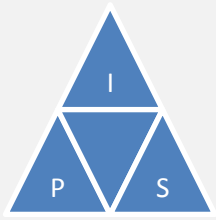
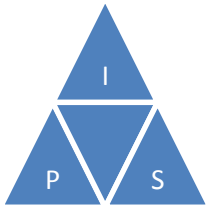
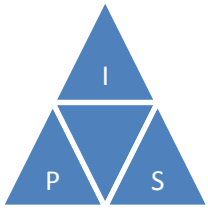
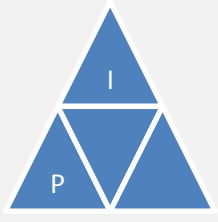
M20 Creek was characterized by classic glide riffle pool habitat type with a site average stream gradient of 0.98%. Substrate particles had an average Wolman D50 of 6.6 cm. In the lower reaches of M20 Creek natural sedimentation was observed from small cut banks at the stream edge. Wetted width ranged from 2.5 m in the upper reaches to 6.0 m in the lower reach, with a depth range from 0.09 m to 0.14 m.

Murray River is one of the larger rivers in the Tumbler Ridge area. Its head waters flow from lower Blue Lake down to the Pine River. It offers an abundant amount of pocket habitat along its banks. The sites average gradient was 0.13% with an average Wolman D50 of 6.58 cm.

Reach specific physical habitat data is summarized in Table 4 for each site. The I,P,S symbols refer to the type of sampling conducted at each site: I= Invertebrates; P=Periphyton; S=Sediment. In-situ water quality data showed that pH values were at or near 6.0 at each site. Conductivity ranged from 145 to 372 µs/cm. Average water velocities ranged from 0.06 to 0.16 m/sec.

[3] Data accessed at: http://www.wateroffice.ec.gc.ca/index_e.html

Table 4. Site specific habitat data for each aquatic life sites sampled in August 2011.

Site	Reach Data	Samples Collected
M20-03	**Habitat Types**: Riffle, Straight run and pool **Canopy Coverage**: 0% **Streamside Vegetation**: Ferns/grasses, shrubs, deciduous and coniferous trees. **Dominant Streamside Vegetation:** Shrubs	
M20-04	**Habitat Types**: Riffle and straight run **Canopy Coverage**: 1-25% **Streamside Vegetation**: Shrubs, deciduous and coniferous trees. **Dominant Streamside Vegetation:** Deciduous trees	
M20-05	**Habitat Types**: Riffle and straight run **Canopy Coverage**: 1-25% **Streamside Vegetation**: shrubs, deciduous and coniferous trees. **Dominant Streamside Vegetation:** Shrubs	
MR-4	**Habitat Types**: Riffle, straight run and pool back eddy **Canopy Coverage**: 0% **Streamside Vegetation**: Ferns/grasses, shrubs, deciduous and coniferous trees. **Dominant Streamside Vegetation:** Shrubs	
MR-7	**Habitat Types**: Straight run and pool back eddy **Canopy Coverage**: 1-25% **Streamside Vegetation**: Coniferous trees. **Dominant Streamside Vegetation:** Coniferous trees.	

Notes: Triangles above symbols are: I= Benthic Invertebrates sample; S= Sediment sample; P= Periphyton sample

3.2 STREAM SEDIMENTS

Sediment sampling occurred at five of the six sites: MR-9, MR-4, M20-03, M20-04, and M20-05. The M20-03 and MR-9 sites are located upstream of all current and proposed Project activities as control sites. M20-05 is located just downstream of a large sediment source (slope failure) on M20 Creek in order to rule out contributions from a natural occurring sediment source to any impacts observed at site M20-04. M20-04 is located downstream of the mine footprint. MR-4 is located approximately 250 m downstream of the confluence of M20 Creek on the Murray River to assess possible effects of mine construction on the Murray River. There was not a suitable depositional zone present at or near Site MR-7 based on field assessments conducted on August 25 and 26, 2011.

Physical Properties

The sediment samples showed that sand was the dominate particle size category at all five sites. The average particle composition of sand among all sites was 68% (SD=17). MR-4 was primarily dominated by sand with 84%, whereas M20-05 showed the lowest average sand content at 40% (SD=9) (Table 5). The average particle composition of silt among all sites was 16% (SD=6). The upstream site MR-9 had the highest silt content at 26%. Among all sites, average particle composition of clay was 11% (SD=13). Just below the natural sediment source, M20-05 had the highest composition of clay at 34% (SD=8), compared to a range of 3 to 6 % clay at the other sites. Gravel was present in the least amount overall with average composition of 5% (SD=4) among all sites. M20-04 had the highest amount of gravel at 12%, which is substantially higher than the other four sites that had an average of 4%.

The pH was fairly consistent over all five sites with an average of 8.51 (SD=0.24). Moisture content ranged between 22% at MR-4 and 45% at M20-04.

Table 5. Physical properties for sediment sampling conducted in August 2011.

Physical Properties	Units	Average Site Composition	MR-9	MR-4	M20-03	M20-04	M20-05
Sand Content	%	68	68	84	77	74	40
Silt Content	%	16	26	12	15	11	17
Clay Content	%	11	6	3	6	4	34
Gravel Content	%	5	<2	2	4	12	6
Moisture	%	33	31	22	37	45	31
Soluble (4: 1) pH	pH Units	8.51	8.52	8.60	8.13	8.79	8.55

Metals

Thirty-two parameters were analyzed for total concentration using Inductively Coupled Plasma Mass Spectroscopy (ICPMS). Table 6 summarizes the parameters that have BC or CCME water quality guidelines; the complete data set is provided in Appendix A. Arsenic concentrations from MR-9,

MR-4, M20-03 and M20-04 all were below the B.C. and CCME ISQG guideline value of 5.9 mg/kg. M20-05 exceeded the arsenic guidelines with an average concentration of 7.22 mg/kg (Table 6). Cadmium concentrations exceeded the CCME and provincial guidelines of 0.6 mg/kg at all five sites. The concentration ranged from 0.63mg/kg at M20-04 to 1.20mg/kg at M20-05 (Table 6). All other metal parameters were within the federal and provincial guidelines at that site. There were consistently higher metal concentrations at M20-05 in comparison to the other four sample sites.

Table 6. Total metal concentrations for sediment sampling conducted in August 2011.

Metal Concentration (mg/kg)	MR-9	MR-4	M20-03*	M20-04	M20-05*	BC Guideline	CCME ISQG
Arsenic	5.3	4.9	5.4	5.1	7.2	5.9	5.9
Cadmium	0.8	0.8	0.8	0.6	1.2	0.6	0.6
Chromium	13	11	10	10	22	37.3	37.3
Copper	15.6	14.8	15.6	12.7	28.2	35.7	35.7
Iron	15600	14600	14950	13900	23683	21200	-
Lead	8.8	8.3	8.5	7.6	12.8	35	35
Manganese	304	253	318	244	425	460 SLC	-
Mercury	<0.05	<0.05	0.06	<0.05	0.07	0.17	0.17
Nickel	22.6	21.2	22.1	19.1	39.9	16-75 SLC	-
Selenium	1.1	1.1	1.1	0.6	1.2	2	-
Silver	0.11	0.13	0.18	0.13	0.22	0.5	-
Zinc	78	73	83	69	116	123	123

Notes: Guideline values from CCME and Working Water Quality Guidelines for BC. Values in orange exceeded guideline.
SLC: Screening Level Concentration

Semi-volatile Organics

Naphthalene concentration exceeded the CCME ISQG of 0.0346 mg/kg with a concentration of 0.76 mg/kg (SD=0.012) at M20-05. All sites downstream of M20-05 were 0.03 mg/kg. The concentration of 2-Methylnaphthalene exceeded the ISQG of 0.0202 mg/kg at all 5 sites, with concentrations ranging from 0.05 mg/kg at MR-9 to 0.33 mg/kg (SD=0.052) at M20-05. Acenaphthylene concentrations at all sites were all below the detection limit of <0.005 mg/kg. Due to a change in the sampling procedure at the laboratory, the detection limit for M20-05 rose to <0.01 mg/kg which is greater than the CCME guideline for Acenaphthylene. Phenanthrene levels exceeded the CCME guideline of 0.0419 mg/kg at MR-4, M20-03, M20-04 and M20-05;

concentrations ranged from 0.10 mg/kg at MR-4 to 0.345 mg/kg at M20-05. All other semi-volatile organics were below the CCME ISQG.

Table 7. Semi-volatile organics for sediment sampling conducted in August 2011.

Concentration (mg/kg)	MR-9	MR-4	M20-03	M20-04	M20-05	CCME ISQG
Naphthalene	0.03	0.03	0.15	0.03	0.76	0.0346
2-Methylnaphthalene	0.05	0.10	0.265	0.15	0.33	0.0202
Acenaphthylene	<0.005	<0.005	<0.005	<0.005	<0.01*	0.00587
Acenaphthene	<0.005	<0.005	<0.005	<0.005	<0.005	0.00671
Phenanthrene	0.007	0.10	0.15	0.13	0.345	0.0419
Fluoranthene	<0.02	<0.02	<0.02	<0.02	0.033	0.111
Pyrene	<0.02	<0.02	<0.02	<0.02	0.053	0.053
Benzo(a)anthracene	<0.02	<0.02	<0.02	<0.02	<0.02	0.0317
Benzo(a)pyrene	<0.02	<0.02	<0.02	<0.02	<0.02	0.0319
Dibenz(a,h)anthracene	<0.005	<0.005	<0.005	<0.005	<0.005	0.00622

Note: Guideline values from CCME. Values in orange exceeded guideline.

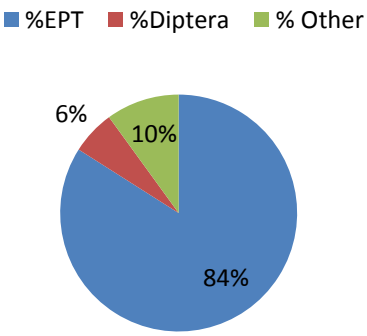
M20-05 consistently had elevated metals and semivolatile organics concentrations. Clay concentrations were highest at M20-05. Dissolved metals may be more readily absorbed in clay, resulting in higher metals and semi-volatile organics in comparison to other sites with a less clay. High concentrations could be linked to the existing, natural bank failures upstream of the site. A rock fracture or seep from bedrock could result in the higher metal concentration and semi-volatile organics.

Cadmium levels exceeded guidelines at all sites. Phenanthrene levels also exceeded CCME guidelines in M20 Creek and any site downstream of confluence into the Murray River.

3.3 BENTHIC INVERTEBRATES

Benthic invertebrate data are summarized into various metrics used to show community composition, pollution indicators and taxa diversity. The results are presented in numerical order of the site names.

Site MR-4

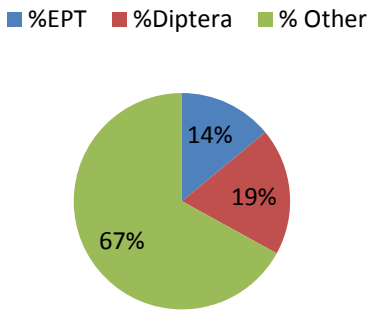


MR-4 is approximately 250 m downstream of the M20 Creek confluence. The mean invertebrate abundance was 210 individuals (SD=62), which was the highest number for the Murray River sites (Table 9). The mean taxa richness was 18 (SD=2) diffent taxa with 10 (SD=2) of these being from the Ephemeroptera, Plecoptera, and Trichoptera (EPT) group (Table 11). The sample community was dominated by EPT organisms which made up 84% abundance on

average at this site. Diptera only composed of 6% of the community (Diagram on right). The other taxa captured the remaining 10%. The Hisenhoff Biotic Index was 2.73 (SD=0.421) which indicates excellent water quality with no apparent organic pollution (Table 11; Appendix E).

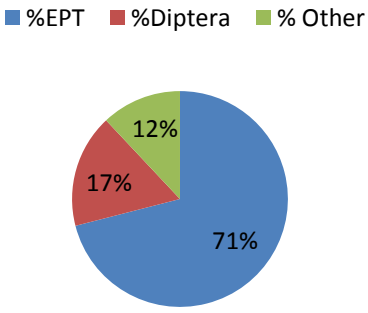
Site MR-7

MR-7 is the far field site downstream of the M20 Creek confluence. The mean benthic invertebrate abundance was 63 individuals (SD=27), the lowest count among all six Murray River sample sites (Table 9). The mean taxa richness was 13 (SD=4) diffent taxa with 4 (SD=3) of these being from the EPT group (Table 11). The sample community was dominated by other taxa such as coleoptera, annelida, and acari, which made up an average of 67% of abundance, with diptera composing 19% (Diagram to the left). The EPT taxa comprised the remaining with 14% of the community composition. The Hilsenhoff Biotic Index was 6.57 (SD=0.524), which indicates fairly poor water quality with substantial organic pollution (Table 11; Appendix E).



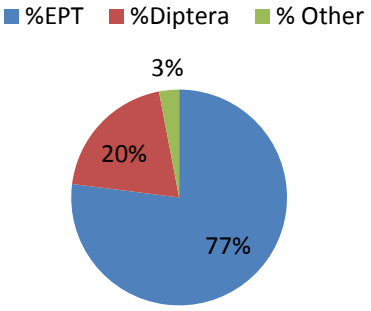
Site MR-9

MR-9 is the upstream control site on the Murray River. The mean benthic invertebrate abundance was 190 individuals (SD=71), the second lowest count for the Murray River monitoring sites (Table 9). The mean taxa richness was 16 (SD=0) diffent taxa with 9.8 (SD=0.5) of these being from the EPT group (Table 11). The sample community was dominated by EPT species which made up a average proportion of 71%, with diptera composing of 17% (diagram on right). With all other taxa making up the rest with 12%. The Hisenhoff Biotic Index was 2.35 (SD=0.527) which indicates excellent water quality with no apparent organic pollution (Table 11; Appendix E).



Site M20-03

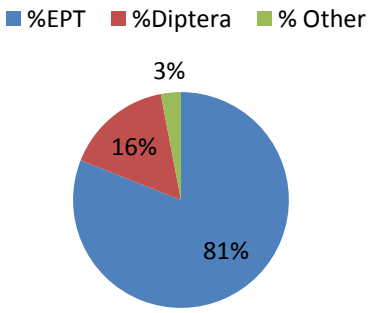
M20-03 is the upstream control site on M20 Creek. The mean benthic invertebrate abundance were 5271 individuals (SD=5104), which is the highest count for the entire Murray River monitoring sites (Table 9). The mean taxa richness was 19 (SD=1.7) diffent taxa with 12 (SD=1.7) of these being from the EPT group (Table 11). The sample community was dominated by EPT species which made up an average proportion of 77%, and diptera composed 20% (diagram on left). All other taxa made up the remaining 3% of invertebrate abundance. The Hisenhoff Biotic Index was 2.5 (SD=0.22) which indicates excellent water quality with no apparent organic pollution (Table 11;



Appendix E). This was the lowest Hisenhoff value over all six sites. And also the greatest density and taxa richness.

Site M20-04

M20-04 is the downstream site on M20 Creek. The mean benthic invertebrate abundance was 795 individuals (SD=789, Table 9), which is the lowest count for the entire M20 Creek sites. The mean taxa richness was 11 (SD=2.65) diffent taxa with 11 (SD=0.57) of these being from the EPT group (Table 11). The sample community was dominated by EPT species which made up an average proportion of 81%, with diptera only composing of 16% (diagram on right). All other taxa comprised the remaining 3% of the average community composition. The Hisenhoff Biotic Index was 3.07 (SD=0.31) which indicates excellent water quality with no apparent organic pollution (Table 11, Appendix E).



Site M20-05

M20-05 is downstream of a natural sediment source on M20 Creek. The mean benthic invertebrate abundance were 1905 individuals (SD=856, Table 9), which the secound highest count among all aquatic monitoring sites. The mean taxa richness was 16 (SD=0.57) different taxa with 11 (SD=0.57) of these being from the EPT group (Table 11). The sample community was dominated by EPT species which made up 93% of the community on average, and diptera composed 6% of the community abundance (diagram on left). The remaining 1% was comprised of other taxa. The Hisenhoff Biotic Index was 3.36 (SD=0.16) which indicates excellent water quality with no apparent organic pollution (Table 11; Appendix E).

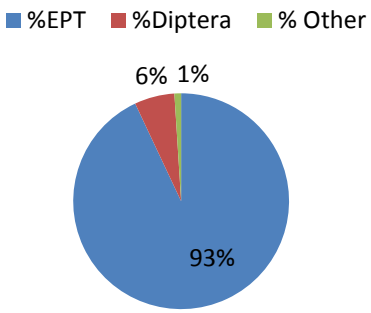


Table 8. Summary of benthic invertebrate metrics conducted in August 2011. Mean statistic is shown for each site with standard deviation in parentheses.

Metric	MR-4	MR-7	MR-9	M20-03	M20-04	M20-05
Total Density	210.3 (62.0)	62.6 (27.3)	189.8 (70.9)	5270.9 (5103.5)	794.8 (788.9)	1905.4 (885.9)
Species Richness	18 (2)	13 (4.4)	16 (0)	19 (1.7)	18 (2.6)	16 (0.6)
EPT Richness	10.3 (1.5)	4.0 (2.7)	9.7 (0.5)	12.0 (1.7)	11.0 (2.7)	11.3 (0.6)
Hilsenhoff Biotic Index	2.73 (0.42)	6.57 (0.52)	2.35 (0.53)	2.50 (0.22)	3.07 (0.31)	3.36 (0.16)
% Ephemeroptera	58.6 (9.5)	5.6 (3.3)	23.2 (4.6)	52.4 (20.2)	31.5 (14.8)	69.6 (4.8)
% Plecoptera	24.3 (4.3)	7.7 (4.5)	47.0 (20.4)	17.1 (9.7)	47.3 (14.0)	18.9 (6.9)
% Trichoptera	0.84 (0.7)	0.4 (0.6)	0.7 (0.5)	7.0 (6.1)	1.7 (0.8)	4.9 (1.5)
% Diptera	5.6 (1.0)	18.8 (5.4)	17.0 (6.7)	20.0 (9.1)	16.4 (4.3)	5.8 (0.8)

General observations are provided below to summarize the benthic invertebrate results.

- Total benthic invertebrate density showed considerable variability within sites, as evidenced by high standard deviations compared to site means. Taxa richness values had somewhat less variability within sites based on relatively lower standard deviations compared to site means.
- Many variables have the potential to affect benthic invertebrate communities, including environmental and habitat variables such as water levels, predator populations, erosion, and primary productivity as well as chemical variables such as water quality (Rosenberg and Resh 1993).
- The Hisenhoff Biotic Index indicated an excellent water quality with no apparent organic polution at five of the six sites (Table 11, Appendix E). MR-7, the most downstream site in the overall watershed, had a high index number in comparison to the other sites.

3.4 PERIPHYTON

In total, 22 live and soft diatoms taxa were identified among the six sample sites (Appendix B). M20-03, the sampling site at the upper reach of M20 Creek, had the highest mean species richness and total number of taxa, with a mean of 11 (SD=3) taxa per sample and a total count of 17 different taxa for the site (Table 9). In relation of densities, M20-03 had the highest mean density of periphyton, followed by M20-04 at the lower reach on M20 creek (Table 10). The least diverse

community was found to be MR-7, where only 4 taxa on average (SD=2) were found in each sample, and a total count of five different taxa were identified. The biomass calculation based on the mean chlorophyll a analysis showed that MR-7 had the highest concentration with 4.95ug/cm² (SD=1.73) and that M20-04 had the lowest value at 0.123ug/cm² (SD=0.08, Table 11).

Table 9. Periphyton species richness and total number of taxa in replicates for Murray River Aquatic Monitoring Sites 2011.

Site	Richness				Total # of Taxa in Replicates
	Min	Max	Mean	SD	
MR-4	2	6	4	2	6
MR-7	0	4	2	2	5
MR-9	3	5	4	1	5
M20-03	7	15	11	3	17
M20-04	11	11	11	0	11
M20-05	4	7	5.7	1.5	7

Table 10. Periphyton density for Murray River Aquatic Monitoring Sites 2011.

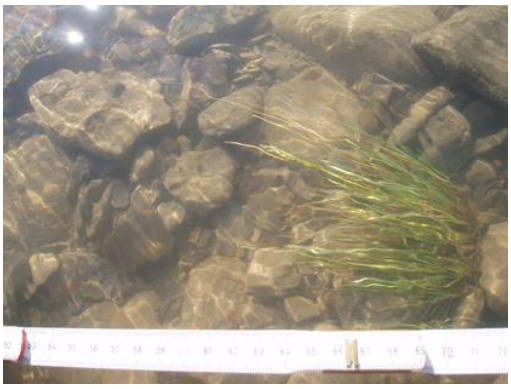
Site	Density (Cells / cm^2)			
	Min	Max	Mean	SD
MR-4	28,592	238,589	116,586	109,051
MR-7	0	82,873	28,638	41,719
MR-9	19,900	155,473	85,524	67,889
M20-03	2,699,387	44,788,732	19,670,885	17,029,855
M20-04	2,131,728	14,000,000	6,506,811	6,519,656
M20-05	16,410	2,459,807	862,462	1,384,152

Table 11. Chlorophyll a analysis for all 2011 Murray River Aquatic Monitoring Sites

Site	Chlorophyll a (µg/cm^2)			
	Min	Max	Mean	SD
MR-4	0.15	4.9	2.16	1.81
MR-7	2.1	6.5	4.95	1.73
MR-9[1]	0.03	0.69	0.31	0.25
M20-03	1.9	4.8	3.76	1.18
M20-04	0.04	0.24	0.12	0.08
[4]M20-05	0.1	0.63	0.36	0.16

[4] Replicate in sample was below lab detection limits so assumption value was made of 0.03

MR-4 Murray River, Downstream of M20 Creek



Site MR-4 had the fouth highest mean density of all the sites within the monitoring program with a density of 116,586 cells/cm² (SD= 109,051) (Table 10). There was also an average species richness of 4 species per replicate (SD=2) , with a total taxa number of 6 overall (Table 9). The species abundance varied between replicates but on average a *Gomphonema sp.* was most dominatet followed by a unknown centric diatom (Appendix B). The site had the third highest biomass value of 2.16 µg/cm² (SD=1.81) chlorophyll a (Table 11).

MR-7 Murray River, Far Field Sample Site

The average periphyton density at MR-7 site was 28,638 cells/cm² (SD=41,719) (Table 10). The mean species richness of the site was 2.3 taxa per sample (SD=2), and the total taxa count for the site was 5 (Table 9). There were three species that primarily made up the taxa density: *Achnanthes sp., Gomphonema sp.*, and an unknown pennate diatom (Appendix B). The mean chlorophyll a concentration was 4.95 µg/cm² (SD=1.73), which was the highest concentration for the study area. This is fairly unusual due to the low densities and taxa richness. This could be explained by a possible environmental benefit at this site such as sun exposure, sediment type, water temperature and water velocity.

MR-9 Murray River, Upstream Control Site

The average periphyton density at MR-9 site was 85,524 cells/cm² (SD=67,889) (Table 10). The mean species richness of the site was 4 taxa per sample (SD=1), and the total taxa count for the site was 5 (Table 9). There were two species that primarily made up the taxa density: *Achnanthes sp. and Gomphonema sp.* (Appendix B). MR-9 chlorophyll a concentrations were the lowest of six sites with a mean value of 0.31 µg/cm² (SD=0.25). This value could be attributed to the deeper water depths observed at the site (Photo 2).

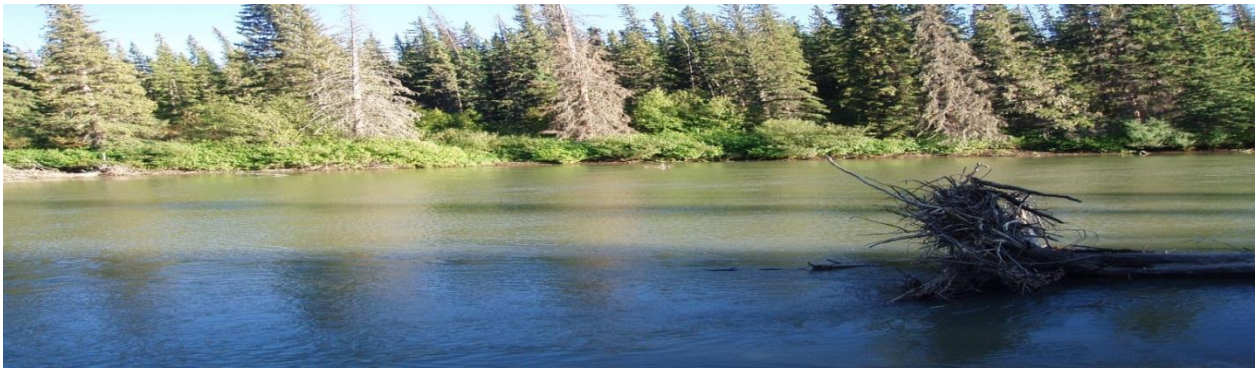


Photo 2. MR-9 sample site picture shows depth and river turbidity in contexts to light penetration.

M20-03, Upstream Control Site

The average periphyton density at M20-03 site was 19,670,885 cells/cm² (SD=17,029,855) (Table 10). The mean species richness of the site was 10.83 taxa per sample (SD=3), and the total taxa count for the site was 17 (Table 9). The three dominate species were *Achnanthes sp., Diatoma sp.,* and *Gomphonema sp.* (Appendix B). This site had the highest density and taxa richness of all monitoring sites during sampling it was noted that certain areas in the sampling zone had a dense filamentous, green algae community (see photo to left). This may have led to the higher density and richness values in comparison to the other sample site. M20-03 mean chlorophyll a concentration was 3.76 µg/cm² (SD=1.18). This was the second highest biomass value from sampling which could be attributed to site attributes. The site had excellent exposure to afternoon sun, shallow water depths and large substrate for attachment.

M20-04, Downstream of Mine Footprint

The average periphyton density at M20-04 site was 116,586 cells/cm² (SD=109,051) (Table 10). The mean species richness of the site was 11 taxa per sample (SD=0), and the total taxa count for the site was 11 (Table 9). The two dominate species were *Diatoma sp.,* and *Gomphonema sp.* (Appendix B). M20-04 mean chlorophyll a concentration was 2.16 µg/cm² (SD=1.81). This was the second highest level on M20 Creek.

M20-05, Downstream of Natural Sediment Source

The average periphyton density at M20-05 site was 862,462 cells/cm² (SD=1,384,152) (Table 9). The mean species richness of the site was 5.67 taxa per sample (SD=1.53), and the total taxa count for the site was 7 (Table 8). The three dominate species were *Diatoma sp., Gomphonema sp.* and *Encyonema sp.* (Appendix B). The chlorophyll a value was relatively low in comparison to the upstream and downstream sites with a mean of 0.36 µg/cm² (SD=0.16). Habitat type was very similar to the other sites on M20 Creek; the lower biomass value could be influenced by the large amount of sediment entering the creek upstream. This would decrease the amount of sunlight entering the water column, and sedimentation on the substrate would cover and minimize periphyton growth.

In summary, some general observations are provided based on the results detailed above:

- Many variables have the potential to affect periphyton communities, including percentage of shade, water clarity, water velocity, and water quality (Azim *et al.* 2005).
- M20 Creek sites had the highest densities of periphyton; sites MR-7 and MR-9 had the lowest densities.
- The number of taxa (richness) was also higher in M20 Creek in comparison to the Murray River sites.
- Periphyton data showed considerable variability among sample replicates, demonstrated by high standard deviations compared to site means. This indicates there is a high amount of within-site variability which has implications on the number of samples needed to effectively carry out a monitoring program.
- Additional replicate samples at each site may be warranted to increase the sample size of periphyton density and community composition estimates.

4 RECOMMENDATIONS

A power analysis was performed using 2011 data, a desired power of 0.8, and effect sizes that are considered large ranging from 0.7 to 0.9. Based on this analysis it was estimated that between four and five samples are required in the pre-impact, baseline sampling period in order to detect an effect in the post-impact period using ANOVA as the statistical test. Our recommendations differ for each component.

Invertebrates

- Do not conduct additional sampling for abundance and community composition. Sampling is sufficient to compare with CABIN reference sites that are in progress.
- Do additional sampling for tissue metals analysis. Tissue sampling was completed in 2011 but data is not presented in this summary.

Periphyton

- If it is a requirement to assess periphyton and detect impacts on periphyton if they occur as a result of this Project, then it is necessary to conduct additional sampling. It is recommended to sample multiple locations upstream and downstream of the Project's area of maximum disturbance, and to restrict this additional sampling to the Murray River.
- It is recommended to conduct sampling for periphyton biomass and community composition but not for tissue sampling. It is not practical to gain sufficient periphyton tissue due to low amounts of periphyton in this watershed.

Sediment

- Similar to periphyton sampling, it is recommended to conduct additional sediment sampling on the Murray River. Our recommendation is to sample four depositional sites each upstream and downstream of the Project.

The rationale for the periphyton and sediment recommendations is that multiple sites can be sampled efficiently on the Murray River with the use of a boat, and it will be most effective if sampling was focused on one upstream/downstream pairing on one watercourse. The overall goal is to achieve sufficient statistical power to definitively determine the presence or absence of a potential impact when this program moves into a monitoring stage.

5 REFERENCES

5.1 LITERATURE CITED

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5.2 SPATIAL DATA

1:50,000 CanVec topographic data from Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Geogratis website (http://geogratis.cgdi.gc.ca).

1:20,000 TRIM positional files from the Land and Resource Data Warehouse (http://lrdw.ca). Copyright belongs to Her Majesty the Queen in Right of the Province of British Columbia.

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APPENDIX A SEDIMENT DATA

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Sample ID				MR-9	MR-4	M20-03 1A	M20-03 1B	M20-04	M20-05 1A	M20-05 1B	M20-05-2	M20-05-3	M20-05-4	M20-05-5
Date Sampled				25/08/2011	25/08/2011	26/08/2011	26/08/2011	25/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011
Maxxam Sample ID				BJ9412	BJ9413	BJ9414	BJ9415	BJ9416	BJ9417	BJ9418	BJ9419	BJ9420	BJ9421	BJ9422
Matrix				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
	Units	Quality Guidelines for BC	CCME Sediment Quality Guidelines											
Total Metals by ICPMS														
Total Aluminum (Al)	mg/kg			6880	5650	5620	5990	4650	12600	12600	11900	13100	14100	12400
Total Antimony (Sb)	mg/kg			0.5	0.5	0.5	0.5	0.5	0.6	0.8	0.8	0.9	0.8	0.8
Total Arsenic (As)	mg/kg	5.9	5.9	5.3	4.9	5.3	5.4	5.1	7.6	7.0	7.2	7.6	7.3	6.6
Total Barium (Ba)	mg/kg			154	241	355	368	443	405	393	391	377	392	422
Total Beryllium (Be)	mg/kg			0.4	<0.4	0.5	0.5	<0.4	1.0	0.9	0.8	0.8	0.7	0.8
Total Bismuth (Bi)	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1
Total Cadmium (Cd)	mg/kg	0.6	0.6	0.76	0.76	0.82	0.83	0.63	1.20	1.23	1.15	1.20	1.19	1.20
Total Calcium (Ca)	mg/kg			54400	44100	6940	6770	41700	62700	60300	60200	64600	67700	63400
Total Chromium (Cr)	mg/kg	37.3	37.3	13	11	10	11	10	21	22	21	22	24	22
Total Cobalt (Co)	mg/kg			6.5	5.8	5.6	5.6	5.6	10.8	10.5	10.5	10.9	11.4	10.7
Total Copper (Cu)	mg/kg	35.7	35.7	15.6	14.8	15.1	16.1	12.7	28.6	28.2	27.1	28.8	29.1	27.7
Total Iron (Fe)	mg/kg	21,200		15600	14600	15000	14900	13900	23800	23000	23200	23800	24900	23400
Total Lead (Pb)	mg/kg	35	35	8.8	8.3	8.5	8.5	7.6	12.6	13.0	12.1	13.1	13.0	12.7
Total Lithium (Li)	mg/kg			12	10	8	8	7	18	19	17	18	21	18
Total Magnesium (Mg)	mg/kg			21300	17800	3250	3270	14500	18300	18400	18300	19300	19000	18800
Total Manganese (Mn)	mg/kg	460 SLC		304	253	320	315	244	419	409	422	431	443	427
Total Mercury (Hg)	mg/kg	0.17	0.17	<0.05	<0.05	0.05	0.07	<0.05	0.06	0.07	0.08	0.07	0.07	0.08
Total Molybdenum (Mo)	mg/kg			1.4	1.2	1.1	1.1	0.9	1.9	2.0	1.9	2.1	2.1	1.9
Total Nickel (Ni)	mg/kg	16-75 SLC**		22.6	21.2	21.8	22.4	19.1	40.1	39.7	38.5	40.6	41.2	39.4
Total Phosphorus (P)	mg/kg			1080	980	808	804	888	959	956	977	1000	986	994
Total Potassium (K)	mg/kg			1110	848	773	833	734	2400	2410	2300	2450	2800	2340
Total Selenium (Se)	mg/kg	2		1.1	1.1	1.0	1.2	0.6	1.2	0.9	1.1	1.5	1.3	1.3
Total Silver (Ag)	mg/kg	0.5		0.11	0.13	0.17	0.19	0.13	0.21	0.23	0.22	0.23	0.23	0.23
Total Sodium (Na)	mg/kg			<100	<100	<100	<100	<100	114	119	109	115	120	114
Total Strontium (Sr)	mg/kg			61.7	53.6	28.5	29.1	59.0	89.6	87.3	85.6	90.5	92.8	90.0
Total Thallium (Tl)	mg/kg			0.19	0.17	0.12	0.11	0.10	0.18	0.19	0.18	0.19	0.17	0.17
Total Tin (Sn)	mg/kg			0.5	0.4	0.3	0.5	0.4	0.3	0.4	0.4	0.4	0.4	0.4
Total Titanium (Ti)	mg/kg			13	8	4	11	41	12	16	22	38	34	20
Total Uranium (U)	mg/kg			0.89	0.82	0.64	0.68	0.72	1.02	1.04	0.99	1.08	1.07	1.10
Total Vanadium (V)	mg/kg			32	25	22	23	21	47	48	47	50	53	47
Total Zinc (Zn)	mg/kg	123	123	78	73	82	84	69	117	116	114	118	117	115
Total Zirconium (Zr)	mg/kg			0.7	0.6	<0.5	<0.5	1.4	2.9	3.1	3.3	3.6	3.2	3.3

ISQC- Interm sediment Quality Guidelines

SLC- Screening Level Concentration

** 16 lowestlevel based on SLC, 75 severe effect based on SLC

SEMIVOLATILE ORGANICS BY GC-MS (SEDIMENT)

Sample ID				MR-9	MR-4	M20-03 1A	M20-03 1B	M20-04	M20-05 1A	M20-05 1B	M20-05-2	M20-05-3	M20-05-4	M20-05-5	Duplicate	Duplicate
Date Sampled				25/08/2011	25/08/2011	26/08/2011	26/08/2011	25/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011	26/08/2011	Relative	Relative
Maxxam Sample ID				BJ9412	BJ9413	BJ9414	BJ9415	BJ9416	BJ9417	BJ9418	BJ9419	BJ9420	BJ9421	BJ9422	Percent	Percent
Matrix				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Difference	Difference
	Units	Quality Guidelines for BC	CCME Sediment Guidelines												M20-03	M20-05
Polycyclic Aromatics																
Naphthalene	mg/kg		**0.0346**	0.03	0.03	0.17	0.13	0.03	0.07	0.07	0.10	0.07	0.07	0.08	26.66667	0
2-Methylnaphthalene	mg/kg		**0.0202**	0.05	0.10	0.29	0.24	0.15	0.29	0.31	0.43	0.34	0.31	0.30	18.86792	6.666667
Acenaphthylene	mg/kg		**0.00587**	<0.005	<0.005	<0.007 (1)	<0.005	<0.005	<0.01 (1)	<0.01 (1)	<0.02 (1)	<0.01 (1)	<0.01 (1)	<0.01 (1)		
Acenaphthene	mg/kg		**0.00671**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Fluorene	mg/kg			<0.02	<0.02	<0.02	<0.02	<0.02	0.07	0.07	0.08	0.07	0.07	0.06		0
Phenanthrene	mg/kg		**0.0419**	0.07	0.10	0.18	0.12	0.13	0.33	0.34	0.39	0.36	0.34	0.31	40	2.985075
Anthracene	mg/kg			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004		
Fluoranthene	mg/kg		**0.111**	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.03	0.04	0.04	0.03	0.03		0
Pyrene	mg/kg		**0.053**	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.05	0.06	0.06	0.05	0.05		0
Benzo(a)anthracene	mg/kg		**0.0317**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Chrysene	mg/kg			0.03	0.05	0.05	0.04	0.06	0.13	0.14	0.15	0.15	0.14	0.12	22.22222	7.407407
Benzo(b&j)fluoranthene	mg/kg			<0.02	0.02	<0.02	<0.02	0.02	0.06	0.06	0.07	0.07	0.06	0.05		0
Benzo(k)fluoranthene	mg/kg			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Benzo(a)pyrene	mg/kg		**0.0319**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Indeno(1,2,3-cd)pyrene	mg/kg			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Dibenz(a,h)anthracene	mg/kg		**0.00622**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Benzo(g,h,i)perylene	mg/kg			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Low Molecular Weight PAH`s	mg/kg			0.15	0.23	0.64	0.50	0.31	0.75	0.78	1.0	0.84	0.78	0.74	24.5614	3.921569
High Molecular Weight PAH`s	mg/kg			<0.05	0.05	0.05	<0.05	0.06	0.21	0.22	0.25	0.25	0.22	0.20		4.651163
Total PAH	mg/kg			0.18	0.29	0.69	0.53	0.36	0.96	1.0	1.3	1.1	1.0	0.94	26.22951	4.081633
Surrogate Recovery																
D10-ANTHRACENE (sur.)	%			90	95	88	90	95	78	84	85	83	75	80		
D8-ACENAPHTHYLENE (sur.)	%			89	96	90	90	95	80	85	91	83	80	84		
D8-NAPHTHALENE (sur.)	%			97	93	102	88	95	94	94	97	93	92	95		
TERPHENYL-D14 (sur.)	%			97	101	96	97	103	85	87	98	95	83	90		

Sediment Physical Properties

Physical Properties	Units	MR-9	MR-4	M20-03 1A	M20-03 1B	M20-04	M20-05 1A	M20-05 1B	M20-05-2	M20-05-3	M20-05-4	M20-05-5	RDL
% sand by hydrometer	%	68	84	79	74	74	36	24	44	46	40	49	2
% silt by hydrometer	%	26	12	14	16	11	18	22	18	14	14	13	2
Clay Content	%	6	3	6	6	4	43	51	37	29	40	32	2
Gravel	%	<2	2	<2	4	12	4	3	<2	12	6	6	2
Moisture	%	31	22	37	36	45	30	31	35	27	32	30	0.3

Physical Properties	Units	MR-9	MR-4	M20-03 1A	M20-03 1B	M20-04	M20-05 1A	M20-05 1B	M20-05-2	M20-05-3	M20-05-4	M20-05-5
Soluble (4: 1) pH	pH Units	8.52	8.6	8.22	8.03	8.79	8.46	8.53	8.54	8.59	8.6	8.59

APPENDIX B PERIPHYTON DATA

EDI Murray River Periphyton 2011

***Counts are in Natural Units and not corrected for subsampling**

	Water Body	**Murray River**	**Murray River**	**Murray River**	**Murray River**	**Murray River**	**Murray River**	**Murray River**	**Murray River**
	Site	**MR-4**	**MR-4**	**MR-4**	**MR-7**	**MR-7**	**MR-7**	**MR-9**	**MR-9**
	Rep	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**
	Date	**08-25-2011**	**08-25-2011**	**08-25-2011**	**08-24-2011**	**08-24-2011**	**08-24-2011**	**08-25-2011**	**08-25-2011**
	Device	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**
	Volume Received (mL)	**52**	**89**	**75**	**118**	**98**	**104**	**87**	**47**
	Percent Counted	**0.01211%**	**0.01928%**	**0.01399%**	**0.01086%**	**0.00643%**	**0.00908%**	**0.02010%**	**0.01608%**
	EcoAnalysts Sample ID	**5906.2-1**	**5906.2-2**	**5906.2-3**	**5906.2-4**	**5906.2-5**	**5906.2-6**	**5906.2-7**	**5906.2-8**
E DIATOM TAXA	Achnanthes sp.	2	6	0	1	0	1	1	15
	Caloneis sp.	0	0	0	0	0	0	0	0
	Cocconeis sp.	0	0	0	0	0	0	0	0
	Cymbella sp.	0	0	0	0	0	1	0	0
	Diatoma sp.	0	0	0	0	0	0	0	0
	Didymosphenia geminata	0	0	0	0	0	0	0	0
	Encyonema sp.	0	0	0	0	0	0	0	0
	Fragilaria sp.	0	0	0	0	0	0	0	0
	Gomphonema sp.	2	26	1	1	0	1	2	6
	Hannaea sp.	0	0	0	0	0	0	0	0
	Meridion sp.	0	0	0	0	0	0	0	0
	Navicula sp.	0	0	0	0	0	0	0	0
	Nitzschia sp.	0	0	0	0	0	0	0	0
	Reimeria sp.	0	0	0	0	0	0	0	1
	Rhopalodia sp.	0	0	0	0	0	0	0	0
	Surirella sp.	0	0	0	0	0	0	0	0
	Synedra sp.	0	0	0	0	0	0	0	1
	Tabellaria sp.	0	2	0	0	0	0	0	0
	unknown Centric diatom	5	7	0	0	0	0	0	0
	unknown Pennate diatom	1	2	3	2	0	0	1	2
LIVE	**DIATOM TAXA SUB TOTAL**	**10**	**43**	**4**	**4**	**0**	**3**	**4**	**25**
)FT BODY TAXA	Euglena sp.	0	0	0	5	0	0	0	0
	Phormidium sp.	0	3	0	0	0	0	0	0
SOF	**T BODY TAXA SUB TOTAL**	**0**	**3**	**0**	**5**	**0**	**0**	**0**	**0**
	GRAND TOTAL	**10**	**46**	**4**	**9**	**0**	**3**	**4**	**25**

EDI Murray River Periphyton 2011

***Counts are in Natural Units and not corrected for subsampling**

	Water Body	Murray River	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek
	Site	MR-9	M20-03 Sub	M20-03 Sub	M20-03 Sub	M20-03 Dom	M20-03 Dom	M20-03 Dom	M20-04
	Rep	3	1	2	3	1	2	3	1
	Date	08-25-2011	08-26-2011	08-26-2011	08-26-2011	08-26-2011	08-26-2011	08-26-2011	08-25-2011
	Device	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Volume Received (mL)	119	103	82	207	41	40	40	60
	Percent Counted	0.01601%	0.00642%	0.00284%	0.01141%	0.00169%	0.00071%	0.00087%	0.00903%
	EcoAnalysts Sample ID	5906.2-9	5906.2-10	5906.2-11	5906.2-12	5906.2-13	5906.2-14	5906.2-15	5906.2-16
E DIATOM TAXA	Achnanthes sp.	1	79	58	144	167	97	81	2
	Caloneis sp.	1	0	0	0	0	0	0	0
	Cocconeis sp.	0	0	2	0	1	0	0	0
	Cymbella sp.	0	6	17	6	8	3	8	2
	Diatoma sp.	0	196	95	87	61	167	149	205
	Didymosphenia geminata	0	0	0	1	4	1	1	0
	Encyonema sp.	0	0	0	14	28	13	15	6
	Fragilaria sp.	0	0	0	0	10	6	8	0
	Gomphonema sp.	10	14	121	41	7	7	11	64
	Hannaea sp.	0	0	0	1	0	1	0	0
	Meridion sp.	0	0	0	0	4	2	12	0
	Navicula sp.	0	8	13	9	33	10	14	1
	Nitzschia sp.	0	0	0	2	9	5	3	1
	Reimeria sp.	0	0	1	1	0	0	0	18
	Rhopalodia sp.	0	0	0	0	0	0	0	1
	Surirella sp.	0	0	0	0	0	1	0	0
	Synedra sp.	0	0	0	0	3	1	0	3
	Tabellaria sp.	0	0	0	0	0	0	0	0
	unknown Centric diatom	0	2	0	0	0	1	0	0
	unknown Pennate diatom	1	3	3	2	1	3	2	3
LIVE	**DIATOM TAXA SUB TOTAL**	**13**	**308**	**310**	**308**	**336**	**318**	**304**	**306**
FT BODY TAXA	Euglena sp.	0	0	0	0	0	0	0	0
	Phormidium sp.	0	0	0	0	0	0	0	0
SOFT	**BODY TAXA SUB TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	GRAND TOTAL	**13**	**308**	**310**	**308**	**336**	**318**	**304**	**306**

EDI Murray River Periphyton 2011

***Counts are in Natural Units and not corrected for subsampling**

	Water Body	**M20 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**
	Site	**M20-04**	**M20-04**	**M20-05**	**M20-05**	**M20-05**
	Rep	**2**	**3**	**1**	**2**	**3**
	Date	**08-25-2011**	**08-25-2011**	**08-26-2011**	**08-26-2011**	**08-26-2011**
	Device	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**
	Volume Received (mL)	**66**	**60**	**101**	**160**	**80**
	Percent Counted	**0.01412%**	**0.00220%**	**0.03047%**	**0.01889%**	**0.01244%**
	EcoAnalysts Sample ID	**5906.2-17**	**5906.2-18**	**5906.2-19**	**5906.2-20**	**5906.2-21**
E DIATOM TAXA	Achnanthes sp.	8	1	0	0	0
	Caloneis sp.	0	0	0	0	0
	Cocconeis sp.	0	0	0	0	0
	Cymbella sp.	3	2	1	2	9
	Diatoma sp.	125	256	1	1	212
	Didymosphenia geminata	0	0	0	0	0
	Encyonema sp.	8	1	0	2	21
	Fragilaria sp.	0	0	0	0	0
	Gomphonema sp.	84	26	2	9	42
	Hannaea sp.	0	0	0	0	0
	Meridion sp.	0	0	0	0	0
	Navicula sp.	5	1	0	6	11
	Nitzschia sp.	1	3	0	0	7
	Reimeria sp.	62	6	1	1	4
	Rhopalodia sp.	0	0	0	0	0
	Surirella sp.	0	0	0	0	0
	Synedra sp.	3	1	0	0	0
	Tabellaria sp.	0	0	0	0	0
	unknown Centric diatom	1	10	0	0	0
	unknown Pennate diatom	1	1	0	0	0
LIVE	**DIATOM TAXA SUB TOTAL**	**301**	**308**	**5**	**21**	**306**
)FT BODY TAXA	Euglena sp.	0	0	0	0	0
	Phormidium sp.	0	0	0	0	0
SOF	**T BODY TAXA SUB TOTAL**	**0**	**0**	**0**	**0**	**0**
	GRAND TOTAL	**301**	**308**	**5**	**21**	**306**

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Sample ID		M20-03 PERI DOM 1A	M20-03 PERI DOM 1B	M20-03 PERI SUB 2	MR4 PERI TISSUE	M20-04 PERI TISSUE	M20-05 PERI TISSUE	MR-9 PERI TISSUE	MR-7 PERI TISSUE	M20-05 PERI TISSUE "A"
Date Sampled		26/08/2011	26/08/2011	26/08/2011	25/08/2011	25/08/2011	26/08/2011	25/08/2011	24/08/2011	26/08/2011
Maxxam Sample ID		BJ9339	BJ9340	BJ9341	BJ9342	BJ9343	BJ9344	BJ9345	BJ9346	BJ9347
Matrix		Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
	Units									
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	2050	2320	2940	4830	3440	4780	5570	3150	5800
Total Antimony (Sb)	mg/kg	0.116	0.141	0.207	0.198	0.117	0.246	0.172	0.124	0.291
Total Arsenic (As)	mg/kg	3.08	2.88	4.66	6.60	3.99	5.14	5.84	4.11	5.59
Total Barium (Ba)	mg/kg	187	238	547	195	300	434	126	135	578
Total Beryllium (Be)	mg/kg	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.2	0.4
Total Bismuth (Bi)	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1	0.1	0.1	<0.1	0.1
Total Boron (B)	mg/kg	4	4	6	3	3	4	4	5	5
Total Cadmium (Cd)	mg/kg	0.59	0.71	0.93	0.79	0.46	0.95	0.64	0.79	1.24
Total Calcium (Ca)	mg/kg	4950	8130	19000	34800	16700	44800	64200	14700	55600
Total Chromium (Cr)	mg/kg	5.1	4.6	6.3	10.7	7.4	10.9	10.9	12.4	13.3
Total Cobalt (Co)	mg/kg	2.80	3.37	7.73	11.5	4.41	7.65	7.70	3.74	9.45
Total Copper (Cu)	mg/kg	8.18	8.15	11.7	15.2	10.7	14.4	13.0	11.1	17.6
Total Iron (Fe)	mg/kg	6890	8760	13500	14700	10800	16000	16100	8980	18500
Total Lead (Pb)	mg/kg	3.44	3.56	6.00	10.3	6.48	9.01	9.24	5.07	10.6
Total Magnesium (Mg)	mg/kg	1110	1460	2930	15800	5660	13600	18900	7010	16400
Total Manganese (Mn)	mg/kg	289	419	3060	1140	202	607	603	117	959
Total Mercury (Hg)	mg/kg	0.07	0.06	0.07	0.05	0.07	0.06	0.03	0.05	0.07
Total Molybdenum (Mo)	mg/kg	0.50	0.54	1.02	1.18	0.74	1.29	1.26	0.53	1.52
Total Nickel (Ni)	mg/kg	12.4	14.1	20.2	22.2	15.1	25.3	20.1	15.6	30.4
Total Phosphorus (P)	mg/kg	465	721	1200	1290	720	997	1060	1020	1150
Total Potassium (K)	mg/kg	524	613	651	817	978	998	807	722	1260
Total Selenium (Se)	mg/kg	2.02	2.04	1.94	0.73	0.75	1.26	0.38	0.73	1.58
Total Silver (Ag)	mg/kg	0.18	0.10	0.19	0.43	0.38	0.36	0.23	0.56	0.55
Total Sodium (Na)	mg/kg	61	125	144	67	68	121	73	36	474
Total Strontium (Sr)	mg/kg	24.1	32.6	56.0	62.9	34.7	72.7	104	20.9	100
Total Thallium (Tl)	mg/kg	0.082	0.070	0.083	0.165	0.138	0.163	0.186	0.087	0.208
Total Tin (Sn)	mg/kg	<0.1	0.1	0.2	0.3	0.2	0.3	0.2	0.1	0.3
Total Titanium (Ti)	mg/kg	4	4	12	43	6	50	58	6	66
Total Uranium (U)	mg/kg	0.473	0.387	0.486	0.770	0.467	0.699	0.761	0.389	0.832
Total Vanadium (V)	mg/kg	8.6	9.8	13.5	19.9	13.5	21.4	21.9	13.8	25.6
Total Zinc (Zn)	mg/kg	38.7	64.5	87.0	111	76.9	105	75.9	111	145

Periphyton Chlorophyll a

Sample ID	MR9-PERI-CHL 1	MR9-PERI-CHL 2	MR9-PERI-CHL 3	MR9-PERI-CHL 4	MR9-PERI-CHL 5	MR9-PERI-CHL 6	MR7-PERI-CHL 1	MR7-PERI-CHL 2	MR7-PERI-CHL 3
Date Sampled	25/08/2011	25/08/2011	25/08/2011	25/08/2011	25/08/2011	25/08/2011	24/08/2011	24/08/2011	27/08/2011
Maxxam Sample ID	BJ9168	BJ9169	BJ9170	BJ9171	BJ9172	BJ9173	BJ9174	BJ9175	BJ9176
Matrix	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Units									
Chlorophyll a ug/cm2	<0.03	0.18	0.11	0.69	0.44	0.13	5.1	6.2	3.7

Sample ID	MR7-PERI-CHL 4	MR7-PERI-CHL 5	MR7-PERI-CHL 6	M20-05-PERICHLOR 1	M20-05-PERICHLOR 2	M20-05-PERICHLOR 3	M20-05-PERICHLOR 4	M20-05-PERICHLOR 5	M20-05-PERICHLOR 6
Date Sampled	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011
Maxxam Sample ID	BJ9177	BJ9178	BJ9179	BJ9180	BJ9181	BJ9182	BJ9183	BJ9184	BJ9185
Matrix	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Units									
Chlorophyll a ug/cm2	6.5	6.1	2.1	0.38	0.36	0.63	0.10	0.31	0.38

Sample ID	M20-03-PERICHLOR 1(A)	M20-03-PERICHLOR 1(B)	M20-03-PERICHLOR 3	M20-03-PERICHLOR 4	M20-03-PERICHLOR 5	M20-03-PERICHLOR 6	MR4-PERI-CHL 1	MR4-PERI-CHL 2	MR4-PERI-CHL 3
Date Sampled	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011
Maxxam Sample ID	BJ9186	BJ9187	BJ9188	BJ9189	BJ9190	BJ9191	BJ9192	BJ9193	BJ9194
Matrix	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Units									
Chlorophyll a ug/cm2	3.5	4.8	4.7	3.0	4.7	1.9	0.15	0.52	2.7

Sample ID	MR4-PERI-CHL 4	MR4-PERI-CHL 5	MR4-PERI-CHL 6	M20-04-PERI-CHLOR 1	M20-04-PERI-CHLOR 2	M20-04-PERI-CHLOR 3	M20-04-PERI-CHLOR 4	M20-04-PERI-CHLOR 5	M20-04-PERI-CHLOR 6
Date Sampled	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011	27/08/2011
Maxxam Sample ID	BJ9195	BJ9196	BJ9197	BJ9198	BJ9199	BJ9200	BJ9201	BJ9202	BJ9203
Matrix	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Units									
Chlorophyll a ug/cm2	1.4	4.9	3.3	0.21	0.24	0.08	0.10	0.07	0.04

APPENDIX C BENTHIC DATA

EDI Murray River CABIN Benthos 2011

Data are NOT adjusted for subsampling

	Water Body	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	M20 Creek	M20 Creek	M20 Creek	M20 Creek
	Site ID	MR-4	MR-4	MR-4	MR-7	MR-7	MR-7	MR-9	MR-9	MR-9	MR-9	M20-03	M20-03	M20-03	M20-04
	Rep	1	2	3	1	2	3	1	2	3	4	1	2	3	1
	Collection Date	08-25-2011	08-25-2011	08-25-2011	08-24-2011	08-24-2011	08-24-2011	08-25-2011	08-25-2011	08-25-2011	08-25-2011	08-26-2011	08-26-2011	08-26-2011	08-24-2011
	Device	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	13.00	16.00	5.00	100.00
	EcoAnalysts Sample ID	5906.1-1	5906.1-2	5906.1-3	5906.1-4	5906.1-5	5906.1-6	5906.1-7	5906.1-8	5906.1-9	5906.1-10	5906.1-11	5906.1-12	5906.1-13	5906.1-14
Ephemeroptera	Ameletidae	22	15	29	0	0	0	11	10	18	47	18	42	2	6
	Baetidae	72	146	36	0	0	2	3	13	32	17	5	3	8	21
	Ephemerellidae	7	18	10	0	0	2	4	4	10	7	46	123	236	15
	Heptageniidae	5	9	7	0	0	0	1	3	17	9	26	49	115	41
	Leptohyphidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Metretopodidae	1	0	1	1	3	3	4	4	0	4	0	0	0	0
Plecoptera	Capniidae	5	0	0	0	0	0	7	5	12	7	0	4	6	30
	Chloroperlidae	18	33	28	5	0	2	14	102	135	69	32	13	14	10
	Leuctridae	0	0	0	0	0	0	0	0	0	0	7	1	7	0
	Nemouridae	6	5	3	0	0	0	0	0	1	0	12	3	44	213
	Perlidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Perlodidae	21	12	9	1	1	6	1	2	7	8	34	2	25	11
	Taeniopterygidae	4	3	0	0	0	1	2	0	1	0	0	0	8	1
Coleoptera	Dytiscidae	1	4	1	0	6	5	3	0	3	3	0	6	0	0
	Elmidae	0	0	0	0	0	1	0	1	0	0	0	0	1	0
	Haliplidae	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Megaloptera	Sialidae	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ra-Chironomidae	Chironomidae	8	9	6	8	5	11	24	20	30	14	68	77	46	87
Diptera	Ceratopogonidae	0	0	1	0	0	0	0	5	0	6	2	3	0	2
	Empididae	0	0	1	1	0	2	1	2	1	0	8	4	1	3
	Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Sciomyzidae	1	0	0	0	1	0	0	0	0	0	0	0	0	0
	Simuliidae	2	4	2	0	0	1	0	0	1	0	0	0	0	0
	Tipulidae	0	0	0	0	4	0	0	0	0	0	7	0	5	3
Trichoptera	Apataniidae	0	0	0	0	0	0	0	0	0	0	5	1	13	8
	Brachycentridae	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	Hydropsychidae	2	1	0	0	0	1	0	1	0	1	0	0	1	0
	Lepidostomatidae	1	0	0	0	0	0	0	1	0	0	1	0	0	0
	Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Rhyacophilidae	0	0	0	0	0	0	1	0	0	0	38	4	18	2
Annelida	Enchytraeidae	1	0	1	3	6	1	0	1	0	0	0	0	0	1
	Piscicolidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Tubificidae	0	0	0	12	4	14	2	0	0	4	0	0	0	0
Acari	Hygrobatidae	23	4	7	14	8	35	23	6	4	5	1	4	0	0
	Lebertiidae	10	6	3	7	2	3	0	0	1	1	10	2	3	9
	Oxidae	0	0	0	2	0	2	1	0	0	0	0	0	0	0
	Sperchontidae	0	0	2	0	0	0	0	0	0	0	7	1	2	5
	Torrenticolidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	**211**	**272**	**148**	**55**	**40**	**93**	**102**	**180**	**274**	**203**	**327**	**342**	**558**	**469**
	Cabin "Rejects" Presence	Ostracoda	Nematoda, Copepoda	Ostracoda	Nematoda	Ostracoda	Copepoda	Nematoda, Ostracoda	Ostracoda, Turbellaria	Turbellaria	Turbellaria, Ostracoda				

EDI Murray River CABIN Benthos 2011

***Data are NOT adjusted for subsampling**

	Water Body	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek
	Site ID	M20-04	M20-04	M20-05	M20-05	M20-05
	Rep	2	3	1	2	3
	Collection Date	08-24-2011	08-24-2011	08-26-2011	08-26-2011	08-26-2011
	Device	Kick	Kick	Kick	Kick	Kick
	Percent Subsampled	100.00	21.01	20.00	30.03	11.00
	EcoAnalysts Sample ID	5906.1-15	5906.1-16	5906.1-17	5906.1-18	5906.1-19
Ephemeroptera	Ameletidae	0	3	0	14	4
	Baetidae	59	28	53	113	41
	Ephemerellidae	9	16	30	12	30
	Heptageniidae	36	59	135	137	133
	Leptohyphidae	0	0	0	0	0
	Metretopodidae	0	0	0	0	0
Plecoptera	Capniidae	0	5	3	0	3
	Chloroperlidae	27	23	9	12	12
	Leuctridae	1	1	0	0	0
	Nemouridae	37	153	25	8	47
	Perlidae	0	0	0	0	0
	Perlodidae	4	4	19	22	16
	Taeniopterygidae	0	7	4	2	4
Coleoptera	Dytiscidae	4	0	0	0	0
	Elmidae	0	1	0	1	0
	Haliplidae	0	0	0	0	0
Megaloptera	Sialidae	0	0	0	0	0
ra-Chironomidae	Chironomidae	32	41	12	7	8
Diptera	Ceratopogonidae	2	0	0	0	1
	Empididae	0	0	1	0	0
	Psychodidae	0	0	0	0	0
	Sciomyzidae	0	0	0	0	0
	Simuliidae	3	0	4	16	6
	Tipulidae	1	1	0	2	2
Trichoptera	Apataniidae	0	0	4	1	0
	Brachycentridae	0	0	0	0	0
	Glossosomatidae	0	1	0	0	0
	Hydropsychidae	0	1	9	12	8
	Lepidostomatidae	0	0	0	0	0
	Limnephilidae	0	0	4	0	2
	Rhyacophilidae	2	5	2	7	0
Annelida	Enchytraeidae	0	1	0	0	0
	Piscicolidae	0	0	0	0	0
	Tubificidae	0	0	0	0	0
Acari	Hygrobatidae	0	1	0	0	0
	Lebertiidae	2	4	0	1	0
	Oxidae	0	0	0	0	0
	Sperchontidae	2	1	1	3	3
	Torrenticolidae	0	0	0	0	0
	TOTAL	**221**	**356**	**315**	**370**	**320**
	Cabin "Rejects" Presence	Nematoda, Turbellaria	Nematoda	Turbellaria	Nematoda	Nematoda

APPENDIX D HILSENHOFF BIOTIC INDEX TABLE

HBI Value	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

APPENDIX E EMAIL CORRESPONDANCE FROM MINISTRY OF ENVIRONMENT

Email Correspondence from MoE

From: Carmichael, Bruce FLNR:EX [mailto:Bruce.Carmichael@gov.bc.ca]
Sent: August-22-11 2:42 PM
To: 'cmackay@edynamics.com'
Cc: Carmichael, Bruce FLNR:EX; Jacklin, James ENV:EX
Subject: RE: Murray periphyton program

Hi Cathy,

I've quickly reviewed both Tissue and Aquatic Life chapters and believe the two should be workable in terms of periphyton. For chlorophyll and population dynamics, it would be a good idea to review Biggs and Kilroy, as Greg Tamblyn (smithers) make frequent reference to it in the Aquatic Life chapter.

Biggs, B.J.F. and C. Kilroy. 2000. *Stream Periphyton Monitoring Manual*. National Institute of Water and Atmospheric Research, Christchurch, New Zealand. 224 pp. www.niwa.cri.nz/ncwr/tools/periphyton.

For metals analysis, use the tissue chapter, particularly:

For consistency with other media, and in particular for baseline programs where selenium is of interest, periphyton should be collected from the same depositional habitats sampled for sediment and invertebrates. However, periphyton may be difficult to collect from deep water, soft substrate (lentic) environments without the use of artificial substrates or alternate collection techniques. While perhaps of less relevance (at least for selenium assessment), periphyton may need to be collected from main stem lotic riffles. In this case, periphyton for contaminant analysis would be collected at the same locations as done for chlorophyll-*a* and community structure analyses.

Tissue samples with excessively high moistures (i.e., > 90% in some periphyton, macrophyte, benthic invertebrate, and bird egg samples) should be dried at ≤60°C and weighed directly prior to acid digestion in order to minimize unnecessary error associated with moisture corrections. Data for these high moisture organisms should be reported as dry weight, with detection limits being five times those listed below, based on the assumed 80% moisture. Associated percent moisture may be reported from associated sub-samples of these tissues, if sufficient sample volumes exist and the measure is requested. All data reports must clearly indicate whether analytical results are being reported as dry weight (dwt) or wet weight (wwt).

8.5.2 Basic (non-statistical) program (for periphyton, macrophytes, benthic invertebrates)

This basic program focuses on the annual collection of single composite samples from each site related to the mine (e.g., reference, near and far-field). The basic program is appropriate for the collection of those organisms that may be relatively difficult to locate in sufficient density to support replicate collections. Collection should occur during the summer/fall low flow period when other biological sampling is underway.

Every third sample should be "field split" to assess sampler and laboratory QA/QC. One site in the mine area should also be sampled and analyzed for up to five replicates, if possible (i.e., if sufficient biomass exists for replicate sampling), in order to quantitatively assess within-site variability in the chemical of concern. It is recognized that this may not be logistically possible for periphyton samples due to analytical biomass requirements. The five replicates will help to assess the suitability of the one replicate per site normally collected. While this program incorporates within-site variability into each composite sample, it does not statistically test this variability other than at the single five-way replicate site. This program does not statistically test for between-site or temporal variability.

Also read 8.6 for specific periphyton methods.

Regarding your proposal below:

Twenty Creek u/s and d/s – yes; if not impacted, it may function as a long term reference stream.
M20-03 – agreed. I have questioned Dehua as to any possible impacts to M20 Ck (possible ventilation drilling, pumping wells, etc further up the watershed). I understand that no use of the drainage is anticipated. However, the "Bulk Sample Surface Facility" map indicates a clear potential for unintended discharge or spill to lower M20 Creek from the North Shaft Site. So, sampling of M20-04 (or a similar site d/s of the North Shaft Site) would be appropriate. This would lead to the question of sampling M20 -05 that yes, should be below the natural sediment source. I believe potential risk to M20 Creek is greater than to Twenty Creek, so if limited budget, I suggest going with M20 sites.
MR9 – agreed
MR4 – agreed.
MR7 – agreed.
MR8 or MR6 – agreed, sample and hold.

Additionally, lenthic habitat will be sampled in duplicate; sediment sites may not coincide with other parameters since depositional sites will be selected.

- This does get complicated. Where to go in the lotic vs depositional vs lentic? Some mines (Wolverine, Willow) provide lots of each type of habitat. In these cases, you are almost doing two separate biological programs, one regular, one focussed on Se. Others may provide only Lotic (Roman), so the program sites will be combined. The program needs to fit the reality of the habitat. Even though you may intend on collecting sediment and benthos in true lentic or depositional habitats, you may be scraping out sediments from small pockets along the Murray and reverting to collecting benthic tissues (for metals) in the same place you collect them for riffle community composition and density. Remember, the guidance doc was written to account for all these possibilities. But if you do find good lentic habitat, follow the guidance doc.

Benthics will be sampled using CABIN standard methods with Kick net. This method is selected anticipating that the reference model to fully use the CABIN analyses will be completed in the next several years. Since it is not yet available, sampling design falls back on a BACI approach with u/s controls paired with d/s impact sites and kick net samples will be replicated at each site.

- Refer to the Aquatic life chapter for this, but generally agreed.

All sampling will be completed as outlined in the Baseline Monitoring Guidelines (draft, MOE 2009) with the following replication.

Parameter	# replicates	Q/A Samples
Benthics- community composition, enumerations	3 reps each site	1 split sample

- Follow Aquatic Life chapter. Is a split necessary?

Benthics- tissue samples	1 composite sample, each site	1 split sample; take 5 reps at 1 site

- Every third sample should be "field split" to assess sampler and laboratory QA/QC. One site in the mine area should also be sampled and analyzed for up to five replicates, if possible (i.e., if sufficient biomass exists for replicate sampling), in order to quantitatively assess within-site variability in the chemical of concern. It is recognized that this may not be logistically possible for periphyton samples due to analytical biomass requirements.

Periphyton- community composition	3 reps each site	1 spilt sample

- Follow Aquatic Life chapter. Is a split necessary? Or is that part of normal analytical procedure?

Periphyton- chlorophyll a	3 reps each site	1 spilt sample

- Follow Aquatic Life chapter, but 3 reps per site is low. 6+ is more typical. Given this higher number at each site, is a split necessary?

Periphyton- tissue samples	1 composite sample each site	1 split sample; take 5 reps at 1 site

- As above for benthic tissues.

Sediment- PAHs	1 composite sample each site	1 split sample; take 5 reps at 1 site

- This basic program focuses on the annual collection of single sample replicates from each site related to the mine (e.g., reference, near and far field). Every third site should be "field split" to assess sampler and laboratory QA/QC, and five replicates should be collected and analyzed at one site to measure within-site variability. While this program incorporates within-site variability into the "field split" sample, it does not statistically test for this variability other than at the single five-way replicate site. Nor does it statistically test for between-site variability. Collection should occur during the summer/fall low flow period. To expedite the overall baseline program, sediment sampling may be timed with the biological program typically required in August or September.

Sediment- metals & grain size	1 composite sample each site	1 split sample; take 5 reps at 1 site

- As for PAHs.

Call me if you would like to discuss.

Thanks, Bruce

Appendix 4-2
Stream Sampling Results 2012

Rescan™
Engineers and Scientists

Murray River Project: Aquatic Life Baseline Data Report 2012

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PROJECT # 12-V-0073
DATE FEBRUARY 20, 2013

2012 ENVIRONMENTAL EMPLOYER OF THE YEAR

EDI ENVIRONMENTAL DYNAMICS INC.

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EXECUTIVE SUMMARY

In August 2012, EDI Environmental Dynamics Inc. conducted year three of the Aquatic Life Baseline Program for HD Mining International's Murray River Coal Mine Project. The project is in the vicinity of the Murray River, located in northern British Columbia near Tumbler Ridge. The Aquatic Life Baseline Program involved sediment, benthic invertebrate, and periphyton sampling at 10 sites on the Murray River and its tributaries of M20 Creek, M19 Creek, and M17 Creek.

Sediment, benthic invertebrate and periphyton sampling methodology were based on field manuals from the BC and federal governments. Sediments were analyzed for particle size, metal concentration and organic content. Means and standard deviations were calculated for each site. Benthic invertebrates were identified to the lowest practicable taxonomic level and selections of abundance diversity metrics were calculated to represent community composition among sites. Periphyton was sampled and analyzed for both community composition (i.e., abundance and richness) and biomass (i.e., chlorophyll *a*).

The results are summarized and key points are presented for each component of the program: sediment, benthic invertebrates, and periphyton. Results in the analysis showed a relative high degree of variability among sites for sediment, benthic invertebrates, and periphyton. The wide variety of aquatic habitat types available throughout the study area contributes to this variability; however, sites were selected according to standard criteria designed to focus on sampling comparable habitat types.

Kick sampling at the ten sites showed that the Murray River sites had a lower cell densities compared to the smaller tributary streams flowing into the Murray M19 Creek, M17 Creek and M20 Creek. The Hilsenhoff Biotic Index indicated an excellent to very good water quality with no apparent organic pollution at nine of the ten benthic invertebrate sites. M17-02, the only site on M17 Creek, had a higher index number than the other sites which indicated good water quality with some organic pollution

ACKNOWLEDGEMENTS

HD Mining initiated this baseline program. Bruce Carmichael with the BC Ministry of Environment reviewed the sampling design and provided valuable insight. Mike Henry (Rescan) reviewed the study design and we appreciated his input. Vicki Smith, Mark Racicot, Cathy Mackay, Jessica Milko, and Jason Yarmish conducted field sampling. Thank you to Jason Yarmish for safely and efficiently navigating to our sites on the Murray River by jet boat.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. EDI staff who contributed to this project include:

Mark Racicot, Dipl. Tech ..... Primary Author

Cathy Mackay, M.Sc., R.P.Bio., P.Ag ..... Senior Review

Tim Antill, M.Sc., R.P.Bio., P.Ag ..... Senior Review

Vicki Smith, B.Sc ..... GIS Mapping

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 STUDY AREA 1

1.2 PREVIOUS STUDIES 2

2 METHODS 4

2.1 STUDY DESIGN 4

2.2 AQUATIC LIFE SAMPLING AND ANALYSIS 6

2.2.1 Aquatic Habitat 6

2.2.2 Stream Sediment 6

2.2.3 Benthic Invertebrates 8

2.2.4 Periphyton 8

3 RESULTS & DISCUSSION 10

3.1 AQUATIC HABITAT 10

3.2 STREAM SEDIMENTS 13

3.3 BENTHIC INVERTEBRATES 18

3.4 PERIPHYTON 22

4 RECOMMENDATIONS 27

5 REFERENCES 28

APPENDIX A MURRAY RIVER COARSE COAL REJECT AND LOAD–UP STATION OPTIONS

APPENDIX B EMAIL CORRESPONDENCE WITH MOE

APPENDIX C SEDIMENT RAW DATA

APPENDIX D BENTHIC INVERTBRATES RAW DATA

APPENDIX E PERIPHYTON RAW DATA

APPENDIX F HILSENHOFF INDEX TABLE

LIST OF TABLES

Table 1. Summary of the Murray River Project Aquatic Life Baseline Program, 2010-2012. 2

Table 2. Aquatic Life sites sampled in the 2012 baseline program for the Murray River Project. 5

Table 3. Metrics used to describe benthic invertebrate abundance, diversity and community similarity. 9

Table 4. Aquatic Life baseline sites sampled in August 2012 for the Murray River Project. 10

Table 5. Site specific habitat data for each aquatic life site sampled in August 2012. 11

Table 6. Physical properties for sediment samples collected in August 2012. 13

Table 7. Composition of samples by particle size at each aquatic life site. 14

Table 8. Average composition by particle size among all aquatic life sites and replicate samples. 14

Table 9. Total metals concentrations for sediment sampling collected in August 2012. 15

Table 10. Semi-volatile organics for sediment sampling conducted in August 2012 17

Table 11. Summary of benthic invertebrate metrics 2012. Mean statistic is shown for each site with standard deviation in parentheses. 21

Table 12. Periphyton species richness for Murray River Aquatic Monitoring Sites 2012. 22

Table 13. Periphyton density for the Murray River Aquatic Monitoring Sites 2012. 23

Table 14. Chlorophyll *a* analysis for the 2012 Murray River Aquatic Monitoring Sites. 23

LIST OF FIGURES

Figure 1. Aquatic Life Sites 2012 3

1 INTRODUCTION

HD Mining International (HD Mining) is undertaking a multi-year Aquatic Life Baseline Program for the Murray River Coal Mine Project. In August 2012, Environmental Dynamics Inc. (EDI) conducted Year-3 of the Aquatic Life Baseline Program. This program is designed to collect sediment, benthic invertebrate and periphyton baseline data in order to monitor future potential impacts of the mine. Baseline data will be used as a reference to statistically compare data from potential impact zones throughout the mine life. The program is also intended to fulfill information requirements for the BC Environment Assessment process. The Aquatic Life Baseline Program was initiated in 2010 and the study design was refined in 2011 and 2012 to address gaps in baseline data related to progression in designs of the proposed project development. The 2012 program was designed based on current planning of surface facilities and associated site infrastructure as illustrated on the map entitled "*Murray River Coarse Coal Reject and Load-up Station Options*" (Appendix A).

Aquatic monitoring of stream sediments, benthic invertebrates and periphyton provide an overall indication of water quality and site productivity. Benthic invertebrates respond to a wide variety of disturbances but not to all impacts; therefore, it is recommended to have a balanced approach by including multiple biological components (Rosenburg and Resh 1993). Periphyton and sediment, two food sources of benthic invertebrates, collect impurities from their surrounding ecosystem either by deposition and adsorption (sediment) or absorption (periphyton). Metal ingested by benthic invertebrates is believed to be the primary cause of elevated metal levels in fish in and around contaminated sites (Biggs and Kilroy 2000; Meret 2003). As these components are highly sensitive to changes in physical, chemical and biological conditions in the aquatic environment, detecting changes downstream can indicate an impact upstream of that point in the watershed.

The objective of the study design is to establish sites upstream and downstream from the Project footprint so that potential impacts can be detected and quantified if they occur as a result of operations throughout the life cycle of the mine. The Project is a proposed underground coal mine and its footprint as known at the time of designing this program includes clearing and grubbing areas, site grading and preparation areas, access construction, surface water management infrastructures, decline portals, laydown area, waste rock area, coal stockpile conveyor, coal sample storage, coal truck loading facility, rail load out area, water control system, fuel storage, and electrical power source. The site is nearby existing transmission, rail, and all season road infrastructures.

1.1 STUDY AREA

The Project is located in northeast British Columbia, southeast of Tumbler Ridge within the Murray River watershed. The local study area covers an elevation ranging from 760 to 1,110 meters. The vegetation in the study area is dominated by Engelmann spruce and subalpine fir in the higher elevations, white and black spruce in the lower elevations and willow species in the streamside riparian areas. The 2012 baseline program included ten sites, five on the Murray River, two on M20 Creek, two on M19 Creek, and one on M17 Creek. M17, M19, and M20 Creeks are tributaries to the Murray River (Figure 1; Table 1).

1.2 PREVIOUS STUDIES

Sampling for the Aquatic Life Baseline Program associated with Murray River Project began in 2010 by Rescan and the first year of work is summarized in a technical report (Rescan 2010). Aquatic life sampling was completed by EDI in 2011. Both the 2010 and 2011 programs included sediment, benthic invertebrates and periphyton sample collection at six sites. Earlier aquatic sampling programs completed for the Herman Mine Project between 2004 and 2006 (WCCC 2007) and Teck Coal partly overlap with the Murray River Project. Site names for the Murray River baseline program were changed in 2011 to match site names from the Hermann Mine baseline program. Sites M20-03 and M20-04 coincide with Hermann Mine aquatic life sampling sites. Other sites coincide with pre-existing water quality sites, and their nomenclature was changed in 2011 to match the existing site names. In 2012, one sample site location was changed and additional sites were added to this program as the proposed facility locations evolved. Table 1 provides a summary of the sampling in the past three years for the Murray River Project.

Table 1. Summary of the Murray River Project Aquatic Life Baseline Program, 2010-2012.

Site Name	Benthic Invertebrate	Periphyton	Sediment
MR-REF [a]	2010	2010	2010
REFST-DS [a]	2010	2010	2010
MR-4 (Rescan 2010)[b]	2010	2010	2010
MR-9	2011, 2012	2011, 2012	2011, 2012
MR-3	2012	2012	2012
MR-4 [c]	2010, 2011, 2012	2010, 2011, 2012	2010, 2011, 2012
MR-7	2011	2011	2011
MR-7b	2012	2012	2012
MR-6	2010, 2011, 2012	2010, 2011, 2012	2010, 2011, 2012
M20-06	2012	2012	2012
M20-05	2011	2011	2011
M20-04 [d]	2011, 2012	2011, 2012	2011, 2012
M20-03	2011	2011	2011
M19-01	2012	2012	2012
M19-02	2012	2012	2012
M17-02	2012	2012	2012

Notes: a. REFST-DS is located on a reference/control tributary of the Murray River that enters the Murray upstream of MR-REF
b. MR-4 (2010) was located on Murray River upstream of M20 Creek confluence and downstream of Twenty Creek confluence
c. MR-4 was previously known as MR-5 by Rescan in 2010
d. M20-04 was previously known as M20-DS by Rescan in 2010 and is the same site location as Hermann Mine M20-04

620000 625000 630000 635000

6110000 6105000 6100000 6095000

Tumbler Ridge

MR6

Murray River

MR7b

M19-02

M19-01

M20 Creek

M20-04

M20-06

M17-02

MR4

MR3

MR9

LEGEND

Aquatic Life Sites (2012)

- Benthic Community
- Benthic Tissue
- Periphyton Chlor a; Abundance; Tissue
- Sediment

Cutline/Seismic/Other

- Pit
- Building or Designated Area
- Cutline or Seismic Line
- Pipeline
- Railways

Roads

- Gravel Road
- Paved Road
- Rough Road

- Streams
- 50K Canvec Waterbody
- HD Mine Surface Facility Boundary

0 0.5 1 2

Kilometers

Scale: 1:65,000

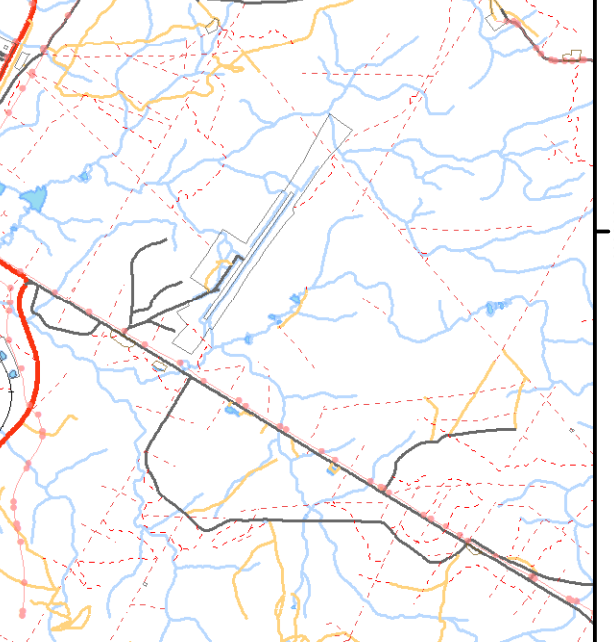
Original Map Size 11x17in

MURRAY RIVER

Figure 1. Aquatic Life Sites 2012

Drawn: V. Smith	Datum/Projection: NAD 1983 UTM Zone 10N
Checked: C. Mackay	EDI Project No.: 12-V-0073
Date: 2/21/2013	Data Sources: Refer to References Section

EDI



Path: J:\Yukon\Projects\2012\12_V_0073_MurrayRiver_WildlifeMapping\Fig1_AquaticLife_21Feb2013_MP.mxd

2 METHODS

2.1 STUDY DESIGN

Study design and methodologies were consistent with *Water and Air Resource Protection Guidelines for Mine Proponents and Operators: Baseline Monitoring* (MOE 2012). The sampling plan was submitted to the BC Ministry of Environment (MOE) Environmental Impact Biologist for review and comment. Review of sampling design and methodologies was provided by MOE and feedback was incorporated into the 2012 sampling program (Appendix B).

The 2012 sampling plan included a number of changes from previous years. New sample sites were added to address infrastructure siting within the current mine plan (Table 2). A plan siting locations for facilities east of the Murray River was issued by HD Mining in June 2012 (Appendix A). Additional sites on M17 Creek and M19 Creek were established to address the potential effect of the rail load-out and associated facilities on watercourses flowing into the Murray River from the east. Initially, paired sites were planned for both M17 Creek and M19 Creek; however, in the field it was apparent that a suitable upstream reference site location did not exist on M17 Creek because of the overlap of influence between existing facilities operated by Teck Coal and proposed HD Mining activities. The creek runs adjacent to Teck Coal's reclaimed tailings storage area, which has been inactive for numerous years. The single site M17-02 serves a temporal replication method used to monitor any potential influence of the Murray River Project proposed load out facility. Site MR7 was moved to a new location at MR7B because the original MR7 was not located far enough downstream on the Murray River to encompass all potential effects from the facilities planned on the east side of the Murray River. Site MR-6 on the lower Murray River, was selected as a far-field impact site but was not sampled in 2011 due to water levels. In 2012 water levels were lower and MR-6 was sampled. Table 2 lists the sites sampled in the 2012 Murray River Aquatic Life Monitoring Program and the rationale for each site location.

Benthic invertebrates were sampled following Canadian Aquatic Biomonitoring Network (CABIN) standard methods. Although not currently available, a CABIN reference model for the Peace Region is under development and is anticipated to be completed in the next several years. MOE requested that the CABIN sampling method be used for this project in anticipation of the Peace Region reference model completion. The CABIN system of biomonitoring uses invertebrate community data from a group of unimpaired reference sites to build a statistical reference model which a test site is compared against. Within the CABIN model, the test site is compared to the reference sites using multivariate statistical analysis to determine if it statistically differs from the reference condition, in which case the site is considered impaired.

Until the CABIN reference model for the Peace Region is completed the current sampling design follows a before-after control-impact design (BACI, Smith 2002) where upstream control sites are paired with downstream impact sites using an ANOVA statistical analysis. Periphyton, sediment, and tissue samples will also be compared using the BACI design. The intention for future monitoring is to statistically compare pre-impact (before) data to post-impact (after) data using two-factor ANOVA.

Table 2. Aquatic Life sites sampled in the 2012 baseline program for the Murray River Project.

Site Name	UTM Coordinates	Site Description	Rationale
M20-06	10 U 6098024 626293	Upstream of M20-04 approximately 0.5km	Upstream control of proposed sediment pond discharge pipe into M20 Creek
M20-04	10 U 626265 6097901	Downstream of mine footprint on lower part of M20 Creek	Monitor potential impacts directly downstream resulting from mine operations.
MR-9	10 U 624311 6094181	200m upstream of the third boat launch on Murray River	Control site for Murray River upstream of all potential impacts of Murray River project.
MR-4	10 U 626493 6097797	Approx. 200m downstream of M20 confluence on Murray River	Downstream of M20 mixing zone. Isolate the influence M20 creek has on Murray River from other potential direct effects on Murray River.
MR-3	10 U 625911 6097042	Approx. 0.7 km upstream of Murray FSR Bridge on the Murray River	Upstream control site for M20 Creek influence on Murray River.
MR-7B	10 U 626730 6101011	Upstream of Pipeline crossing on the Murray River.	Murray River near-field downstream of project footprint.
MR-6	10 U 625521 6109103	Between HWY 29 bridge and railway bridge on the Murray River	Downstream site downstream of all proposed facilities.
M19-01	10 U 6099185 630433	Approx. 0.3km upstream of M19 Creek bridge on the Murray FSR.	M19 Creek upstream control site.
M19-02	10 U 6100044 627283	Approx. 1.5km upstream from Murray River confluence on M19 Creek.	Downstream monitoring site on M19 Creek.
M17-02	10 U 627038 6098308	Approx. 0.6km upstream from Murray River confluence on M17 Creek.	Downstream Monitoring site on M17 Creek.

2.2 AQUATIC LIFE SAMPLING AND ANALYSIS

Sampling was conducted August 28 to 31, 2012. Benthic invertebrate, stream sediment, and periphyton sampling was conducted by three experienced EDI personnel. Aquatic habitat data and benthic invertebrates were collected based on the Canadian Aquatic Biomonitoring Network (CABIN) method at each site. CABIN is the national biomonitoring program developed by Environment Canada that delivers a standardized sampling protocol, and the three EDI personnel are certified to conduct this sampling. Sampling methods and field techniques for stream sediments and periphyton were based on *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emission, Waste, Wastewater, Soil, Sediment, and Biological Samples* (Clark 2003) and *Stream Periphyton Monitoring Manual* (Biggs and Kilroy 2000).

2.2.1 Aquatic Habitat

At each site, the following habitat parameters were recorded for the stream reach, as per CABIN methodology.

- **Pebble Count and Embeddedness**: A minimum of 100 particles (i.e. pebbles) were randomly selected from the streambed. The intermediate axis of each particle was measured, as well as the depth of the substrate it was buried in (i.e. embedded).
- **Elevation and UTM coordinate**: Determined from a handheld GPS unit or topographic map (scale 1:50,000).
- **Channel morphology**: Features measured included stream gradient, wetted and bankfull width, average water depth and velocity.
- **Reach Data**: Habitat types, canopy coverage, vegetation, periphyton coverage category, surrounding land use.

2.2.2 Stream Sediment

Sediments support aquatic life by providing habitat for attached algae, rooted plants and benthic invertebrates. Fine grained sediments (silts and clays) can also bind to chemical contaminants such as metals and organics. Contaminants bound to fine sediment can in turn affect the health of organisms that use sediment as their habitat or that feed on organic matter associated with sediment (BC MOE 2012). Sediments also incorporate periodic or storm based contamination events that can be missed by regular water quality sampling.

Field sampling focussed on collecting fine grained sediment. Samples were subsequently sieved in the lab and analysis was completed on the fraction containing particles less than 63µm (silt/clay). This is done in order to target the size fraction most biologically relevant and that can most readily bind contaminants. Due to analytical requirements, polycyclic aromatic hydrocarbons (PAHs) and Total Organic Carbon (TOC) were analyzed on the entire sample. This analysis was completed on wet samples to prevent alteration of organic compounds since sieving requires drying the sample.

Particle size analysis was conducted to assess comparability of samples based on their composition of particle size fractions. Particle size distribution was completed based on six sieve sizes less than 63 µm for the metals samples, and based on categories of sand, silt, clay and gravel for the PAH/TOC samples.

In 2012, sediment samples for metals analysis were collected at ten sites and sediment samples for PAH and TOC were collected at seven sites. The three sites where PAH/TOC sampling was omitted in 2012 were previously sampled in 2011 and did not require further sampling at this time.

- **Particle size distribution** describes the physical properties of the sediment, including the percentage of sand, silt and clay, which highly influences the chemical and biological characteristics of sediment at the site.
- **Metals** are naturally present in all sediments; most metals tend to be associated with suspended solids which settle out in the sediments over time.
- **Polycyclic aromatic hydrocarbons (PAHs)** are a group of organic contaminants that form from the incomplete combustion of hydrocarbons, such as coal and gasoline.
- **Total Organic Carbon (TOC)** affects the bioavailability and toxicity of metals and organic contaminants.

Samples were collected at each site within the wetted channel using a Teflon coated spoon for metals analysis and a stainless steel spoon for PAHs. Each sample was a composite of numerous scoops of sediment from depositional zones at several locations per site. For quality assurance, five replicates were taken at one site for metals and for PAH/TOC. Three sets of split samples were taken for metals and two sets of split samples for PAH/TOC. New nitrile gloves were worn at each site. To avoid contamination between sites, the Teflon scoop was washed with 10% nitric acid and the steel scoop was washed with acetone each followed by rinsing with deionized water. Data on sediment texture, colour, sample depth, smell and presence of organic debris were recorded at each site.

Samples were stored in glass jars in a cool environment (4˚C) and promptly shipped to the laboratory within the specified holding period. Metals samples were stored in plastic ziplock bags and kept cool prior to shipping. Laboratory analysis was conducted by Maxxam Analytics in Burnaby, BC. The portion of the sample with particles sized less than 0.063 mm were analyzed for total metals (33 elements scan) by ICPMS. PAH/ TOC samples were analyzed wet and percent moisture content was reported.

Results for each replicate sample were averaged for each site and compared to the Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG) and the BC Ambient Water Quality Guidelines[1] (AWQG) (BC MOE 2006) for the Protection of Aquatic Life[2]

[1] http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html#table2

[2] http://ceqg-rcqe.ccme.ca/

2.2.3 Benthic Invertebrates

As sedentary, bottom-dwelling and detritus-feeding aquatic organisms, benthic invertebrates sustain exposure to stream water and sediments throughout their life cycle. Some species of benthic invertebrates are known to be intolerant to elevated concentrations of metals often associated with mining activity, allowing other more tolerant species to become dominant at contaminated sites (Maret et al. 2003). Benthic invertebrates are generally abundant and easy to sample. They are commonly used to assess ecological impacts to the ecosystem because of their sedentary and relatively long-lived characteristics.

In 2012, benthic invertebrates were sampled at ten sites within the project area. At each site, riffles and glides were targeted for sampling. Sampling was conducted at water depths between 10 cm and 45 cm for a period of three minutes with a 400µm mesh, CABIN protocol kick net. Substrate and debris upstream of the kick net was disturbed by kicking and turning rocks over to dislodge invertebrates. After the three minutes, the kick net was removed from the stream and all invertebrates and debris in the net and collection cup were rinsed carefully into the sample jar. Samples were preserved with a 10% buffered formalin solution, at a ratio of 1:3 parts formalin to water. A total of three sample replicates were collected at each site, moving in an upstream direction within the identified riffle or glide. Water depth and average water velocity were measured at each sample replicate location. In-situ water quality, substrate type and riparian vegetation were also recorded at each site.

Samples were sent to EcoAnalysts, Inc. for enumeration and identification to the family and genus taxonomic level. In the CABIN method it is anticipated that identification to family is required but samples were identified to genus level for a very small additional cost in case that level of detail is needed. A selection of metrics was chosen for presentation in this report to represent community composition, proportion of pollution intolerant species and overall productivity (Table 3). These metrics were analyzed using data from each replicate sample. Mean and standard deviation statistics were calculated for each site.

2.2.4 Periphyton

Periphyton provides food to many aquatic invertebrates and purifies water by absorbing impurities such as metals. Periphyton can be found on rock and stable substrates in streams. Periphyton is very responsive to changes in the ecosystem. Responses to environmental change can be measured in both biomass (measured in Chlorophyll *a*) and shifts in taxonomic community (Biggs and Kilroy 2000).

In 2012, periphyton was sampled at ten sites and analyzed for total metals, taxonomy and biomass. Samples were collected using a circular template (10 cm diameter) to isolate a uniform area on a rock or group of rocks. Periphyton was then scraped and rinsed from this area into a plastic sample jar. The number of templates used for each sample depended on the density of periphyton and was recorded for each site. If two visual periphyton communities were present at a site (i.e. a filamentous community and brown algae on rocks), both the dominant the sub-dominant community were sampled.

Samples were processed according to sample type:

- **Taxonomic samples** were preserved with Lugol's solution and sent to a taxonomic laboratory (EcoAnalysts Inc.) for identification to the lowest taxonomic level. Enumeration was completed to obtain a density of cells per site.

- **Biomass samples** were placed and stored in a cooler until filtering. Each sample was filtered using a peristaltic pump with a membrane filter of 0.45µm pore size, folded inside a larger Whatman type paper filter. A magnesium carbonate solution ($MgCO_3$) was added to the periphyton during filtering to act as a drying and stabilizing agent. Filtered samples were then wrapped in aluminium foil and kept cool (4°C) until shipment to the laboratory (Maxxam Analytics). Chlorophyll *a* was analyzed as a surrogate variable for periphyton biomass.

Table 3. Metrics used to describe benthic invertebrate abundance, diversity and community similarity.

Metrics	Description
Total Density	The total number of individuals of all taxon categories collected at each site.
Taxa Richness	The average number of distinct taxa counted at each site. Distinct taxa include individuals identified only to order if there were no individuals identified to a lower level for that taxon (Karr and Chu 1999).
EPT Richness	Measures the amount of pollution sensitive species (Ephemeroptera, Plecoptera and Trichoptera) that are present. This was calculated by counting the number of different taxa from each of these orders. High numbers typically indicate good water quality (Rosenberg and Resh 1993).
Hilsenhoff Biotic Index (HBI)	The sum of abundance weighted by assigned tolerance to organic pollution value for each taxon (Hilsenhoff 1982).
Ephemeroptera (%)	The abundance of Ephemeroptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Plecoptera (%)	The abundance of Plecoptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Trichoptera (%)	The abundance of Trichoptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).
Diptera (%)	The abundance of Diptera divided by the total number of individuals in each sample, averaged among samples replicates (Karr and Chu 1999).

3 RESULTS & DISCUSSION

Results are summarized and discussed below for each component of the 2012 Murray River Aquatic Monitoring Program. The raw data for sediment, benthic invertebrates, and periphyton are provided in Appendix C, D, and E respectively.

Ten aquatic life sites were samples in August 2012 (Table 4). Weather conditions through the days of August 28-31, 2012 were typical for late summer: Light rainfall occurred on the morning of August the 30th but cleared in the late morning. Ambient air temperatures ranged from 9˚C to 13˚C. Water levels within the study area were a great deal lower than the 2011 sampling event. Although Environment Canada data were not available at the time of writing, this observation can be confirmed by water levels records from the Water Survey Canada Murray River Station.

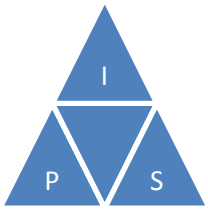
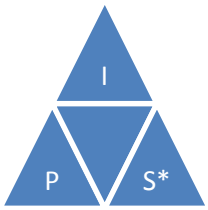
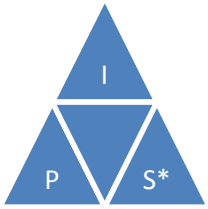
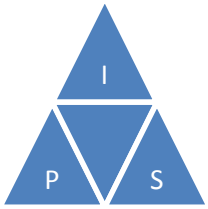
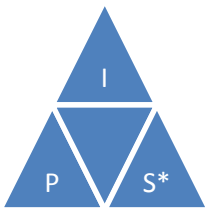
Table 4. Aquatic Life baseline sites sampled in August 2012 for the Murray River Project.

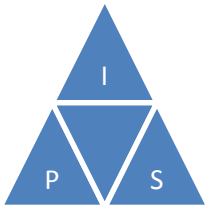
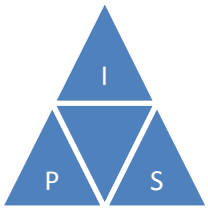
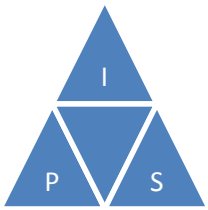
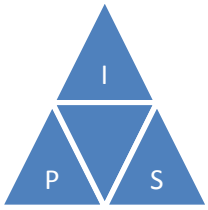
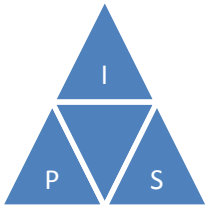
Site Name	Site Description
M20-06	M20 Creek: Reference site , upstream paired site
M20-04	M20 Creek: Impact site, downstream paired site
MR-9	Murray River: Reference site, upstream of all Murray River Project (MRP) influence
MR-4	Murray River: Impact site, downstream near-field site
MR-3	Murray River: Impact site, downstream near-field site
MR-7B	Murray River: Impact site; downstream of all MRP influence
MR-6	Murray River: Impact site, far-field downstream of all MRP influence
M19-01	M19 Creek: Reference site , upstream paired site
M19-02	M19 Creek Impact site, downstream paired site
M17-02	M17 Creek: Impact site, downstream unpaired site

3.1 AQUATIC HABITAT

Reach specific physical habitat data is summarized in Table 5. *In situ* water quality data showed that pH values were at or near 8.1 at each site. Specific Conductivity ranged from 105.8 to 495.5 µs/cm. Average water velocities ranged from 0.16 to 0.47 m/sec.

Table 5. Site specific habitat data for each aquatic life site sampled in August 2012.

Site	Reach Data	Samples Collected I=Invertebrates P=Periphyton S=Sediment all S*=Metals only
M20-06	Habitat Types: Riffle Canopy Coverage: 1-25% Streamside Vegetation: ferns, grasses, shrubs, deciduous and coniferous trees. Dominant Streamside Vegetation: Shrubs	
M20-04	Habitat Types: Riffle and straight run Canopy Coverage: 1-25% Streamside Vegetation: Shrubs, deciduous and coniferous trees. Dominant Streamside Vegetation: Shrubs	
MR-9	Habitat Types: Straight run Canopy Coverage: 0% Streamside Vegetation: Ferns/grasses, shrubs, deciduous and coniferous trees. Dominant Streamside Vegetation: Coniferous trees	
MR-3	Habitat Types: Riffle and straight run. Canopy Coverage: 0% Streamside Vegetation: Shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	
MR-4	Habitat Types: Riffle, straight run and pool/back eddy Canopy Coverage: 1-25% Streamside Vegetation: Shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	

Site	Reach Data	Samples Collected I=Invertebrates P=Periphyton S=Sediment all S*=Metals only
MR-7b	Habitat Types: Riffle and straight run. Canopy Coverage: 0% Streamside Vegetation: Shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	
MR-6	Habitat Types: Riffle Canopy Coverage: 0% Streamside Vegetation: Ferns, grasses, shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	
M19-01	Habitat Types: Riffle and pool/back eddy Canopy Coverage: 26-50% Streamside Vegetation: Ferns, grasses, shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	
M19-02	Habitat Types: Riffle and pool/back eddy Canopy Coverage: 1-25% Streamside Vegetation: Ferns, grasses, shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	
M17-02	Habitat Types: Riffle Canopy Coverage: 26-50% Streamside Vegetation: Ferns, grasses, shrubs, deciduous and Coniferous trees. Dominant Streamside Vegetation: Shrubs.	

3.2 STREAM SEDIMENTS

Sediment sampling occurred at all ten sites, and PAH samples were collected at seven of the ten sites: MR-6, MR-7b, M19-01, M19-02, M17-02, and M20-06. Sampling for PAHs was not done at Sites MR-4, MR-9 and M20-04 because sufficient sampling for PAH had been completed during past sampling events. MR-9 was located upstream of all current and proposed project activities. MR-3 was approximately 250m downstream of TC Creek which flows alongside the project south site. M20-04 and M20-06 were located downstream and upstream, respectively, of the project north sites settling pond outflow. MR-4 was located downstream of M20 Creek's confluence with the Murray River. Estimation was made to locate the site downstream of the zone of influence of M20 Creek. This estimation is not supported by any calculations, only a visual field assessment. MR-7b was situated downstream of both M17 and M19 Creek. This site represents the near-field site and is relatively close to the project footprint. MR-6 was the far-field site on the Murray River.

Physical Properties

Particle size analysis for the PAH samples showed that sand was the dominate particle size sampled in depositional zones at all seven of the sites. The average composition of the sand among sites was 58.3% (SD=13.8). M19-01 samples had the highest amount of sand with 76.0%, whereas M20-06 samples had the lowest concentration of sand with 42.0% (Table 6). The average site composition of silt was 31.1% (SD=9.7). M20-06, the upstream site on M20 Creek, had the highest silt content of 44.0%. Clay content was highest on the tributary creeks to the Murray River. M17, M19 and M20 Creek had a clay content range between 3.6 and 17.0%, where in the Murray clay content ranged between <2.0 and 7.2%. Gravel was the lowest in the compositional breakdown of the samples with an average of 2.7% (SD=1.1).

The pH was consistent over all seven sites with an average of 8.1 (SD=0.1). Moisture content of samples ranged between 31.0% at M19-01 and 41.0% at M17-02.

Table 6. Physical properties for sediment samples collected in August 2012.

Physical Properties	Units	MR-3	MR-6	MR-7B	MR17-02	MR19-02	M19-01	M20-06
Sand Content	%	60.2	74.0	54.0	50.0	52.0	76.0	42.0
Silt Content	%	32.2	24.0	39.0	34.0	26.0	18.8	44.0
Clay Content	%	6.6	<2.0	7.2	13.0	17.0	3.6	12.0
Gravel Content	%	2.7	<2.0	<2.0	2.9	4.8	2.7	<2.0
Moisture	%	36.0	32.0	37.0	41.0	31.0	38.0	36.0
pH, Soluble(2:1)	n/a	8.1	8.3	8.17	8.2	7.97	7.9	8.1

Metals

Metals analysis was done at all ten sites that were sampled in 2012. Analysis was done on particles smaller than 0.063 mm to target the silt and clay range. Average sieve analysis on each site can be found in Table 7. The primary component of the samples was >0.063 mm with this particle size averaging 70.4% composition (SD=7.5) (Table 8). The smallest grain size quantified was between 0.020 mm and 0.025 mm. Samples contained 1% of this particle size on average (SD=0.9).

Table 7. Composition of samples by particle size at each aquatic life site.

Physical Properties	Units	MR-3	MR-4	MR-6	MR-7B	MR-9	M17-02	M19-02	M19-01	M20-04	M20-06
Grain Size	N/A	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Sieve >0.063mm	%	77.4	78	73	63	73	66	75	79	61	59
Sieve >0.053mm	%	6.0	6.5	8.1	9.3	7.6	8.5	7.4	5.9	8.3	7.5
Sieve >0.045mm	%	3.8	3.9	4.7	6.3	4.7	6.3	5.4	3.8	7.2	6.6
Sieve >0.038mm	%	3.1	3.0	3.8	5.0	3.9	5.4	3.4	2.9	5.2	3.8
Sieve >0.032mm	%	1.9	1.8	2.0	2.8	2.1	3.7	2.2	1.8	11	21
Sieve >0.025mm	%	5.9	5.4	5.8	9.5	7.5	9.2	6.4	4.5	6.5	<0.2
Sieve >0.020mm	%	1.0	0.3	2.0	2.8	1.4	0.4	<0.2	1.1	<0.2	<0.2
Sieve Pan	%	0.9	0.8	1.1	1.4	<0.2	0.4	0.5	0.93	0.7	2.4

Table 8. Average composition by particle size among all aquatic life sites and replicate samples.

Physical Properties	Units	Average Composition Among Sites	Standard Deviation Among Sites	Within Site Standard Deviation(MR-3)
Sieve >0.063 mm	%	70.4	7.5	10.1
Sieve >0.053 mm	%	7.5	1.1	1.8
Sieve >0.045 mm	%	5.3	1.3	1.6
Sieve >0.038 mm	%	4.0	1.0	1.5
Sieve >0.032 mm	%	5.0	6.2	0.9
Sieve >0.025 mm	%	6.1	2.6	3.6
Sieve >0.020 mm	%	1.0	0.9	0.8
Sieve Pan	%	1.0	0.6	0.5

Thirty-two parameters were analyzed for total concentration using an Inductively Coupled Plasma Mass Spectroscopy (ICPMS). Table 9 summarizes the parameters that have BC or CCME ISQG water quality guidelines for sediment; the complete data set is provided in Appendix C. Cadmium concentrations at every site were elevated over the BC and CCME guideline of 0.6 mg/kg except at M19-01where the value was 0.5 mg/kg. All other metal parameters were within the federal and provincial guidelines at the 10 sites. There were consistently higher metal concentrations at M20-06 in comparison to the other ten sites.

Table 9. Total metals concentrations for sediment sampling collected in August 2012.

Metal Concentration (mg/kg)	MR-3	MR-4	MR-6	MR-7B	MR-9	M17-02	M19-02	M19-01	M20-04	M20-06	BC Guidelines	CCME ISQG
Arsenic	4.0	4.4	4.2	4.2	4.3	3.8	3.6	3.1	4.4	5.5	5.9	5.9
Cadmium	0.8	0.8	0.8	0.8	0.9	0.7	0.7	0.5	0.7	0.9	0.6	0.6
Chromium	12.7	12.1	11.7	11.5	12.1	13.5	13.4	10.0	9.3	13.4	37.3	37.3
Copper	18.9	22.7	26.6	18.7	15.4	23.5	25.9	22.1	22.0	29.6	35.7	35.7
Iron	14740	14450	14300	14800	15300	15500	16700	12650	13400	17500	21,200	
Lead	8	8	8	8	8	9	10	7	8	10	35	35
Manganese	250	245	226	245	238	266	267	230	226	336	460 SLC	
Mercury	0.05	0.05	0.05	0.05	0.05	0.07	0.06	0.05	0.05	0.06	0.17	0.17
Nickel	22	22	20	21	21	26	25	16	19	27	16-75 SLC	
Selenium	0.6	0.6	0.6	0.5	<0.5	0.7	0.8	0.5	0.7	1.2	2.0	
Silver	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.3	0.5	
Zinc	79	81	77	78	77	89	92	63	75	102	123	123

Notes: 1. Guideline values from the CCME and Working Water Quality Guidelines for BC. Values in orange exceeded guidelines.
2. SLC: Screening Level Concentrations.

Semi-volatile Organics

Twenty-four parameters were analysed for semi-volatile organics at seven of the ten sites. Table 10 shows the concentrations for all organics under the federal guidelines (CCME ISQG). There are no provincial guidelines available. Naphthalene concentration exceeded the CCME ISQG of 0.0346 mg/kg at six of the seven sites, with exceeding concentrations ranging between 0.0430 mg/kg at MR-7B to 0.0910 mg/kg at MR17-02. The concentration of 2-Methylnaphthalene surpassed the CCME ISQG limit of 0.0202 mg/kg at all seven sites with the highest vale being at M20-06 with a concentration of 0.4400 mg/kg. Phenanthrene levels exceeded the CCME guidelines of 0.0419 mg/kg at all seven sites, concentration ranged between 0.0518 mg/kg at M19-01 to 0.3300 mg/kg at site M20-06. All other semi-volatile organics were below the CCME ISQG guidelines

General observations are provided below to summarize the sediment results.

- M20-06 in most circumstances had predominately higher concentrations in both metals and semi-volatile organics analysis. The silt content in the physical properties showed that M20-06 had the highest content of silt. Dissolved metals and organics are more readily absorbed into finer particulate size. M20 Creek had an abundant amount of natural sediment sources due to sloughing banks of finer textured material and this may contribute to the higher concentrations.

- Selenium levels at all sites were below the provincial guidelines of 2.0 mg/kg. Concentrations ranged from 0.5 mg/kg to 1.2 mg/kg at M20-05.

Table 10. Semi-volatile organics for sediment sampling conducted in August 2012

Metal Concentration (mg/kg)	MR-3	MR-6	MR-7B	M17-02	M19-02	M19-01	M20-06	CCME ISQG
Naphthalene	0.0494	0.0580	0.0430	0.0910	0.0450	0.0265	0.0870	0.0346
2-Methylnaphthalene	0.0870	0.0890	0.0790	0.2700	0.1000	0.0523	0.4400	0.0202
Acenaphthylene	0.00266	0.00240	0.00240	0.00560	0.00220	0.00168	0.01200	0.00587
Acenaphthene	0.00147	0.00055	0.00071	0.00250	0.00068	0.00105	0.00250	0.00671
Phenanthrene	0.1048	0.0950	0.0950	0.1600	0.0810	0.0518	0.3300	0.0419
Fluoranthene	0.010	0.008	0.009	0.012	0.007	0.005	0.019	0.111
Pyrene	0.018	0.013	0.015	0.021	0.012	0.013	0.031	0.053
Benzo(a)anthracene	0.0039	0.0037	0.0038	0.0076	0.0033	0.0028	0.0059	0.0317
Benzo(a)pyrene	0.0027	0.0012	0.0014	0.0050	0.0026	0.0024	0.0050	0.0319
Dibenz(a,h)anthracene	0.00332	0.00280	0.00330	0.00610	0.00260	0.00213	0.00610	0.00622

Note:. Values in orange exceeded CCME guidelines.

3.3 BENTHIC INVERTEBRATES

The Hilsenhoff Biotic Index (HBI) indicated excellent to very good water quality with no apparent organic pollution at nine of the ten benthic invertebrates sites (Table 11, Appendix D). HBI is a relative scoring system where higher scores indicate organic pollution and lower scores indicate the best water quality. M17-02, the only site on M17 Creek, had a higher index number than the other sites of 4.9 (SD= 0.4). This HBI score indicates a good water quality with some organic pollution. Other general observations that summarize the benthic invertebrate results are as follows.

- MR-9 displayed a low quantity of benthic invertebrates compared to the other sites and the previous year. Many variables have the potential to affect benthic habitat at the MR-9 site from previous years including environmental and habitat variables. In this case it is suspected that water levels contributed to differences in the samples. In 2011 the water level was much higher which resulted in large differences in the water depth, light attenuation, and substrate where sampling occurred. In 2012, in the same sample location the substrate was boulder sized rather than cobble, the sample area was in deeper water near a drop off in depth rather than shallower water along a flatter profile.

- Total benthic invertebrate density demonstrated considerable variability within sites, shown in the high standard deviations compared to the site means. Taxa richness values had somewhat less variability within the site standard deviations. It is typical with invertebrate data to have wide variability and this is why multiple years of sampling are needed in order to have appropriate statistical power to conduct a before-after control-impact study design. It is an advantage to use the CABIN system because a test site will be compared to multiple years of publically available reference data across numerous sites in the region.

Benthic invertebrate data are summarized into various metrics used to show community composition, pollution indicators and taxa diversity. Metals analysis was also completed on tissue samples at all ten of the sites. Raw data is provided in Appendix D.

M20-06

M20-06 was the reference site upstream of discharge and primary potential impact site on M20 Creek. The mean benthic invertebrate abundance was 1,442.7 individuals (SD=231.3), which was the lower count for the two sites on M20 Creek (Table 11). The taxa richness was 42.7 (SD=3.8), with 22.0 (SD=2.0) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 3.0 (SD=0.0), suggesting excellent water quality with no apparent organic pollution.

M20-04

M20-04 was the test site downstream of discharge and primary potential impact site on M20 Creek. The mean benthic invertebrate abundance was 3,562 individuals (SD=2,064.3), which was the greatest count for the two sites located on M20 Creek. This site displayed the greatest abundance in the 2012 Murray River monitoring program (Table 11). The taxa richness was 39.7 (SD=6.5) with 22.0 (SD=1.0) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 2.6 (SD=0.6) which indicated excellent water quality with no apparent organic pollution.

MR-9

MR-9 was the upstream control site for the Murray River. The mean benthic invertebrate abundance was 60.3 individuals (SD=70.1), which was the lowest count for the Murray River monitoring program (Table 11). The mean taxa richness was 11.7 (SD=5.1), with 6.8 (SD=4.2) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 1.6 (SD=0.6), indicating excellent water quality with no apparent organic pollution.

MR-3

MR-3 was approximately 250 m downstream of TC Creek which flows alongside the project south perimeter. The mean benthic invertebrate abundance was 124.0 individuals (SD=43.0), which was the second lowest count for the Murray River monitoring program (Table 11). The mean taxa richness was 25.3 (SD=4.5) diffent taxa with 9.7 (SD=0.6) of these being from the EPT group (Table 11). The Hilsenhoff Biotic Index was 1.6 (SD=3.3) which indicated excellent water quality with no apparent organic pollution.

MR-4

MR-4 was a Murray River near field site, situated approximately 100 m downstream of M20 Creek. The mean benthic invertebrate abundance was 233.0 individuals (SD=114.9), which was the third highest count for the Murray River monitoring sites (Table 11). The mean taxa richness was 37.0 (SD=8.9) with 15.3 (SD=2.9) of these being from the EPT group (Table 11). The Hilsenhoff Biotic Index was 2.4 (SD=0.7) which indicateed excellent water quality with no apparent organic pollution.

MR-7B

MR-7B was a Murray River near field site downstream of the project footprint. The mean benthic invertebrate abundance was 563.4 individuals (SD=120.2), which was the second highest count for the Murray River monitoring sites (Table 11). The mean taxa richness was 44.0 (SD=12.8) with 23.0 (SD=4.6) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 1.6 (SD=0.2) which indicated excellent water quality with no apparent organic pollution.

MR-6

MR-6 was the Murray River far field site was located downstream of the project footprint. The mean benthic invertebrate abundance was 2,284.0 individuals (SD=400.8), which was the highest count for the Murray River monitoring sites (Table 11). The taxa richness was 42.7 (SD=2.5) with 19.7 (SD=1.5) of these being from the EPT group (Table 11). The Hilsenhoff Biotic Index was 2.3 (SD=0.2) which indicates excellent water quality with no apparent organic pollution.

M19-01

M19-01 was the reference site upstream of proposed project facilities. The mean benthic invertebrate abundance was 2,197.7 individuals (SD=296.8). Abundance was greater at this site than at the downstream site M19-02 (Table 11). The mean taxa richness was 40.3 (SD=3.2) with 19.3 (SD=0.6) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 2.5 (SD=0.1) indicated excellent water quality with no apparent organic pollution.

M19-02

M19-02 was the test site downstream of proposed project facilities. The mean benthic invertebrate abundance was 1,841.0 individuals (SD=182.3), which was the lowest count of the two monitoring sites on M19 Creek (Table 11). The mean taxa richness was 34.7 (SD=4.0) with 14.3 (SD=2.9) of these being from the EPT group (Table 11). The mean Hilsenhoff Biotic Index was 4.4 (SD=0.5) indicating very good water quality with slight organic pollution.

M17-02

M17-02 was the test site downstream of proposed project facilities on M17 Creek. The mean benthic invertebrate abundance was 1,824.5 individuals (SD=660.6), which was the fourth highest count for all of the monitoring sites on Murray River (Table 11). The taxa richness was 45.7 (SD=3.8), with 17.7 (SD=3.8) of these being from the EPT group (Table 11). The average Hilsenhoff Biotic Index was 4.9 (SD=0.4) which indicates good water quality with some organic pollution.

Table 11. Summary of benthic invertebrate metrics 2012. Mean statistic is shown for each site with standard deviation in parentheses.

Metric	M20-06	M20-04	MR-9	MR-3	MR-4	MR-7B	MR-6	M19-01	M19-02	M17-02
Total Density	1442.7 (231.3)	3562.3 (2064.3)	60.3 (70.1)	124.0 (43.0)	233.0 (114.9)	563.4 (120.2)	2284.0 (400.8)	2197.7 (296.8)	1841.0 (182.3)	1824.5 (660.6)
Species Richness	42.7 (3.8)	39.7 (6.5)	11.7 (5.1)	25.3 (4.5)	37.0 (8.9)	44.0 (12.8)	42.7 (2.5)	40.3 (3.2)	34.7 (4.0)	45.7 (3.8)
EPT Richness	22.0 (2.0)	22.0 (1.0)	6.7 (4.2)	9.7 (0.6)	15.3 (2.9)	23.0 (4.6)	19.7 (1.5)	19.3 (0.6)	14.3 (2.9)	17.7 (3.8)
Hilsenhoff Biotic Index	3.0 (0.0)	2.6 (0.6)	1.6 (0.6)	3.3 (0.4)	2.4 (0.7)	1.6 (0.2)	2.3 (0.2)	2.5 (0.1)	4.4 (0.5)	4.9 (0.4)
% Ephemeroptera	35.5 (3.9)	28.2 (5.2)	36.1 (11.2)	9.4 (2.5)	32.2 (8.6)	50.3 (11.9)	38.0 (2.6)	53.8 (1.3)	16.4 (6.7)	7.6 (2.9)
% Plecoptera	28.9 (5.3)	47.4 (16.8)	34.7 (19.6)	16.2 (6.9)	13.1 (2.2)	15.1 (6.8)	23.3 (2.3)	15.4 (5.8)	14.9 (3.6)	13.0 (2.8)
% Trichoptera	2.7 (0.7)	3.1 (1.6)	1.0 (1.7)	1.6 (1.0)	2.7 (1.8)	5.0 (0.7)	11.2 (4.8)	7.0 (1.7)	3.6 (1.8)	7.0 (1.4)
% Diptera	30.9 (1.8)	19.4 (12.3)	19.3 (17.7)	43.4 (6.6)	35.4 (4.2)	16.4 (2.7)	15.0 (2.7)	13.3 (1.3)	56.1 (9.1)	61.2 (6.9)

3.4 PERIPHYTON

In summary, some general observations are provided based on the results below:

- Periphyton results showed considerable variability among sample replicates demonstrated by high standard deviations, indicating there is a high degree of within-site variability among samples.
- The Murray River sites had lower cell densities compared to the smaller tributary streams flowing into the Murray M19 Creek, M17 Creek and M20 Creek. This could be the result of a number of different variables, including percentage of shade, water clarity, water velocity, and water quality (Azim *et al.* 2005).

Periphyton data is summarized into species richness, taxa diversity and biomass (Chlorophyll *a*), these values can be found in Tables 12, 13 and 14. Chlorophyll *a* indicates the total amount of autotrophic organisms in the sample, therefor the higher the chlorophyll *a* values the greater the amount of periphyton present in the sample. Metals analysis on periphyton tissue was completed at all ten of the sites. Additional data is provided in Appendix E.

Table 12. Periphyton species richness for Murray River Aquatic Monitoring Sites 2012.

Site	Richness			
	Min	Max	Mean	SD
M20-06	9.0	10.0	9.3	0.6
M20-04	8.0	8.0	8.0	0.0
MR-9	10.0	12.0	11.3	1.2
MR-3	10.0	12.0	11.0	1.0
MR-4	9.0	14.0	10.7	2.9
MR-7B	9.0	11.0	10.3	1.2
MR-6	13.0	14.0	13.3	0.6
M19-01	7.0	10.0	8.3	1.5
M19-02	8.0	11.0	9.0	1.7
M17-02	8.0	13.0	9.7	2.9

Table 13. Periphyton density for the Murray River Aquatic Monitoring Sites 2012.

Site	Density (# of Cells)			
	Min	Max	Mean	SD
M20-06	19,783,908.0	56,516,214.3	36,578,073.0	1,856,689.7
M20-04	28,030,675.0	161,024,884.0	86,448,480.9	67,953,587.9
MR-9	20,895,996.4	55,857,714.2	42,114,902.5	18,641,336.3
MR-3	19,197,268.3	102,281,431.1	57,817,510.3	41,849,208.1
MR-4	6,425,975.2	73,240,211.6	39,164,682.2	33,427,172.6
MR-7B	49,056,761.3	54,981,322.6	51,401,906.7	7,366,876.0
MR-6	15,175,406.7	23,664,200.8	1,517,506.8	3,149,233.9
M19-01	118,134,968.2	427,061,405.9	28,408,367.7	155,738,708.1
M19-02	452,989,367.6	535,070,597.1	497,661,913.2	41,519,932.8
M17-02	373,678,730.2	50,391,710.8	456,510,328.4	71,934,656.0

Table 14. Chlorophyll *a* analysis for the 2012 Murray River Aquatic Monitoring Sites.

Site	Chlorophyll a (µg/cm²)			
	Min	Max	Mean	SD
M20-06	0.06	0.20	0.13	0.06
M20-04	0.18	0.32	0.25	0.05
MR-9	0.04	0.53	0.17	0.19
MR-3	0.43	0.95	0.66	0.19
MR-4	0.04	0.46	0.17	0.18
MR-7B	0.03	0.24	0.10	0.09
MR-6	0.40	0.58	0.49	0.07
M19-01	0.15	0.43	0.31	0.12
M19-02	0.26	0.72	0.50	0.15
M17-02	0.10	1.43	0.83	0.51

M20-06

The average periphyton density at M20-06 was 36,578,073.0 cells (SD=1,856,689.7) (Table 13). The mean species richness was 9.3 taxa per sample (SD=0.6) (Table 12). The dominant species that made up the taxa density was*Gomphonema sp* (Appendix E). M20-06 chlorophyll *a* concentrations was the second lowest of all the 2012 sites sampled with a mean value of 0.13µg/cm² (SD=0.06).

M20-04

M20-04 had the highest mean density of the two sites on M20 Creek with an average density of 86,448,480.9 cells (SD=67,953,587.9) (Table 13). There was an average species richness of 8.0 species per replicate (SD=0.0) (Table 12). The two primary species were *Gomphonema sp.* and *Coconeis sp.* (Appendix E). M20-04 chlorophyll *a* concentrations was the fifth lowest of all the sites sampled with a mean value of 0.25µg/cm² (SD=0.05).

MR-9

The average periphyton density at MR-9 was 42,114,902.5 cells (SD=18,641,336.2) (Table 13). The mean species richness of the site was 11.3 taxa per sample (SD=1.2). There were two species that primarily made up the taxa density, *Cymbella sp. and Gomphonema sp.* (Appendix E). MR-9 chlorophyll *a* concentrations were one of the lowest on the Murray River sites with a mean value of 0.17µg/cm² (SD=0.19). This value could be attributed to the deeper water depths observed at the site.

MR-3

MR-3 had the highest mean density of all the Murray River sites within the monitoring program with a mean density of 57,817,510.3 cells (SD=41,849,208.1). There was an average species richness of 11 species per replicate (SD=1) (Table 12). The species abundance varied among replicates but on average *Achnanthes sp.* was most dominant followed by *Gomphonema sp.* (Appendix E). The site also had the highest biomass of the Muarry River sites with a mean value of 0.66 ug.cm² (SD=0.19) chlorophyll *a* (Table 14).

MR-4

The average periphyton density at MR-4 was 39,164,682.22 cells (SD=33,427,172.6) (Table 13). The mean species richness of the site was 10.67 taxa per sample (SD=2.9). There were two species that primarily made up the taxa density, *Gomphonema sp.* and *Cymbella sp.* (Appendix E). MR-4 chlorophyll *a* concentrations were one of the lowest on the Murray River sites with a mean value of 0.17µg/cm² (SD=0.18) indicating a lower biomass. This value may also be attributed to the deeper water depths observed at the site.

MR-7B

The average periphyton density at MR-7B was 51,401,906.7 cells (SD=7,366,876.0) (Table 13). The mean species richness of the site was 10.3 taxa per sample (SD=1.2). The species that primarily made up the taxa was *Gomphonema sp.* (Appendix E). MR-7B chlorophyll *a* concentrations was the lowest of all the sites sampled with a mean value of 0.10µg/cm² (SD=0.09).

MR-6

MR-6 had the lowest mean density of all the sites within the monitoring program, with a mean density of 1,517,506.8 cells (SD=3,149,233.9). There was an average species richness of 13.3 species per replicate (SD=0.6) (Table 12). The two primary species that composed the taxa were *Synedra sp.* and *Cymbella sp.* (Appendix E). The site also had the second highest biomass of the Murray River sites with a value of 0.49µg.cm² (SD=0.07) chlorophyll *a* (Table 14).

M19-01

M19-01 had the second lowest mean density of all the sites within the monitoring program, with an average density of 28,408,367.7 cells (SD=155,738,708.1). The average species richness was 8.3 species per replicate (SD=1.5) (Table 12). *Gomphonema sp.* was the dominate speceis at this site (Appendix E). The site had the lowest biomass of the two sites on M19 Creek with a mean value of 0.31µg.cm² (SD=0.12) chlorophyll *a* (Table 14).

M19-02

M19-02 had the highest mean density of all the sites within the monitoring program, with a density of 497,661,913.2 cells (SD=41,519,932.9). The average species richness was 9.0 species per replicate (SD=1.7) (Table 12). *Achnanthes sp.* and *Navicula sp.* were the two primary species encountered at this site (Appendix E). The site had the highest biomass of the two sites on M19 Creek with a mean value of 0.50µg.cm² (SD=0.15) chlorophyll *a* (Table 14).

M17-02

M17-02 had the second highest mean density of all the sites within the monitoring program, with a mean density of 456,510,328.4 cells (SD=71,934,656.0). The average species richness for this site was 9.7 species per replicate (SD=2.9) (Table 12). The two dominate species were *Achnanthes sp.* and *Gomphonema sp.* (Appendix E). This site had the highest biomass of all sites sampled in 2012, with a mean value of 0.83µg.cm² (SD=0.51) chlorophyll *a* (Table 13).

4 RECOMMENDATIONS

This is the third year of Aquatic Life baseline sampling completed on the Murray River Project. Annual reports have been technical data reports, similar to this one. It is recommended that the data from the past three years be compiled into a single baseline technical report. The report should include power analysis to ensure that the desired sampling effort has been completed during baseline data collection to statistically detect a potential effect in the post-impact period. If the power analysis shows that there is not enough consecutive data at specific sites it will be recommended where additional sampling should be completed. The Aquatic Life Baseline Program was designed by EDI with input from BC MOE to meet the goal of effects detection. Power analysis would demonstrate that an appropriate baseline sampling program has been completed.

Sites located downstream of confluences of M17, M19, and M20 Creeks had the goal of being below the zone of influence on the Murray River. Sites were established based on visual observation. Confirmation is recommended to ensure that the sites are located downstream of suspected zones of influence. Various techniques can be used to estimate the mixing zone. The technique of using dye can be used on these stream confluences to get a visual demonstration and measurement of zones of influence to determine whether downstream sites are placed appropriately. The dye technique is recommended because it can be done with low investment of resources and it will provide the desired data. In this case it will provide a defined distance on the Murray that is influenced by each tributary of interest. It can be done in various flow regimes if desired to provide the range of mixing zone throughout a typical season. It would be valuable to use dye at all three confluences, but at a minimum it is recommend to be used at the confluence of M20 Creek. M20 Creek is expected to have the most direct potential influence from the mine facilities.

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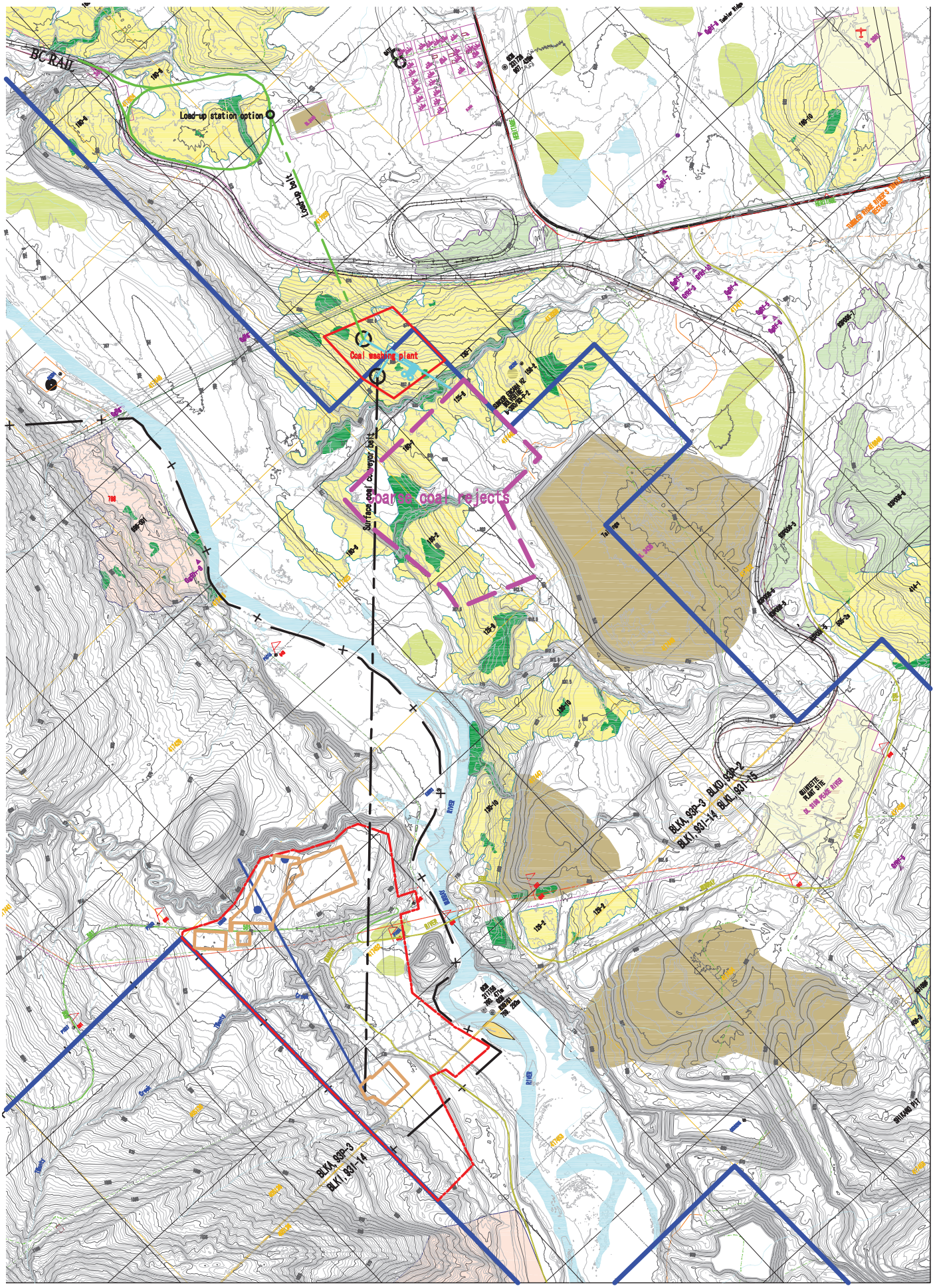
APPENDIX A MURRAY RIVER COARSE COAL REJECT AND LOAD–UP STATION OPTIONS


BC RAIL
Load-up station option
Load-up belt
Coal washing plant
Surface coal conveyor belt
coarse coal rejects
BLK. 93P-3
BLK. 93J-14
BLK. 93P-2
BLK. 93J-15
BLK. 93P-3
BLK. 93J-14

APPENDIX B EMAIL CORRESPONDENCE WITH MOE

Email Correspondence from MoE

Hi Cathy and Mike,

For your comments/edits. I may have missed stuff from later in our discussion. I'll finalize with your comments on Monday and distribute to the larger group.

Thank you both for this morning's discussions. As mentioned on the call, I feel we have a very good team working on Murray baseline development. The open communication is appreciated. With firming up of HD's development plans for both the bulk sample and full production (including North discharge to M20 Ck, South decline discharge to ground, and the potential for Coarse Coal Refuse east of the Murray), we are better able to design water quality and biological monitoring for both development stages. The North Pond discharge into M20 Creek, which I anticipate for sometime after this fall, also allows extension of what could be considered baseline for the bulk sample phase. Thanks to Rescan and EDI for your efforts to date.

- This discussion did not include of fisheries or fish tissue. Reference to water quality monitoring was general in nature.

- Reference below to biological sampling usually includes benthic invertebrate (BI) and periphyton population, density and tissue chemistry and sediment chemistry.

- MR7 and MR7b – We agree that MR7 (west side Murray) will be relocated to east side of Murray d/s of M19 coarse coal refuse and named MR7b, thus becoming a near-field site for the coarse coal refuse. Water quality and biological (2011) baseline have been collected at MR7 and will be included in baseline writeup. Both water quality and biology will shift to MR7b, with MR7 water quality continued on a quarterly basis for one year to allow comparison between east and west. MR4 will continue to act as near field on West side of Murray for M20 Ck dilution. MR6 will be the far-field site for full mixing of M17, M19, M20 Creeks into Murray. Dilutions estimates for each tributary into Murray should be provided to support these site locations and should be included in the EA application.

- Mike will look into flow monitoring recent history and future plans for M19, M17 and M20?? Old Hermann EA Application will include flow data for M20 Creek, perhaps only for M20-03. Old Qunitette reports (from operational phase) should include flow data for M17 and M19.

.- We are agreed with Mike's suggestion to monitor a continuum of sites in one year, focussing this year on the Murray.

- The addition of M20-06 to the biological baseline will account for the possibility of groundwater effects from the North Shaft site to M20 Ck. M20-05 will continue in the baseline program as a reference site, but was fully sampled in 2011, so does not require sampling this year. M20-05 may be compromised in

future by proximity of natural slide zone and very high TSS in M20 Creek. M20 Creek above the North Shaft site but well below M20-05 are not accessible due to extreme valley wall slopes.

- Depositional sediment zones (or good biological zones for that matter) don't necessarily line up with chosen water quality sites. We agree that these locations may need to vary from the associated water quality sites. We agree with Maxxam's recommendation to collect additional fine sediment volumes. Bags should work well for this. Remember that you can collect larger bulk samples (collect 1000 mL rather than typical 500 mL).

- Good discussion occurred on MR3. Located between M20 Ck and South Decline water discharge to ground, this site will initially function as a second reference to M20 Ck (with MR9). During operational mine life (perhaps late into this period), it will function as a near-field site for the South Decline discharge to ground. MR3 appears to be regularly sampled for WQ baseline and is a required site for the bulk sample. Partial biology was done in 2010. MR3 should be sampled again to fill gaps, during 2012 if possible. Agreed, this can be a low priority for 2012 given that the site will remain a reference, assumed for several years. If not sampled biologically this year, then as part of a 2013 supplemental program.

- North Pond can be expected to discharge mineralized water some time prior to the 2013 Aug/Sept biological field season. Accordingly, sites in M20 Creek and in Murray downstream of the future M20 North Pond discharge should be priorities for 2012 (biological sampling).

-With focus now on two reference sites on both M20 Creek and Murray River, agreed that we can cancel the named sites MR-001, 002, 003.

- It is agreed that the sediment program has a higher status than tissue metals and should include 3 (or 4??) replicates at each site if time allows. Minimum requirement for 2012 is one site 5 reps, most sites 1 rep, ever third site for a "split". If the "5 reps at one site" does not provide low variance, we will need to reconsider a program of replicates for 2013. Sediment PAH will be done at 1 rep/site for those sites lacking 2010 or 2011 PAH data (supplemental).

- BI at all sites will use CABIN methods, but will collect 3 kick reps per site to allow BACI application. BI sample replicates will be sorted (from debris) but not sorted to analyze a target species. **Question not discussed this morning - Are you providing a general indication of BI tax used for tissue analysis, or can we assume the CABIN will do the same? Will you be collecting the BI metals in riffle zones?**

- It is agreed that for periphyton: 3 reps for community composition, 6 for chlorophyll.

- tissue for metals analysis (BI and periphyton): use basic program from Tissue Chapter of mine guidance doc. 1 composited rep per site, "splits" every third site, use a rich site for 5 reps to determine variability and validity of the single replicate approach. Do periphyton tissues for metals where possible (focussing on abundant (filamentous) populations if present). Mike is cautious of value of doing

periphyton metals due to potential for attached materials, so he supports use of basic program. Please refer to guidance doc with regard to high moisture content, analysis wet or dry, and actual measurement of moisture content.

- Rescan (Mike?) to update Bruce on status of fish tissue program.

Thanks, Bruce

APPENDIX C SEDIMENT RAW DATA

RESULTS OF CHEMICAL ANALYSES OF SEDIMENT (Metals)																			
		MR3 REP1	**MR3 REP2**	**MR3 REP3**	**MR3 REP4**	**MR3 REP5**	**MR4 1A**	**MR4 1B**	**MR6**	**MR7B**	**MR9**	**MR17-02**	**MR19-02**	**M19-01 A**	**M19-01 B**	**M19-01 C**	**M19-01 D**	**M20-04**	**M20-06**
Maxxam ID		EK8760	EK8761	EK8762	EK8763	EK8764	EK8765	EK8766	EK8767	EK8768	EK8769	EK8770	EK8771	EK8793	EK8794	EK8795	EK8796	EK8797	EK8798
Sampling Date		29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	31/08/2012	30/08/2012	30/08/2012	31/08/2012	31/08/2012	31/08/2012	31/08/2012	28/08/2012	30/08/2012
	UNITS																		
Physical Properties																			
Soluble (2:1) pH	pH Units	8.21	8.12	8.16	8.13	8.10	8.22	8.33	8.27	8.17	8.20	8.16	7.97	7.90	7.82	7.99	8.00	8.35	8.14
Physical Properties																			
Grain Size	N/A	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE	FINE
Sieve - #230 (>0.063mm)	%	89	86	77	67	68	75	81	73	63	73	66	75	78	77	80	81	61	59
Sieve - #270 (>0.053mm)	%	4.1	4.3	6.0	7.7	7.8	7.4	5.6	8.1	9.0	7.6	8.5	7.4	5.8	5.8	6.0	6.1	8.3	7.5
Sieve - #325 (>0.045mm)	%	2.1	2.2	4.1	5.4	5.2	4.4	3.4	4.7	6.3	4.7	6.3	5.4	4.1	3.9	3.7	3.5	7.2	6.6
Sieve - #400 (>0.038mm)	%	1.4	1.8	3.3	4.7	4.5	3.4	2.5	3.8	5.0	3.9	5.4	3.4	3.1	3.1	2.8	2.7	5.2	3.8
Sieve - #450 (>0.032mm)	%	0.91	1.1	1.7	3.0	2.6	2.0	1.5	2.0	2.8	2.1	3.7	2.2	1.9	2.1	1.8	1.5	11	21
Sieve - #500 (>0.025mm)	%	2.0	2.3	7.3	10	8.0	6.5	4.3	5.8	9.5	7.5	9.2	6.4	5.5	6.0	3.3	3.0	6.5	<0.20
Sieve - #635 (>0.020mm)	%	0.55	0.77	0.42	0.79	2.5	0.20	0.38	2.0	2.8	1.4	0.44	<0.20	0.94	0.94	1.4	1.1	<0.20	<0.20
Sieve - Pan	%	0.2	1.2	0.76	0.61	1.5	0.68	0.99	1.1	1.4	<0.20	0.35	0.52	0.68	1.1	0.74	1.2	0.68	2.4
RDL = Reportable Detection Limit																			
EDL = Estimated Detection Limit																			

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)																					
Sample ID				MR3 REP1	MR3 REP2	MR3 REP3	MR3 REP4	MR3 REP5	MR4 1A	MR4 1B	MR6	MR7B	MR9	MR17-02	MR19-02	M19-01 A	M19-01 B	M19-01 C	M19-01 D	M20-04	M20-06
Maxxam ID				EK8760	EK8761	EK8762	EK8763	EK8764	EK8765	EK8766	EK8767	EK8768	EK8769	EK8770	EK8771	EK8793	EK8794	EK8795	EK8796	EK8797	EK8798
Sampling Date				29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	31/08/2012	30/08/2012	30/08/2012	31/08/2012	31/08/2012	31/08/2012	31/08/2012	28/08/2012	30/08/2012
	UNITS	Working Water Quality Guidelines for BC	CCME Sediment Quality Guidelines for the Protection of Aquatic Life																		
Total Metals by ICPMS																					
Total Aluminum (Al)	mg/kg			5420	5810	7110	7610	7240	6440	6360	6520	6510	6680	7670	8170	6250	6870	5770	5180	5060	7580
Total Antimony (Sb)	mg/kg			0.35	0.39	0.46	0.50	0.44	0.48	0.44	0.39	0.43	0.46	0.45	0.46	0.28	0.28	0.26	0.23	0.49	0.62
Total Arsenic (As)	mg/kg	5.9	5.9	3.68	3.52	4.39	4.38	4.14	4.47	4.39	4.19	4.20	4.31	3.83	3.61	3.28	3.06	3.17	2.79	4.44	5.47
Total Barium (Ba)	mg/kg			133	135	130	131	131	184	193	137	134	134	321	221	199	196	177	157	393	457
Total Beryllium (Be)	mg/kg			0.41	0.43	<0.40	<0.40	0.48	<0.40	0.45	0.44	<0.40	<0.40	<0.40	0.51	<0.40	<0.40	<0.40	<0.40	<0.40	0.43
Total Bismuth (Bi)	mg/kg			<0.10	<0.10	0.11	0.11	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	0.11
Total Cadmium (Cd)	mg/kg	0.6	0.6	0.649	0.839	0.937	0.956	0.847	0.840	0.836	0.798	0.765	0.895	0.673	0.736	0.518	0.470	0.526	0.446	0.685	0.879
Total Calcium (Ca)	mg/kg			45500	46500	47500	48400	46900	46200	46300	47800	48300	50400	30900	27100	16700	15300	13700	13400	34000	48100
Total Chromium (Cr)	mg/kg	37.3	37.3	10.9	11.4	13.6	13.6	14.2	12.1	12.1	11.7	11.5	12.1	13.5	13.4	10.3	11.2	9.7	8.7	9.3	13.4
Total Cobalt (Co)	mg/kg			5.09	5.28	6.43	6.63	6.41	5.89	5.92	5.56	5.77	5.94	7.49	7.54	5.51	5.36	4.66	4.17	5.75	8.42
Total Copper (Cu)	mg/kg	35.7	35.7	17.9	16.9	19.2	17.5	23.2	19.0	26.4	26.6	18.7	15.4	23.5	25.9	17.7	26.8	18.0	26.0	22.0	29.6
Total Iron (Fe)	mg/kg	21,200		12500	12800	15700	16700	16000	14400	14500	14300	14800	15300	15500	16700	13400	13100	12500	11600	13400	17500
Total Lead (Pb)	mg/kg	35	35	6.95	7.53	9.08	9.23	9.11	8.13	8.44	7.97	8.20	8.38	9.05	9.83	7.20	7.51	6.68	5.97	7.85	10.4
Total Lithium (Li)	mg/kg			8.3	8.6	11.7	13.2	12.6	10.6	9.8	9.8	10.6	10.3	11.7	11.7	8.6	8.9	8.0	7.5	7.4	10.7
Total Magnesium (Mg)	mg/kg			17200	17700	18100	18100	17800	17000	17000	17500	17700	18200	10600	10700	6850	6470	5860	5720	11100	14500
Total Manganese (Mn)	mg/kg	460 SLC		208	211	266	287	276	250	240	226	245	238	266	267	290	266	194	171	226	336
Total Mercury (Hg)	mg/kg	0.17	0.17	<0.050	<0.050	<0.050	<0.050	<0.050	0.053	<0.050	<0.050	0.054	<0.050	0.072	0.064	0.058	0.050	<0.050	<0.050	<0.050	0.064
Total Molybdenum (Mo)	mg/kg			1.17	1.14	1.31	1.31	1.28	1.16	1.20	1.15	1.12	1.35	0.90	0.90	0.50	0.52	0.56	0.52	0.98	1.31
Total Nickel (Ni)	mg/kg	16-75 SLC**		19.4	20.1	23.5	24.4	23.9	21.3	21.8	20.4	21.2	21.4	26.4	24.6	18.2	17.7	15.5	14.1	19.1	27.0
Total Phosphorus (P)	mg/kg			1030	1010	1000	1010	978	999	1030	950	986	1000	766	806	801	770	756	700	770	882
Total Potassium (K)	mg/kg			1020	1090	1140	1180	1130	1110	1070	1100	1030	1060	1320	1300	836	915	783	714	948	1410
Total Selenium (Se)	mg/kg	2		0.51	0.52	0.74	0.72	<0.50	0.61	0.61	0.62	0.51	<0.50	0.71	0.79	<0.50	0.50	0.51	<0.50	0.73	1.20
Total Silver (Ag)	mg/kg	0.5		0.120	0.149	0.154	0.200	0.166	0.175	0.169	0.132	0.148	0.137	0.191	0.199	0.161	0.149	0.155	0.134	0.186	0.269
Total Sodium (Na)	mg/kg			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	134	<100	<100	<100	119
Total Strontium (Sr)	mg/kg			50.7	51.2	55.6	56.9	54.7	54.3	53.9	52.5	53.9	56.7	46.0	34.2	24.6	23.5	21.8	20.0	50.4	70.3
Total Thallium (Tl)	mg/kg			0.153	0.166	0.212	0.210	0.191	0.168	0.166	0.167	0.179	0.178	0.175	0.176	0.102	0.110	0.091	0.090	0.112	0.186
Total Tin (Sn)	mg/kg			0.26	0.25	0.28	0.25	0.23	0.22	0.23	0.22	0.22	0.20	0.23	0.26	0.24	0.21	0.24	0.18	0.17	0.28
Total Titanium (Ti)	mg/kg			10.4	13.2	14.4	16.7	21.9	17.6	13.1	13.2	9.5	10.5	41.5	19.7	12.2	8.4	9.1	12.9	24.8	41.0
Total Uranium (U)	mg/kg			0.847	0.871	0.841	0.841	0.821	0.831	0.873	0.772	0.822	0.839	0.726	0.687	0.590	0.578	0.534	0.486	0.663	0.847
Total Vanadium (V)	mg/kg			27.1	29.1	32.8	33.7	32.8	29.0	29.6	28.6	30.2	31.0	27.8	28.4	21.9	23.1	19.7	17.9	20.4	28.5
Total Zinc (Zn)	mg/kg	123	123	68.4	71.4	83.4	87.6	83.6	78.6	84.1	77.2	77.6	76.6	89.1	91.7	64.3	66.2	60.7	61.5	75.2	102
Total Zirconium (Zr)	mg/kg			0.73	0.81	0.80	0.83	0.90	0.74	0.71	0.66	0.74	0.69	1.36	1.05	0.57	0.56	<0.50	0.55	0.93	0.99

Sediment Physical Properties																			
Physical Properties	**Units**	**MR3 REP 1**	**MR3 REP 2**	**MR3 REP 3**	**MR3 REP 4**	**MR3 REP 5**	**MR6**	**MR7B**	**MR17-02**	**MR19-02**	**MR19-01A**	**MR19-01B**	**MR19-01C**	**M19-01 D**	**M20-06**				
% sand by hydrometer	%	64	62	72	58	45	74	54	50	52	73	74	77	80	42				
% silt by hydrometer	%	31	30	24	31	45	24	39	34	26	20	18	19	18	44				
Clay Content	%	5	7.7	3.6	5.6	11	<2.0	7.2	13	17	3.9	4	4	2.4	12				
Gravel	%	<2.0	<2.0	<2.0	5.6	<2.0	<2.0	<2.0	2.9	4.8	3.3	3.3	<2.0	<2.0	<2.0				
Moisture	%	32	38	30	33	47	32	37	41	31	38	37	28	37	36				
Physical Properties	**Units**	**MR3 REP 1**	**MR3 REP 2**	**MR3 REP 3**	**MR3 REP 4**	**MR3 REP 5**	**MR6**	**MR7B**	**MR17-02**	**MR19-02**	**MR19-01A**	**MR19-01B**	**MR19-01C**	**M19-01 D**	**M20-06**	**MR-9**	**M20-04**		
Soluble (4: 1) pH	pH Units	8.21	8.12	8.16	8.13	8.1	8.27	8.17	8.16	7.97	7.90	7.82	7.99	8.00	8.14	8.2	8.35		
Misc. Inorganics	**UNITS**	**MR3 REP1**	**MR3 REP2**	**MR3 REP3**	**MR3 REP4**	**MR3 REP5**	**MR4 1A**	**MR4 1B**	**MR6**	**MR7B**	**MR9**	**MR17-02**	**MR19-02**	**M19-01 A**	**M19-01 B**	**M19-01 C**	**M19-01 D**	**M20-04**	**M20-06**
Total Organic Carbon (	%	1.6	2.2	2.1	2.1	2.0	2.1	1.8	2.0	2.1	1.8	2.2	2.6	2.6	2.5	2.7	2.4	1.4	2.0

SEMIVOLATILE ORGANICS																	
Sample ID				MR3 Rep 1	MR3 Rep 2	MR3 Rep 3	MR3 Rep 4	MR3 Rep 5	MR6	MR7B	MR17-02	MR19-02	MR19-01A	MR19-01B	MR19-01C	MR19-01D	M20-06
Date Sampled				29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	29/08/2012	30/08/2012	30/08/2012	31/08/2012	31/08/2012	31/08/2012	31/08/2012	30/08/2012
Matrix				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
	Units	Working Water Quality Guidelines for BC	CCME Sediment Quality Guidelines for the Protection of Aquatic Life														
Polycyclic Aromatics																	
Naphthalene	mg/kg		0.0346	0.038	0.057 (1)	0.045	0.033	0.074 (1)	0.058	0.043	0.091 (1)	0.045	0.031	0.028 (1)	0.021	0.026	0.087 (1)
2-Methylnaphthalene	mg/kg		0.0202	0.071	0.10 (1)	0.077	0.057	0.13 (1)	0.089	0.079	0.27 (1)	0.1	0.06	0.058 (1)	0.04	0.051	0.44 (1)
Acenaphthylene	mg/kg		0.00587	<0.0023 (2)	<0.0031 (2)	<0.0023 (2)	<0.0018 (2)	<0.0038 (2)	<0.0024 (2)	<0.0024 (2)	<0.0056 (2)	<0.0022 (2)	<0.0016 (2)	<0.0025 (1)	<0.0011 (2)	<0.0015 (2)	<0.012 (2)
Acenaphthene	mg/kg		0.00671	0.00062	<0.0025 (1)	0.001	0.00075	<0.0025 (1)	0.00055	0.00071	<0.0025 (1)	0.00068	<0.00050	<0.0025 (1)	0.00069	0.00052	<0.0025 (1)
Fluorene	mg/kg			0.0068	0.0068 (1)	0.0066	0.0057	0.0083 (1)	0.0058	0.0087	0.019 (1)	0.01	0.0067	0.0057 (1)	0.0036	0.0053	0.038 (1)
Phenanthrene	mg/kg		0.0419	0.088	0.14 (1)	0.09	0.066	0.14 (1)	0.095	0.095	0.16 (1)	0.081	0.054	0.059 (1)	0.042	0.052	0.33 (1)
Anthracene	mg/kg			<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)
Fluoranthene	mg/kg		0.111	0.009	0.012 (1)	0.0082	0.006	0.013 (1)	0.0077	0.0088	0.012 (1)	0.0067	0.0053	0.0054 (1)	0.0041	0.0049	0.019 (1)
Pyrene	mg/kg		0.053	0.016	0.023 (1)	0.015	0.011	0.023 (1)	0.013	0.015	0.021 (1)	0.012	0.013	0.016 (1)	0.0086	0.015	0.031 (1)
Benzo(a)anthracene	mg/kg		0.0317	0.0032	<0.0050 (1)	0.0035	0.0024	0.0055 (1)	0.0037	0.0038	0.0076 (1)	0.0033	0.0022	<0.0050 (1)	0.0018	0.0021	0.0059 (1)
Chrysene	mg/kg			0.041	0.056 (1)	0.041	0.031	0.061 (1)	0.039	0.047	0.065 (1)	0.029	0.025	0.028 (1)	0.022	0.026	0.11 (1)
Benzo(b&j)fluoranthene	mg/kg			0.023	0.029 (1)	0.022	0.018	0.033 (1)	0.021	0.026	0.030 (1)	0.014	0.012	0.013 (1)	0.011	0.012	0.040 (1)
Benzo(k)fluoranthene	mg/kg			<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)	<0.0010	<0.0010	<0.0050 (1)
Benzo(a)pyrene	mg/kg		0.0319	0.0013	<0.0050 (1)	0.0013	<0.0010	<0.0050 (1)	0.0012	0.0014	<0.0050 (1)	0.0026	0.0016	<0.0050 (1)	0.0012	0.0016	<0.0050 (1)
Indeno(1,2,3-cd)pyrene	mg/kg			<0.0020	<0.010 (1)	<0.0020	<0.0020	<0.010 (1)	<0.0020	<0.0020	<0.010 (1)	<0.0020	<0.0020	<0.010 (1)	<0.0020	<0.0020	<0.010 (1)
Dibenz(a,h)anthracene	mg/kg		0.00622	0.0031	0.0037 (1)	0.003	0.0024	0.0044 (1)	0.0028	0.0033	0.0061 (1)	0.0026	0.0019	<0.0025 (1)	0.0017	0.0024	0.0061 (1)
Benzo(g,h,i)perylene	mg/kg			0.004	<0.010 (1)	0.0036	0.003	<0.010 (1)	0.0038	0.0044	0.011 (1)	0.007	0.0053	<0.010 (1)	0.0048	0.0075	0.013 (1)
Low Molecular Weight PAH`s	mg/kg			0.2	0.3	0.22	0.16	0.36	0.25	0.23	0.5	0.24	0.15	0.15	0.11	0.14	0.89
High Molecular Weight PAH`s	mg/kg			0.073	0.096	0.072	0.053	0.11	0.067	0.079	0.11	0.057	0.05	0.05	0.04	0.052	0.17
Total PAH	mg/kg			0.28	0.4	0.29	0.22	0.46	0.31	0.3	0.65	0.29	0.2	0.2	0.15	0.19	1.1
Surrogate Recovery																	
D10-ANTHRACENE (sur.)	%			75	89	77	76	94	74	77	90	77	78	99	74	77	94
D8-ACENAPHTHYLENE (sur.)	%			71	79	72	73	86	70	73	80	74	72	87	71	73	82
D8-NAPHTHALENE (sur.)	%			71	80	75	74	88	70	73	78	73	72	88	71	75	78
TERPHENYL-D14 (sur.)	%			79	91	81	79	99	78	82	91	81	82	97	77	79	91

APPENDIX D BENTHIC INVERTBRATES RAW DATA

EDI Murray River CABIN Benthos 2012
Data are not adjusted for subsampling

EcoAnalysts, Inc.

	Water Body	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	M17 Creek
	Site #	MR3	MR3	MR3	MR4	MR4	MR4	MR6	MR6	MR6	MR7b	MR7b	MR7b	MR9	MR9	MR9	M17-02
	Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
	Device Type	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Collection Date	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	21.00	16.00	14.00	100.00	49.25	100.00	100.00	100.00	100.00	21.00
	EcoAnalysts Sample ID	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-7	6266.1-8	6266.1-9	6266.1-10	6266.1-11	6266.1-12	6266.1-13	6266.1-14	6266.1-15	6266.1-16
Ephemeroptera	Acentrella sp.	0	0	0	3	0	0	2	0	1	11	13	21	0	0	0	0
	Acentrella turbida	0	0	0	0	0	0	0	3	0	0	3	6	0	0	0	0
	Ameletus sp.	7	6	2	9	3	7	0	0	1	24	4	3	6	3	50	22
	Baetis bicaudatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Baetis flavistriga	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
	Baetis sp.	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0
	Baetis tricaudatus	0	0	0	0	0	0	11	16	10	10	10	60	0	0	0	9
	Caudatella edmundsi	0	0	0	0	0	0	3	5	3	0	0	0	0	0	0	0
	Cinygma sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Cinygmula sp.	0	1	0	4	1	0	0	0	0	0	0	0	1	0	13	1
	Drunella coloradensis/flavilinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Drunella doddsii	0	0	0	0	0	0	0	1	0	21	23	57	0	0	0	0
	Drunella grandis	6	3	0	14	14	6	9	1	12	10	3	6	0	0	0	1
	Epeorus deceptivus/hesperus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Epeorus grandis/permagnus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Epeorus longimanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerella aurivillii	0	0	0	0	46	38	134	104	103	0	0	59	1	0	0	0
	Ephemerella sp.	1	7	1	52	0	0	0	0	0	55	27	0	0	0	0	1
	Heptageniidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Metretopodidae	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	1	6	4	24	85	156	0	0	2	0
	Serratella tibialis	0	0	0	0	2	1	0	0	1	1	4	2	0	0	0	1
Plecoptera	Capniidae	3	6	1	13	4	0	0	0	1	0	0	0	6	0	20	5
	Chloroperlidae	0	0	0	6	0	1	1	0	0	0	6	6	0	0	1	0
	Claassenia sabulosa	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0
	Cultus sp.	0	0	0	3	2	1	0	0	0	6	0	0	0	0	0	0
	Eucapnopsis brevicauda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hesperoperla pacifica	0	0	0	0	0	0	0	3	9	0	0	0	0	0	0	0
	Isoperla sp.	0	0	0	0	0	0	0	0	0	8	0	18	1	0	3	3
	Leuctridae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Megarcys sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Paraleuctra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Perlodidae	0	0	0	8	6	5	40	41	47	1	3	2	0	0	0	2
	Pteronarcella sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Skwala sp.	0	0	0	11	2	5	1	0	2	19	9	20	0	0	0	0
	Suwallia sp.	27	8	6	0	2	0	0	0	0	13	0	4	3	1	40	0
	Sweltsa sp.	0	2	1	7	7	3	2	2	2	12	2	4	1	0	5	1
	Taeniopterygidae	0	2	0	6	2	0	31	41	21	37	15	7	0	0	0	5
	Zapada cinctipes	2	0	0	0	1	0	5	8	6	0	0	1	1	0	0	29
	Zapada columbiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	4
	Zapada sp.	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Haliplidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Haliplus sp.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Heterlimnius corpulentus	0	0	0	0	3	1	0	2	0	0	0	1	0	0	0	13
	Oreodytes sp.	0	2	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Diptera-Chironomidae	Brillia sp.	0	0	0	5	1	0	0	0	0	0	0	1	0	0	0	1
	Brundiniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chaetocladius sp.	0	0	0	2	1	0	0	0	0	3	1	2	1	0	0	2
	Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Constempellina sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4
	Corynoneura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11

	Water Body	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	M17 Creek
	Site #	MR3	MR3	MR3	MR4	MR4	MR4	MR6	MR6	MR6	MR7b	MR7b	MR7b	MR9	MR9	MR9	M17-02
	Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
	Device Type	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Collection Date	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	21.00	16.00	14.00	100.00	49.25	100.00	100.00	100.00	100.00	21.00
	EcoAnalysts Sample ID	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-7	6266.1-8	6266.1-9	6266.1-10	6266.1-11	6266.1-12	6266.1-13	6266.1-14	6266.1-15	6266.1-16
	Cricotopus bicinctus gr.	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
	Cricotopus sp.	0	0	0	7	8	1	1	0	0	0	0	0	0	0	0	0
	Diplocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella claripennis gr.	0	0	0	0	0	0	0	2	2	2	0	3	0	0	0	0
	Eukiefferiella coerulescens gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Eukiefferiella devonica gr.	0	0	0	1	0	0	4	6	5	0	0	1	0	0	0	0
	Eukiefferiella gracei gr.	0	0	0	0	0	0	0	0	10	0	1	3	1	0	0	11
	Eukiefferiella sp.	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0
	Heleniella sp.	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1
	Heterotrissocladius marcidus gr.	2	21	2	0	0	0	0	0	0	0	0	0	1	1	1	0
	Hydrobaenus sp.	3	1	0	3	0	0	0	0	0	0	0	0	0	0	0	13
	Limnophyes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Micropsectra sp.	0	0	0	14	0	0	0	3	2	1	0	1	1	0	0	88
	Monodiamesa sp.	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius (Euortho.) rivicola gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius (Euorthocladius) sp.	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0
	Orthocladius (Symp.) lignicola	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Orthocladius Complex	1	0	0	19	8	3	18	9	16	4	3	1	0	0	0	7
	Orthocladius sp.	3	0	0	15	6	8	1	0	0	1	0	2	0	0	0	2
	Pagastia sp.	0	0	0	0	0	0	4	0	2	0	0	2	0	0	0	0
	Paracladopelma sp.	11	15	11	2	3	0	0	0	0	0	0	0	0	0	0	0
	Parakiefferiella sp.	3	7	0	10	1	3	0	0	0	0	0	0	0	0	0	0
	Parametriocnemus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parorthocladius sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Phaenopsectra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum sp.	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum tuberculum	3	2	2	0	0	0	1	0	0	2	0	0	0	0	0	0
	Prodiamesa sp.	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	1
	Pseudodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rheocricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Rheotanytarsus exiguus gr.	0	0	0	4	0	0	9	2	6	1	0	0	0	0	0	0
	Stempellinella sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Stictochironomus sp.	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sublettea sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
	Thienemanniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thienemannimyia gr. sp.	0	0	0	1	1	0	7	2	4	0	0	0	0	0	0	6
	Tvetenia bavarica gr.	0	0	0	1	0	0	1	6	5	3	0	4	0	0	0	9
	Tvetenia discoloripes gr.	0	0	0	0	0	0	5	4	1	0	0	0	0	0	0	0
	Zavrelimyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Diptera	Antocha sp.	0	0	0	0	0	0	3	2	1	0	0	0	0	0	0	0
	Bezzia/Palpomyia sp.	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	2
	Chelifera/Metachela sp.	1	2	0	7	7	0	2	8	2	24	14	25	0	0	1	0
	Dicranota sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	Dolichopodidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephydridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hemerodromia sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Hesperoconopa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hexatoma sp.	18	18	14	40	34	21	0	0	0	32	22	43	0	0	0	0
	Limnophila sp.	1	2	2	0	2	0	0	1	0	1	0	0	0	0	0	0
	Meringodixa chalonensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Neoplasta sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Oreogeton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Pericoma/Telmatoscopus sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	15
	Protanyderus sp.	1	0	0	2	0	0	0	0	0	1	1	1	0	0	0	0
	Rhabdomastix fascigera gr.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Simulium sp.	1	0	0	0	0	0	0	1	0	3	3	1	0	0	0	0

	Water Body	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	Murray River	M17 Creek
	Site #	MR3	MR3	MR3	MR4	MR4	MR4	MR6	MR6	MR6	MR7b	MR7b	MR7b	MR9	MR9	MR9	M17-02
	Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
	Device Type	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Collection Date	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	21.00	16.00	14.00	100.00	49.25	100.00	100.00	100.00	100.00	21.00
	EcoAnalysts Sample ID	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-7	6266.1-8	6266.1-9	6266.1-10	6266.1-11	6266.1-12	6266.1-13	6266.1-14	6266.1-15	6266.1-16
	Wiedemannia sp.	0	1	0	3	0	3	0	0	0	0	0	0	0	0	0	3
Trichoptera	Apatania sp.	0	0	0	0	2	1	0	0	0	3	0	2	0	0	0	7
	Arctopsyche grandis	0	0	0	0	0	0	2	19	0	2	2	10	0	0	0	1
	Brachycentrus americanus	1	1	0	8	6	0	15	18	7	9	6	10	0	0	0	0
	Ecclisomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glossosoma sp.	0	0	0	0	0	0	0	2	1	3	0	3	0	0	0	1
	Glossosomatidae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Hydropsyche sp.	0	0	0	1	0	0	14	20	18	3	4	6	0	0	0	0
	Hydroptila sp.	0	0	1	2	0	0	0	2	0	1	0	0	0	0	0	9
	Lepidostoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnephilidae	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	5
	Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Oligophlebodes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parapsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila angelita gr.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Rhyacophila arnaudi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Rhyacophila betteni gr.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Rhyacophila brunnea gr.	0	0	0	0	0	0	2	1	2	0	0	3	1	0	0	0
	Rhyacophila hyalinata gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila pellisa/valuma	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
	Rhyacophila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila vofixa gr.	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Sphaeriidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelida	Enchytraeidae	0	0	0	0	0	0	8	3	9	0	0	0	0	0	0	1
	Lumbricina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nais bretscheri	0	1	0	1	0	0	4	1	1	0	0	0	0	0	0	0
	Nais sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Tubificidae w/ cap setae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Tubificidae w/o cap setae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Acari	Acari	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Atractides sp.	0	0	0	1	0	1	0	0	1	3	1	3	0	0	0	0
	Aturidae	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	Feltria sp.	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0
	Hydryphantidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	10	13	6	6	1	3	1	0	0	3	0	3	4	1	2	0
	Lebertia sp.	28	29	16	45	20	10	16	8	22	35	19	39	0	0	0	13
	Oribatei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oxus sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protzia sp.	0	0	0	4	1	0	3	5	3	9	2	5	0	0	0	0
	Sperchon sp.	0	0	0	4	1	2	4	9	9	15	13	24	0	0	0	2
	Sperchonopsis sp.	0	0	0	0	0	0	4	4	9	0	0	0	0	0	0	0
	Stygothrombium sp.	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0
	Testudacarus sp.	0	0	0	2	0	0	4	6	1	3	0	1	0	0	0	0
	Torrenticola sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wandesia sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Other Organisms	Hydra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	**137**	**159**	**76**	**358**	**209**	**132**	**388**	**379**	**369**	**426**	**303**	**649**	**33**	**8**	**140**	**331**
	Cabin "Rejects" Presence	Ostracods	Nematodes		Ostracods, Turbellarians	Ostracods, Nematodes			Nematodes		Nematodes	Nematodes	Turbellarians			Ostracods	Ostracods

EDI Murray River CABIN Benthos 2012
Data are not adjusted for subsampling

EcoAnalysts, Inc.

	Water Body	**M17 Creek**	**M17 Creek**	**M19 Creek**	**M19 Creek**	**M19 Creek**	**M19 Creek**	**M19 Creek**	**M19 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**	**M20 Creek**
	Site #	**M17-02**	**M17-02**	**M19-01**	**M19-01**	**M19-01**	**M19-02**	**M19-02**	**M19-02**	**M20-04**	**M20-04**	**M20-04**	**M20-06**	**M20-06**	**M20-06**
	Rep	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
	Device Type	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**	**Kick**
	Collection Date	**30-Aug-12**	**30-Aug-12**	**31-Aug-12**	**31-Aug-12**	**31-Aug-12**	**30-Aug-12**	**30-Aug-12**	**30-Aug-12**	**28-Aug-12**	**28-Aug-12**	**28-Aug-12**	**30-Aug-12**	**30-Aug-12**	**30-Aug-12**
	Percent Subsampled	**25.00**	**15.00**	**20.00**	**16.00**	**13.00**	**18.00**	**19.00**	**16.00**	**6.00**	**16.00**	**13.00**	**30.00**	**18.00**	**22.00**
	EcoAnalysts Sample ID	**6266.1-17**	**6266.1-18**	**6266.1-19**	**6266.1-20**	**6266.1-21**	**6266.1-22**	**6266.1-23**	**6266.1-24**	**6266.1-25**	**6266.1-26**	**6266.1-27**	**6266.1-28**	**6266.1-29**	**6266.1-30**
Ephemeroptera	Acentrella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Acentrella turbida	0	0	0	0	0	0	0	0	0	0	0	4	0	0
	Ameletus sp.	9	6	18	13	13	7	0	1	0	1	1	0	3	1
	Baetis bicaudatus	0	0	75	77	92	25	0	0	13	13	32	25	4	22
	Baetis flavistriga	0	0	0	0	0	0	0	0	0	0	0	2	0	0
	Baetis sp.	0	13	0	0	0	0	20	0	0	0	0	0	0	0
	Baetis tricaudatus	5	0	0	0	0	0	0	0	7	0	11	8	13	23
	Caudatella edmundsi	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cinygma sp.	0	0	1	1	2	0	0	0	0	0	0	0	0	0
	Cinygmula sp.	2	2	53	23	22	14	4	0	18	19	22	16	12	8
	Drunella coloradensis/flavilinea	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Drunella doddsii	0	0	0	0	0	0	2	0	3	1	2	3	1	1
	Drunella grandis	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Epeorus deceptivus/hesperus	0	0	0	1	2	0	0	0	2	2	2	5	0	3
	Epeorus grandis/permagnus	0	0	0	0	0	0	0	0	2	0	0	1	0	1
	Epeorus longimanus	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Ephemerella aurivillii	0	0	0	0	0	0	10	0	0	0	0	0	0	0
	Ephemerella sp.	4	0	45	88	30	37	0	27	4	6	2	7	2	7
	Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leptophlebiidae	1	0	2	6	3	4	4	8	0	0	0	0	0	0
	Metretopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	0	0	43	38	47	50	67	58
	Serratella tibialis	0	0	0	0	0	0	0	0	1	0	1	1	0	0
Plecoptera	Capniidae	8	6	24	13	10	3	0	11	14	4	1	5	2	10
	Chloroperlidae	0	0	0	0	3	0	0	0	7	3	2	7	0	3
	Claassenia sabulosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cultus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eucapnopsis brevicauda	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	Hesperoperla pacifica	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Isoperla sp.	0	1	0	0	0	0	2	0	0	0	0	0	0	0
	Leuctridae	0	0	1	0	0	0	0	0	0	0	0	1	0	0
	Megarcys sp.	0	1	0	1	0	1	0	0	0	1	1	3	2	0
	Paraleuctra sp.	0	0	0	0	0	0	0	0	0	4	0	0	3	0
	Perlodidae	4	4	2	0	3	7	8	4	5	2	8	8	1	2
	Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Skwala sp.	0	0	0	0	1	3	2	0	1	0	0	0	0	0
	Suwallia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sweltsa sp.	2	0	17	16	4	0	0	0	0	1	3	3	7	0
	Taeniopterygidae	0	1	8	10	4	0	0	0	18	8	5	19	18	7
	Zapada cinctipes	31	25	14	11	8	38	36	17	97	172	65	59	52	41
	Zapada columbiana	0	0	0	0	0	0	0	0	7	8	8	6	2	1
	Zapada oregonensis gr.	0	0	15	1	0	5	8	1	27	5	10	10	5	7
	Zapada sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Haliplidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliplus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Heterlimnius corpulentus	19	14	23	21	33	34	15	22	0	0	0	1	0	0
	Oreodytes sp.	2	2	0	1	0	0	0	0	0	0	0	0	0	0
Diptera-Chironomidae	Brillia sp.	0	1	6	4	1	0	0	0	1	5	0	1	1	2
	Brundiniella sp.	2	1	0	0	0	0	0	0	0	0	0	0	0	0
	Chaetocladius sp.	0	0	1	0	0	1	0	1	0	0	0	0	0	0
	Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Constempellina sp.	8	3	0	1	0	0	0	0	0	0	0	0	0	2
	Corynoneura sp.	7	9	1	2	1	0	0	0	2	0	0	2	0	1

	Water Body	M17 Creek	M17 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek
	Site #	M17-02	M17-02	M19-01	M19-01	M19-01	M19-02	M19-02	M19-02	M20-04	M20-04	M20-04	M20-06	M20-06	M20-06
	Rep	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Device Type	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Collection Date	30-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12	30-Aug-12	30-Aug-12	28-Aug-12	28-Aug-12	28-Aug-12	30-Aug-12	30-Aug-12	30-Aug-12
	Percent Subsampled	25.00	15.00	20.00	16.00	13.00	18.00	19.00	16.00	6.00	16.00	13.00	30.00	18.00	22.00
	EcoAnalysts Sample ID	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24	6266.1-25	6266.1-26	6266.1-27	6266.1-28	6266.1-29	6266.1-30
	Cricotopus bicinctus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cricotopus sp.	0	0	0	0	0	2	14	3	0	0	0	2	0	1
	Diplocladius sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	Eukiefferiella claripennis gr.	0	1	1	2	2	4	13	2	13	3	13	12	18	10
	Eukiefferiella coerulescens gr.	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Eukiefferiella devonica gr.	1	0	0	0	1	2	2	0	0	0	0	1	3	1
	Eukiefferiella gracei gr.	5	0	2	0	2	24	38	1	13	3	16	14	10	5
	Eukiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Heleniella sp.	3	1	0	0	0	0	0	0	0	0	0	0	0	0
	Heterotrissocladius marcidus gr.	0	2	0	0	0	0	0	1	0	0	0	0	0	0
	Hydrobaenus sp.	6	4	3	2	1	0	0	1	2	1	1	3	0	0
	Limnophyes sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Micropsectra sp.	77	163	14	26	3	5	2	27	4	1	3	4	8	3
	Monodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius (Euortho.) rivicola gr.	0	0	0	0	0	0	0	0	0	0	10	36	0	25
	Orthocladius (Euorthocladius) sp.	0	0	0	0	0	0	0	0	6	0	0	0	13	0
	Orthocladius (Symp.) lignicola	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Orthocladius Complex	4	0	0	0	6	12	7	7	1	1	5	5	4	3
	Orthocladius sp.	1	0	0	0	0	34	42	33	0	0	1	1	2	1
	Pagastia sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	Paracladopelma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parakiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parametriocnemus sp.	0	0	0	2	0	0	0	0	0	0	1	0	0	0
	Parorthocladius sp.	0	0	0	3	0	0	0	0	1	0	0	0	0	0
	Phaenopsectra sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum tuberculum	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	Prodiamesa sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Pseudodiamesa sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Rheocricotopus sp.	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Rheotanytarsus exiguus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Stempellinella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Stictochironomus sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Sublettea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thienemanniella sp.	0	0	0	1	2	0	1	0	0	0	1	0	2	2
	Thienemannimyia gr. sp.	3	10	5	4	1	35	23	101	0	0	0	0	0	0
	Tvetenia bavarica gr.	3	0	1	0	3	23	31	0	2	3	5	1	4	3
	Tvetenia discoloripes gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zavrelimyia sp.	3	5	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Antocha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bezzia/Palpomyia sp.	2	7	0	0	1	0	0	0	4	1	0	3	1	2
	Chelifera/Metachela sp.	3	0	1	0	0	1	4	0	0	0	3	0	0	1
	Dicranota sp.	1	0	3	0	1	0	0	0	1	0	2	3	1	1
	Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Ephydridae	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Hemerodromia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hesperoconopa sp.	0	0	0	0	1	0	0	0	1	0	0	0	0	0
	Hexatoma sp.	0	0	0	0	0	0	0	0	0	1	1	1	1	0
	Limnophila sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Meringodixa chalonensis	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Muscidae	0	2	0	0	0	3	10	6	0	0	1	0	0	0
	Neoplasta sp.	0	1	0	0	0	2	0	0	2	0	2	1	0	0
	Oreogeton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pericoma/Telmatoscopus sp.	56	48	0	0	0	5	0	1	0	0	1	1	0	1
	Protanyderus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhabdomastix fascigera gr.	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Simulium sp.	1	0	5	7	10	3	0	0	8	0	30	6	12	27

	Water Body	M17 Creek	M17 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M19 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek	M20 Creek
	Site #	M17-02	M17-02	M19-01	M19-01	M19-01	M19-02	M19-02	M19-02	M20-04	M20-04	M20-04	M20-06	M20-06	M20-06
	Rep	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Device Type	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick	Kick
	Collection Date	30-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12	30-Aug-12	30-Aug-12	28-Aug-12	28-Aug-12	28-Aug-12	30-Aug-12	30-Aug-12	30-Aug-12
	Percent Subsampled	25.00	15.00	20.00	16.00	13.00	18.00	19.00	16.00	6.00	16.00	13.00	30.00	18.00	22.00
	EcoAnalysts Sample ID	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24	6266.1-25	6266.1-26	6266.1-27	6266.1-28	6266.1-29	6266.1-30
	Wiedemannia sp.	6	4	2	0	1	6	0	0	9	4	13	13	11	10
Trichoptera	Apatania sp.	3	1	2	2	0	1	0	3	0	0	1	0	0	1
	Arctopsyche grandis	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Brachycentrus americanus	0	0	0	0	0	0	1	0	6	8	1	0	2	3
	Ecclisomyia sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Glossosoma sp.	0	0	4	3	0	0	0	0	0	0	0	0	0	0
	Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydroptila sp.	2	10	0	0	0	2	1	11	0	0	1	0	0	0
	Lepidostoma sp.	11	6	5	3	3	2	1	3	1	2	0	1	1	0
	Limnephilidae	8	1	4	14	11	1	1	0	0	0	0	0	0	0
	Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Oligophlebodes sp.	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	Parapsyche sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Rhyacophila angelita gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila arnaudi	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila betteni gr.	2	1	4	11	5	4	2	0	1	1	0	3	0	0
	Rhyacophila brunnea gr.	0	0	2	0	0	0	0	0	3	4	2	3	0	5
	Rhyacophila hyalinata gr.	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila pellisa/valuma	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila sp.	0	1	0	1	1	0	0	0	0	0	0	0	2	0
	Rhyacophila vofixa gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Enchytraeidae	0	2	0	0	0	0	0	0	0	0	1	0	0	0
	Lumbricina	0	0	2	0	0	1	0	1	0	0	0	0	0	0
	Nais bretscheri	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nais sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tubificidae w/ cap setae	10	2	0	0	3	0	0	0	0	0	0	0	0	0
	Tubificidae w/o cap setae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari	Acari	0	0	1	0	0	0	1	0	0	1	0	0	0	0
	Atractides sp.	1	1	0	2	1	0	1	0	0	0	0	0	0	0
	Aturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Feltria sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Hydryphantidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	2	7	0	0	0	0	0	0	0	0	0
	Lebertia sp.	8	17	0	1	1	5	2	1	1	0	4	2	1	0
	Oribatei	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Oxus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protzia sp.	0	0	1	1	2	0	0	0	0	0	0	0	1	0
	Sperchon sp.	1	0	1	0	4	0	0	1	3	3	7	5	6	3
	Sperchonopsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Stygothrombium sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Testudacarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Torrenticola sp.	0	0	0	0	0	1	0	2	0	0	0	0	0	0
	Wandesia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Organisms	Hydra sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	TOTAL	**331**	**386**	**371**	**379**	**308**	**360**	**312**	**301**	**355**	**330**	**352**	**369**	**304**	**310**
	Cabin "Rejects" Presence	Ostracods, Turbellarians	Ostracods, Turbellarians	Ostracods, Nematodes	Ostracods, Nematodes	Ostracods, Nematodes	Ostracods	Ostracods	Ostracods		Ostracods, Nematodes	Nematodes, Turbellarians	Ostracods, Turbellarians	Nematodes	Nematodes, Turbellarians

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)												
		MR3	**MR4**	**MR6**	**MR7B**	**MR9**	**M17-02**	**M19-02**	**M19-01A**	**M20-04**	**M20-06**	**M19-01B**
Maxxam ID		EJ8129	EJ8130	EJ8131	EJ8132	EJ8133	EJ8134	EJ8135	EJ8136	EJ8137	EJ8138	EJ8139
Sampling Date		29/08/2012	29/08/2012	29/08/2012	29/08/2012	31/08/2012	30/08/2012	30/08/2012	31/08/2012	28/08/2012	30/08/2012	31/08/2012
Matrix		Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue	Benthic Tissue
	UNITS											
Mercury by CVAA												
Total Mercury (Hg)	mg/kg	<0.0020 (1)	0.0056 (1)	<0.0020 (1)	<0.0020 (1)	0.0078 (1)	0.0048 (1)	0.0060 (1)	0.0119 (1)	0.0030 (1)	0.0070 (1)	0.0233 (1)
Total Metals by ICPMS												
Total Aluminum (Al)	mg/kg	5.23	309	66.1	27.2	75.3	283	194	225	256	218	400
Total Antimony (Sb)	mg/kg	0.0020	0.0174	0.0093	0.0039	0.0123	0.0210	0.0133	0.0109	0.0156	0.0126	0.0174
Total Arsenic (As)	mg/kg	0.080	0.184	0.085	0.060	<0.065	0.208	0.182	0.130	0.169	0.080	0.219
Total Barium (Ba)	mg/kg	0.302	12.9	8.46	2.02	6.47	11.0	9.02	13.4	12.2	9.20	23.0
Total Beryllium (Be)	mg/kg	<0.020	<0.14	<0.030	<0.020	<0.13	<0.030	<0.020	<0.020	<0.030	<0.040	<0.040
Total Bismuth (Bi)	mg/kg	<0.020	<0.14	<0.030	<0.020	<0.13	<0.030	<0.020	<0.020	<0.030	<0.040	<0.040
Total Boron (B)	mg/kg	<0.40	<2.8	<0.60	<0.40	<2.6	<0.60	0.47	0.41	<0.60	<0.80	<0.80
Total Cadmium (Cd)	mg/kg	0.135	1.08	0.297	0.823	0.252	0.639	0.274	1.09	0.673	0.525	1.53
Total Calcium (Ca)	mg/kg	168	2100	1340	612	2480	1450	1230	1180	990	1030	1810
Total Chromium (Cr)	mg/kg	<0.040	0.62	0.125	0.051	<0.26	0.488	0.383	0.404	0.431	0.358	0.722
Total Cobalt (Co)	mg/kg	0.488	0.759	0.237	0.217	0.076	0.436	0.267	0.450	2.13	1.45	0.628
Total Copper (Cu)	mg/kg	4.95	7.04	5.86	6.48	6.81	5.93	4.24	7.24	7.10	6.28	7.02
Total Iron (Fe)	mg/kg	448	623	171	64.6	127	576	463	476	385	269	834
Total Lead (Pb)	mg/kg	0.0748	0.381	0.101	0.0557	0.103	0.342	0.252	0.213	0.254	0.191	0.380
Total Magnesium (Mg)	mg/kg	115	719	491	285	538	609	398	407	502	476	606
Total Manganese (Mn)	mg/kg	5.33	37.7	33.8	16.7	10.2	21.2	13.9	31.8	20.2	15.4	54.5
Total Mercury (Hg)	mg/kg	0.0029	0.022	0.0045	0.0027	0.019	0.0066	0.0079	0.0147	0.0055	0.0105	0.0290
Total Molybdenum (Mo)	mg/kg	0.010	0.224	0.078	0.065	0.122	0.116	0.092	0.129	0.112	0.103	0.171
Total Nickel (Ni)	mg/kg	0.305	1.02	0.366	0.287	0.155	1.13	0.818	0.510	1.33	0.716	0.905
Total Phosphorus (P)	mg/kg	453	1330	1730	1070	2230	1180	1160	1120	1560	1380	1390
Total Potassium (K)	mg/kg	623	261	387	126	285	478	322	196	1080	372	301
Total Selenium (Se)	mg/kg	0.288	0.680	0.515	0.587	0.696	0.780	1.17	0.660	1.33	1.17	0.752
Total Silver (Ag)	mg/kg	<0.0040	<0.028	0.0270	0.0382	0.029	0.0239	0.0234	0.0243	0.0271	0.0238	0.0283
Total Sodium (Na)	mg/kg	590	78	141	69.1	82	190	114	64.1	466	155	76.3
Total Strontium (Sr)	mg/kg	0.289	3.52	2.67	1.47	5.21	2.83	2.15	2.26	2.39	2.62	3.52
Total Thallium (Tl)	mg/kg	0.0146	0.0146	0.00349	0.00249	0.0033	0.0136	0.00678	0.00757	0.0118	0.00909	0.0130
Total Tin (Sn)	mg/kg	0.023	0.90	0.168	<0.020	<0.13	<0.030	0.239	0.098	0.086	0.113	<0.040
Total Titanium (Ti)	mg/kg	<0.20	8.8	1.17	0.50	1.8	4.64	2.23	5.69	4.29	3.83	7.26
Total Uranium (U)	mg/kg	0.00090	0.0314	0.0118	0.00468	0.0108	0.0483	0.0236	0.0225	0.0220	0.0214	0.0394
Total Vanadium (V)	mg/kg	<0.040	1.09	0.218	0.095	<0.26	1.17	0.803	0.832	0.948	0.783	1.55
Total Zinc (Zn)	mg/kg	19.8	43.7	95.9	64.8	46.9	49.6	29.7	39.1	53.9	51.9	47.8

RDL = Reportable Detection Limit

EDL = Estimated Detection Limit

(1) Sample extracted past recommended hold time.

APPENDIX E PERIPHYTON RAW DATA

EDI Murray River Periphyton 2012
Taxa and Biovolumes

EcoAnalysts, Inc.

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Volume Received (mL)	Percent Counted	Taxon	EcoA TIN	Class	Order	Family	Genus
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Epithemia sp.	559	Bacillariophyceae	Pennales	Rhopalodiaceae	Epithemia
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-1	Murray River	MR3	1	29-Aug-12	60	0.059%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Caloneis sp.	251	Bacillariophyceae	Pennales	Pinnulariaceae	Caloneis
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Oedogonium sp.	2065	Chlorophyceae	Oedogoniales	Oedogoniaceae	Oedogonium
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-2	Murray River	MR3	2	29-Aug-12	49	0.157%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Geminella sp.	3076	Chlorophyceae	Ulotrichales	Ulotrichaceae	Geminella
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-3	Murray River	MR3	3	29-Aug-12	55	0.030%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Geminella sp.	3076	Chlorophyceae	Ulotrichales	Ulotrichaceae	Geminella
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Mougeotia sp.	2053	Chlorophyceae	Zygnematales	Zygnemataceae	Mougeotia
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Volume Received (mL)	Percent Counted	Taxon	EcoA TIN	Class	Order	Family	Genus
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Oedogonium sp.	2065	Chlorophyceae	Oedogoniales	Oedogoniaceae	Oedogonium
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-4	Murray River	MR4	1	29-Aug-12	26	0.472%	Ulothrix tenerrima	3104	Chlorophyceae	Ulotrichales	Ulotrichaceae	Ulothrix
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Cosmarium sp.	2012	Chlorophyceae	Zygnematales	Desmidiaceae	Cosmarium
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-5	Murray River	MR4	2	29-Aug-12	39	0.042%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-6	Murray River	MR4	3	29-Aug-12	50	0.080%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Calothrix sp.	2047	Myxophyceae	Nostocales	Rivulariaceae	Calothrix
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Geminella sp.	3076	Chlorophyceae	Ulotrichales	Ulotrichaceae	Geminella
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Oedogonium sp.	2065	Chlorophyceae	Oedogoniales	Oedogoniaceae	Oedogonium
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-7	Murray River	MR6	1	29-Aug-12	29	0.293%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Calothrix sp.	2047	Myxophyceae	Nostocales	Rivulariaceae	Calothrix
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Diploneis sp.	533	Bacillariophyceae	Pennales	Diploneidaceae	Diploneis
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Oedogonium sp.	2065	Chlorophyceae	Oedogoniales	Oedogoniaceae	Oedogonium
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Volume Received (mL)	Percent Counted	Taxon	EcoA TIN	Class	Order	Family	Genus
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Surirella sp.	1885	Bacillariophyceae	Pennales	Surirellaceae	Surirella
6266.2-8	Murray River	MR6	2	29-Aug-12	34	0.267%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Calothrix sp.	2047	Myxophyceae	Nostocales	Rivulariaceae	Calothrix
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Geminella sp.	3076	Chlorophyceae	Ulotrichales	Ulotrichaceae	Geminella
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Oedogonium sp.	2065	Chlorophyceae	Oedogoniales	Oedogoniaceae	Oedogonium
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-9	Murray River	MR6	3	29-Aug-12	40	0.128%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-10	Murray River	MR7b	1	29-Aug-12	34	0.055%	Ulothrix sp.	2025	Chlorophyceae	Ulotrichales	Ulotrichaceae	Ulothrix
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-11	Murray River	MR7b	2	29-Aug-12	48	0.062%	Ulothrix sp.	2025	Chlorophyceae	Ulotrichales	Ulotrichaceae	Ulothrix
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Cosmarium sp.	2012	Chlorophyceae	Zygnematales	Desmidiaceae	Cosmarium
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-12	Murray River	MR7b	3	29-Aug-12	47	0.061%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Amphora sp.	173	Bacillariophyceae	Pennales	Catenulaceae	Amphora

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6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-13	Murray River	MR9	1	31-Aug-12	36	0.144%	Ulothrix sp.	2025	Chlorophyceae	Ulotrichales	Ulotrichaceae	Ulothrix
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Amphora sp.	173	Bacillariophyceae	Pennales	Catenulaceae	Amphora
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Epithemia sp.	559	Bacillariophyceae	Pennales	Rhopalodiaceae	Epithemia
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-14	Murray River	MR9	2	31-Aug-12	28	0.062%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Mougeotia sp.	2053	Chlorophyceae	Zygnematales	Zygnemataceae	Mougeotia
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-15	Murray River	MR9	3	31-Aug-12	61	0.054%	Ulothrix sp.	2025	Chlorophyceae	Ulotrichales	Ulotrichaceae	Ulothrix
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Meridion sp.	955	Bacillariophyceae	Pennales	Fragilariaceae	Meridion
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Rhopalodia sp.	1809	Bacillariophyceae	Pennales	Rhopalodiaceae	Rhopalodia
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	34	0.006%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria

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6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	32	0.006%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	26	0.008%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Meridion sp.	955	Bacillariophyceae	Pennales	Fragilariaceae	Meridion
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	44	0.007%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Anabaena sp.	2087	Myxophyceae	Nostocales	Nostocaceae	Anabaena
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Calothrix sp.	2047	Myxophyceae	Nostocales	Rivulariaceae	Calothrix
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	44	0.010%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Rhoicosphenia sp.	1806	Bacillariophyceae	Pennales	Rhoicospheniaceae	Rhoicosphenia
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	21	0.026%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	42	0.006%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis

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6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Microspora sp.	2108	Chlorophyceae	Chlorococcales	Microsporaceae	Microspora
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Rhopalodia sp.	1809	Bacillariophyceae	Pennales	Rhopalodiaceae	Rhopalodia
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	34	0.006%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	21	0.007%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Closterium sp.	2011	Chlorophyceae	Zygnematales	Desmidiaceae	Closterium
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Cosmarium sp.	2012	Chlorophyceae	Zygnematales	Desmidiaceae	Cosmarium
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Draparnaldiopsis sp	#N/A	Chlorophyceae	Chaetophorales	Chaetophoraceae	Draparnaldiopsis
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Fragilaria sp.	654	Bacillariophyceae	Pennales	Fragilariaceae	Fragilaria
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Meridion sp.	955	Bacillariophyceae	Pennales	Fragilariaceae	Meridion
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Merismopedia sp.	2064	Myxophyceae	Chroococcales	Merismopediaceae	Merismopedia
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Microspora sp.	2108	Chlorophyceae	Chlorococcales	Microsporaceae	Microspora
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Mougeotia sp.	2053	Chlorophyceae	Zygnematales	Zygnemataceae	Mougeotia
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Oscillatoria sp.	2016	Myxophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Spirogyra sp.	2022	Chlorophyceae	Zygnematales	Zygnemataceae	Spirogyra
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Staurastrum sp.	2023	Chlorophyceae	Zygnematales	Desmidiaceae	Staurastrum
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	146	0.010%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	67	0.065%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella

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6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	84	0.019%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	88	0.043%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Pinnularia sp.	1685	Bacillariophyceae	Pennales	Pinnulariaceae	Pinnularia
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	27	0.092%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Cosmarium sp.	2012	Chlorophyceae	Zygnematales	Desmidiaceae	Cosmarium
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	28	0.054%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Achnanthes sp.	3	Bacillariophyceae	Pennales	Achnanthaceae	Achnanthes
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Cocconeis sp.	309	Bacillariophyceae	Pennales	Achnanthaceae	Cocconeis
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Cymbella sp.	379	Bacillariophyceae	Pennales	Cymbellaceae	Cymbella
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Eunotia sp.	582	Bacillariophyceae	Pennales	Eunotiaceae	Eunotia
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Gomphonema sp.	751	Bacillariophyceae	Pennales	Gomphonemataceae	Gomphonema
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Navicula sp.	959	Bacillariophyceae	Pennales	Naviculaceae	Navicula
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Nitzschia sp.	1470	Bacillariophyceae	Pennales	Bacillariaceae	Nitzschia
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Stigeoclonium sp.	2024	Chlorophyceae	Chaetophorales	Chaetophoraceae	Stigeoclonium
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	18	0.153%	Synedra sp.	1930	Bacillariophyceae	Pennales	Fragilariaceae	Synedra

EDI Murray River Periphyton 2012
Taxa and Biovolumes

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EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-1	Murray River	MR3	1	29-Aug-12	152	1	152	255664.16	4261.07
6266.2-1	Murray River	MR3	1	29-Aug-12	15	1	15	25230.02	420.50
6266.2-1	Murray River	MR3	1	29-Aug-12	3	1	3	5046.00	84.10
6266.2-1	Murray River	MR3	1	29-Aug-12	10	1	10	16820.01	280.33
6266.2-1	Murray River	MR3	1	29-Aug-12	8	1	8	13456.01	224.27
6266.2-1	Murray River	MR3	1	29-Aug-12	28	1	28	47096.03	784.93
6266.2-1	Murray River	MR3	1	29-Aug-12	52	1	52	87464.05	1457.73
6266.2-1	Murray River	MR3	1	29-Aug-12	1	1	1	1682.00	28.03
6266.2-1	Murray River	MR3	1	29-Aug-12	1	1	1	1682.00	28.03
6266.2-1	Murray River	MR3	1	29-Aug-12	1	10	10	16820.01	280.33
6266.2-1	Murray River	MR3	1	29-Aug-12	38	1	38	63916.04	1065.27
6266.2-2	Murray River	MR3	2	29-Aug-12	88	1	88	55939.06	1141.61
6266.2-2	Murray River	MR3	2	29-Aug-12	1	1	1	635.67	12.97
6266.2-2	Murray River	MR3	2	29-Aug-12	46	1	46	29240.87	596.75
6266.2-2	Murray River	MR3	2	29-Aug-12	34	1	34	21612.82	441.08
6266.2-2	Murray River	MR3	2	29-Aug-12	8	1	8	5085.37	103.78
6266.2-2	Murray River	MR3	2	29-Aug-12	51	1	51	32419.23	661.62
6266.2-2	Murray River	MR3	2	29-Aug-12	24	1	24	15256.11	311.35
6266.2-2	Murray River	MR3	2	29-Aug-12	3	1	3	1907.01	38.92
6266.2-2	Murray River	MR3	2	29-Aug-12	1	18	18	11442.08	233.51
6266.2-2	Murray River	MR3	2	29-Aug-12	4	1	4	2542.68	51.89
6266.2-2	Murray River	MR3	2	29-Aug-12	2	6.5	13	8263.72	168.65
6266.2-2	Murray River	MR3	2	29-Aug-12	40	1	40	25426.85	518.92
6266.2-3	Murray River	MR3	3	29-Aug-12	210	1	210	704232.80	12804.23
6266.2-3	Murray River	MR3	3	29-Aug-12	17	1	17	57009.32	1036.53
6266.2-3	Murray River	MR3	3	29-Aug-12	4	1	4	13413.96	243.89
6266.2-3	Murray River	MR3	3	29-Aug-12	8	1	8	26827.92	487.78
6266.2-3	Murray River	MR3	3	29-Aug-12	1	8	8	26827.92	487.78
6266.2-3	Murray River	MR3	3	29-Aug-12	24	1	24	80483.75	1463.34
6266.2-3	Murray River	MR3	3	29-Aug-12	16	1	16	53655.83	975.56
6266.2-3	Murray River	MR3	3	29-Aug-12	3	1	3	10060.47	182.92
6266.2-3	Murray River	MR3	3	29-Aug-12	5	1	5	16767.45	304.86
6266.2-3	Murray River	MR3	3	29-Aug-12	17	1	17	57009.32	1036.53
6266.2-4	Murray River	MR4	1	29-Aug-12	31	1	31	6574.43	252.86
6266.2-4	Murray River	MR4	1	29-Aug-12	37	1	37	7846.90	301.80
6266.2-4	Murray River	MR4	1	29-Aug-12	1	1	1	212.08	8.16
6266.2-4	Murray River	MR4	1	29-Aug-12	15	1	15	3181.18	122.35
6266.2-4	Murray River	MR4	1	29-Aug-12	6	5	30	6362.35	244.71
6266.2-4	Murray River	MR4	1	29-Aug-12	26	1	26	5514.04	212.08
6266.2-4	Murray River	MR4	1	29-Aug-12	2	2.5	5	1060.39	40.78
6266.2-4	Murray River	MR4	1	29-Aug-12	22	1	22	4665.72	179.45
6266.2-4	Murray River	MR4	1	29-Aug-12	1	1	1	212.08	8.16

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-4	Murray River	MR4	1	29-Aug-12	1	5	5	1060.39	40.78
6266.2-4	Murray River	MR4	1	29-Aug-12	3	1	3	636.24	24.47
6266.2-4	Murray River	MR4	1	29-Aug-12	4	16.75	67	14209.25	546.51
6266.2-4	Murray River	MR4	1	29-Aug-12	153	1	153	32447.99	1248.00
6266.2-4	Murray River	MR4	1	29-Aug-12	1	10	10	2120.78	81.57
6266.2-5	Murray River	MR4	2	29-Aug-12	84	1	84	199746.03	5121.69
6266.2-5	Murray River	MR4	2	29-Aug-12	1	1	1	2377.93	60.97
6266.2-5	Murray River	MR4	2	29-Aug-12	1	1	1	2377.93	60.97
6266.2-5	Murray River	MR4	2	29-Aug-12	6	1	6	14267.57	365.84
6266.2-5	Murray River	MR4	2	29-Aug-12	1	1	1	2377.93	60.97
6266.2-5	Murray River	MR4	2	29-Aug-12	6	1	6	14267.57	365.84
6266.2-5	Murray River	MR4	2	29-Aug-12	170	1	170	404247.92	10365.33
6266.2-5	Murray River	MR4	2	29-Aug-12	9	1	9	21401.36	548.75
6266.2-5	Murray River	MR4	2	29-Aug-12	30	1	30	71337.87	1829.18
6266.2-6	Murray River	MR4	3	29-Aug-12	9	1	9	11199.04	223.98
6266.2-6	Murray River	MR4	3	29-Aug-12	54	1	54	67194.22	1343.88
6266.2-6	Murray River	MR4	3	29-Aug-12	3	1	3	3733.01	74.66
6266.2-6	Murray River	MR4	3	29-Aug-12	41	1	41	51017.84	1020.36
6266.2-6	Murray River	MR4	3	29-Aug-12	139	1	139	172962.91	3459.26
6266.2-6	Murray River	MR4	3	29-Aug-12	8	1	8	9954.70	199.09
6266.2-6	Murray River	MR4	3	29-Aug-12	3	1	3	3733.01	74.66
6266.2-6	Murray River	MR4	3	29-Aug-12	2	7	14	17420.72	348.41
6266.2-6	Murray River	MR4	3	29-Aug-12	45	1	45	55995.19	1119.90
6266.2-7	Murray River	MR6	1	29-Aug-12	35	1	35	11958.86	412.37
6266.2-7	Murray River	MR6	1	29-Aug-12	20	14	280	95670.92	3299.00
6266.2-7	Murray River	MR6	1	29-Aug-12	55	1	55	18792.50	648.02
6266.2-7	Murray River	MR6	1	29-Aug-12	8	1	8	2733.45	94.26
6266.2-7	Murray River	MR6	1	29-Aug-12	12	1	12	4100.18	141.39
6266.2-7	Murray River	MR6	1	29-Aug-12	1	9	9	3075.14	106.04
6266.2-7	Murray River	MR6	1	29-Aug-12	50	1	50	17084.09	589.11
6266.2-7	Murray River	MR6	1	29-Aug-12	14	1	14	4783.55	164.95
6266.2-7	Murray River	MR6	1	29-Aug-12	2	3	6	2050.09	70.69
6266.2-7	Murray River	MR6	1	29-Aug-12	11	14.2727272727273	157	53644.05	1849.79
6266.2-7	Murray River	MR6	1	29-Aug-12	16	1	16	5466.91	188.51
6266.2-7	Murray River	MR6	1	29-Aug-12	1	10	10	3416.82	117.82
6266.2-7	Murray River	MR6	1	29-Aug-12	81	1	81	27676.23	954.35
6266.2-8	Murray River	MR6	2	29-Aug-12	26	1	26	9755.61	286.93
6266.2-8	Murray River	MR6	2	29-Aug-12	29	13.1034482758621	380	142581.93	4193.59
6266.2-8	Murray River	MR6	2	29-Aug-12	46	1	46	17259.92	507.64
6266.2-8	Murray River	MR6	2	29-Aug-12	1	1	1	375.22	11.04
6266.2-8	Murray River	MR6	2	29-Aug-12	4	1	4	1500.86	44.14
6266.2-8	Murray River	MR6	2	29-Aug-12	15	1	15	5628.23	165.54
6266.2-8	Murray River	MR6	2	29-Aug-12	72	1	72	27015.52	794.57
6266.2-8	Murray River	MR6	2	29-Aug-12	18	1	18	6753.88	198.64
6266.2-8	Murray River	MR6	2	29-Aug-12	1	2	2	750.43	22.07
6266.2-8	Murray River	MR6	2	29-Aug-12	9	11.6666666666667	105	39397.64	1158.75
6266.2-8	Murray River	MR6	2	29-Aug-12	10	1	10	3752.16	110.36
6266.2-8	Murray River	MR6	2	29-Aug-12	10	9.4	94	35270.27	1037.36

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-8	Murray River	MR6	2	29-Aug-12	1	1	1	375.22	11.04
6266.2-8	Murray River	MR6	2	29-Aug-12	62	1	62	23263.37	684.22
6266.2-9	Murray River	MR6	3	29-Aug-12	21	1	21	16455.24	411.38
6266.2-9	Murray River	MR6	3	29-Aug-12	19	20	380	297761.47	7444.04
6266.2-9	Murray River	MR6	3	29-Aug-12	57	1	57	44664.22	1116.61
6266.2-9	Murray River	MR6	3	29-Aug-12	5	1	5	3917.91	97.95
6266.2-9	Murray River	MR6	3	29-Aug-12	19	1	19	14888.07	372.20
6266.2-9	Murray River	MR6	3	29-Aug-12	1	5	5	3917.91	97.95
6266.2-9	Murray River	MR6	3	29-Aug-12	55	1	55	43097.05	1077.43
6266.2-9	Murray River	MR6	3	29-Aug-12	25	1	25	19589.57	489.74
6266.2-9	Murray River	MR6	3	29-Aug-12	1	2	2	1567.17	39.18
6266.2-9	Murray River	MR6	3	29-Aug-12	17	15.0588235294118	256	200597.20	5014.93
6266.2-9	Murray River	MR6	3	29-Aug-12	7	1	7	5485.08	137.13
6266.2-9	Murray River	MR6	3	29-Aug-12	8	10.625	85	66604.54	1665.11
6266.2-9	Murray River	MR6	3	29-Aug-12	67	1	67	52500.05	1312.50
6266.2-10	Murray River	MR7b	1	29-Aug-12	105	1	105	189279.96	5567.06
6266.2-10	Murray River	MR7b	1	29-Aug-12	11	1	11	19829.33	583.22
6266.2-10	Murray River	MR7b	1	29-Aug-12	2	1	2	3605.33	106.04
6266.2-10	Murray River	MR7b	1	29-Aug-12	4	1	4	7210.67	212.08
6266.2-10	Murray River	MR7b	1	29-Aug-12	142	1	142	255978.62	7528.78
6266.2-10	Murray River	MR7b	1	29-Aug-12	5	1	5	9013.33	265.10
6266.2-10	Murray River	MR7b	1	29-Aug-12	10	9.1	91	164042.63	4824.78
6266.2-10	Murray River	MR7b	1	29-Aug-12	25	1	25	45066.66	1325.49
6266.2-10	Murray River	MR7b	1	29-Aug-12	1	10	10	18026.66	530.20
6266.2-11	Murray River	MR7b	2	29-Aug-12	35	1	35	56479.82	1176.66
6266.2-11	Murray River	MR7b	2	29-Aug-12	7	1	7	11295.96	235.33
6266.2-11	Murray River	MR7b	2	29-Aug-12	18	1	18	29046.77	605.14
6266.2-11	Murray River	MR7b	2	29-Aug-12	3	1	3	4841.13	100.86
6266.2-11	Murray River	MR7b	2	29-Aug-12	1	1	1	1613.71	33.62
6266.2-11	Murray River	MR7b	2	29-Aug-12	124	1	124	200099.95	4168.75
6266.2-11	Murray River	MR7b	2	29-Aug-12	7	1	7	11295.96	235.33
6266.2-11	Murray River	MR7b	2	29-Aug-12	3	9.66666666666667	29	46797.57	974.95
6266.2-11	Murray River	MR7b	2	29-Aug-12	74	5.78378378378378	428	690667.56	14388.91
6266.2-11	Murray River	MR7b	2	29-Aug-12	31	1	31	50024.99	1042.19
6266.2-11	Murray River	MR7b	2	29-Aug-12	1	3	3	4841.13	100.86
6266.2-12	Murray River	MR7b	3	29-Aug-12	25	1	25	41121.01	874.92
6266.2-12	Murray River	MR7b	3	29-Aug-12	1	1	1	1644.84	35.00
6266.2-12	Murray River	MR7b	3	29-Aug-12	1	1	1	1644.84	35.00
6266.2-12	Murray River	MR7b	3	29-Aug-12	21	1	21	34541.65	734.93
6266.2-12	Murray River	MR7b	3	29-Aug-12	1	1	1	1644.84	35.00
6266.2-12	Murray River	MR7b	3	29-Aug-12	3	1	3	4934.52	104.99
6266.2-12	Murray River	MR7b	3	29-Aug-12	115	1	115	189156.66	4024.61
6266.2-12	Murray River	MR7b	3	29-Aug-12	9	1	9	14803.56	314.97
6266.2-12	Murray River	MR7b	3	29-Aug-12	2	1	2	3289.68	69.99
6266.2-12	Murray River	MR7b	3	29-Aug-12	18	5.83333333333333	105	172708.26	3674.64
6266.2-12	Murray River	MR7b	3	29-Aug-12	109	1	109	179287.62	3814.63
6266.2-13	Murray River	MR9	1	31-Aug-12	39	1	39	27074.55	752.07
6266.2-13	Murray River	MR9	1	31-Aug-12	1	1	1	694.22	19.28

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-13	Murray River	MR9	1	31-Aug-12	73	1	73	50678.00	1407.72
6266.2-13	Murray River	MR9	1	31-Aug-12	9	1	9	6247.97	173.55
6266.2-13	Murray River	MR9	1	31-Aug-12	7	1	7	4859.53	134.99
6266.2-13	Murray River	MR9	1	31-Aug-12	112	1	112	77752.54	2159.79
6266.2-13	Murray River	MR9	1	31-Aug-12	13	1	13	9024.85	250.69
6266.2-13	Murray River	MR9	1	31-Aug-12	1	1	1	694.22	19.28
6266.2-13	Murray River	MR9	1	31-Aug-12	44	1	44	30545.64	848.49
6266.2-13	Murray River	MR9	1	31-Aug-12	2	6.5	13	9024.85	250.69
6266.2-14	Murray River	MR9	2	31-Aug-12	52	1	52	84548.58	3019.59
6266.2-14	Murray River	MR9	2	31-Aug-12	1	1	1	1625.93	58.07
6266.2-14	Murray River	MR9	2	31-Aug-12	17	1	17	27640.88	987.17
6266.2-14	Murray River	MR9	2	31-Aug-12	3	1	3	4877.80	174.21
6266.2-14	Murray River	MR9	2	31-Aug-12	2	1	2	3251.87	116.14
6266.2-14	Murray River	MR9	2	31-Aug-12	19	1	19	30892.75	1103.31
6266.2-14	Murray River	MR9	2	31-Aug-12	190	1	190	308927.52	11033.13
6266.2-14	Murray River	MR9	2	31-Aug-12	2	1	2	3251.87	116.14
6266.2-14	Murray River	MR9	2	31-Aug-12	4	1	4	6503.74	232.28
6266.2-14	Murray River	MR9	2	31-Aug-12	1	10	10	16259.34	580.69
6266.2-14	Murray River	MR9	2	31-Aug-12	2	1	2	3251.87	116.14
6266.2-14	Murray River	MR9	2	31-Aug-12	12	1	12	19511.21	696.83
6266.2-15	Murray River	MR9	3	31-Aug-12	22	1	22	40556.76	664.86
6266.2-15	Murray River	MR9	3	31-Aug-12	1	1	1	1843.49	30.22
6266.2-15	Murray River	MR9	3	31-Aug-12	74	1	74	136418.18	2236.36
6266.2-15	Murray River	MR9	3	31-Aug-12	18	1	18	33182.80	543.98
6266.2-15	Murray River	MR9	3	31-Aug-12	6	1	6	11060.93	181.33
6266.2-15	Murray River	MR9	3	31-Aug-12	150	1	150	276523.34	4533.17
6266.2-15	Murray River	MR9	3	31-Aug-12	1	4	4	7373.96	120.88
6266.2-15	Murray River	MR9	3	31-Aug-12	3	1	3	5530.47	90.66
6266.2-15	Murray River	MR9	3	31-Aug-12	1	1	1	1843.49	30.22
6266.2-15	Murray River	MR9	3	31-Aug-12	4	1	4	7373.96	120.88
6266.2-15	Murray River	MR9	3	31-Aug-12	20	1	20	36869.78	604.42
6266.2-15	Murray River	MR9	3	31-Aug-12	3	3.33333333333333	10	18434.89	302.21
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	200	1	200	3268127.99	96121.41
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	6	1	6	98043.84	2883.64
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	3	1	3	49021.92	1441.82
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	1	1	1	16340.64	480.61
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	31	1	31	506559.84	14898.82
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	10	1	10	163406.40	4806.07
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	11	1	11	179747.04	5286.68
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	4	1	4	65362.56	1922.43
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	1	7	7	114384.48	3364.25
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	23	1	23	375834.72	11053.96
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	1	1	1	16340.64	480.61
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	10	11.7	117	1911854.88	56231.03
6266.2-16	M17 Creek	M17-02	1	30-Aug-12	7	1	7	114384.48	3364.25
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	90	1	90	1448707.48	45272.11
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	23	1	23	370225.25	11569.54
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	4	1	4	64387.00	2012.09

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	66	1	66	1062385.49	33199.55
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	21	1	21	338031.75	10563.49
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	49	1	49	788740.74	24648.15
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	35	7.28571428571429	255	4104671.20	128270.98
6266.2-17	M17 Creek	M17-02	2	30-Aug-12	18	1	18	289741.50	9054.42
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	185	1	185	2274031.75	87462.76
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	4	1	4	49168.25	1891.09
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	2	1	2	24584.13	945.54
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	50	1	50	614603.17	23638.58
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	8	1	8	98336.51	3782.17
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	28	1	28	344177.78	13237.61
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	23	5.30434782608696	122	1499631.75	57678.14
6266.2-18	M17 Creek	M17-02	3	30-Aug-12	4	1	4	49168.25	1891.09
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	130	1	130	1826249.43	41505.67
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	11	1	11	154528.80	3512.02
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	101	1	101	1418855.33	32246.71
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	2	1	2	28096.15	638.55
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	3	1	3	42144.22	957.82
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	5	1	5	70240.36	1596.37
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	1	1	1	14048.07	319.27
6266.2-19	M19 Creek	M19-01	1	31-Aug-12	51	5.27450980392157	269	3778931.52	85884.81
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	68	1	68	682334.95	15507.61
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	4	10.25	41	411407.84	9350.18
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	1	10	10	100343.38	2280.53
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	6	1	6	60206.03	1368.32
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	175	1	175	1756009.07	39909.30
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	15	1	15	150515.06	3420.80
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	2	1	2	20068.68	456.11
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	6	1	6	60206.03	1368.32
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	24	6.95833333333333	167	1675734.37	38084.87
6266.2-20	M19 Creek	M19-01	2	31-Aug-12	5	1	5	50171.69	1140.27
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	15	1	15	57720.67	2748.60
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	7	1	7	26936.31	1282.68
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	154	1	154	592598.86	28218.99
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	12	1	12	46176.53	2198.88
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	1	1	1	3848.04	183.24
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	2	1	2	7696.09	366.48
6266.2-21	M19 Creek	M19-01	3	31-Aug-12	116	4.6551724137931	540	2077944.07	98949.72
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	120	1	120	2077944.07	49474.86
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	1	1	1	17316.20	412.29
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	65	1	65	1125553.04	26798.88
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	20	1	20	346324.01	8245.81
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	90	1	90	1558458.05	37106.14
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	7	1	7	121213.40	2886.03
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	2	5	10	173162.01	4122.90
6266.2-22	M19 Creek	M19-02	1	30-Aug-12	4	1	4	69264.80	1649.16
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	175	1	175	2859611.99	84106.24
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	1	1	1	16340.64	480.61

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	40	1	40	653625.60	19224.28
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	2	1	2	32681.28	961.21
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	23	1	23	375834.72	11053.96
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	2	6.5	13	212428.32	6247.89
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	49	1	49	800691.36	23549.75
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	1	1	1	16340.64	480.61
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	1	1	1	16340.64	480.61
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	3	6.33333333333333	19	310472.16	9131.53
6266.2-23	M19 Creek	M19-02	2	30-Aug-12	12	1	12	196087.68	5767.28
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	185	1	185	2729740.49	129987.64
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	5	1	5	73776.77	3513.18
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	38	1	38	560703.45	26700.16
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	24	1	24	354128.50	16863.26
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	25	1	25	368883.85	17565.90
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	1	1	1	14755.35	702.64
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	16	5.5	88	1298471.15	61831.96
6266.2-24	M19 Creek	M19-02	3	30-Aug-12	13	1	13	191819.60	9134.27
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	16	1	16	154528.80	1058.42
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	1	1	9658.05	66.15
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	2	1	2	19316.10	132.30
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	1	1	9658.05	66.15
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	34	1	34	328373.70	2249.13
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	25	138.48	3462	33436168.71	229014.85
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	1	1	9658.05	66.15
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	2	1	2	19316.10	132.30
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	22	1	22	212477.10	1455.32
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	18	1	18	173844.90	1190.72
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	52	52	502218.59	3439.85
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	30	9.76666666666667	293	2829808.62	19382.25
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	4	1.75	7	67606.35	463.06
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	11	1	11	106238.55	727.66
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	40	40	386322.00	2646.04
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	4	1	4	38632.20	264.60
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	2	2	19316.10	132.30
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	1	1	1	9658.05	66.15
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	3	9.33333333333333	28	270425.40	1852.23
6266.2-25	M19 Creek	M19-02	B	30-Aug-12	131	1	131	1265204.54	8665.78
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	3	1	3	4645.97	69.34
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	31	1	31	48008.34	716.54
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	17	1	17	26327.15	392.94
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	76	1	76	117697.86	1756.68
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	28	1	28	43362.37	647.20
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	1	1	1	1548.66	23.11
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	1	4	4	6194.62	92.46
6266.2-26	M20 Creek	M20-04	1	28-Aug-12	24	1	24	37167.75	554.74
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	9	1	9	47515.54	565.66
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	45	1	45	237577.70	2828.31
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	15	1	15	79192.57	942.77

EcoAnalysts Sample ID	Water Body	Site #	Replicate	Collection Date	Number of Natural Units	Cells per Natural Unit	Total Number of Cells	Cells/ sample	Cells per mL (in sample received)
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	56	1	56	295652.25	3519.67
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	94	1	94	496273.41	5908.02
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	2	1	2	10559.01	125.70
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	42	7.54761904761905	317	1673602.89	19923.84
6266.2-27	M20 Creek	M20-04	2	28-Aug-12	42	1	42	221739.18	2639.75
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	9	1	9	20947.32	238.04
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	93	1	93	216455.60	2459.72
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	5	1	5	11637.40	132.24
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	1	1	1	2327.48	26.45
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	152	1	152	353776.90	4020.19
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	12	1	12	27929.76	317.38
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	9	4.55555555555556	41	95426.66	1084.39
6266.2-28	M20 Creek	M20-04	3	28-Aug-12	21	1	21	48877.07	555.42
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	12	1	12	13026.27	482.45
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	49	1	49	53190.61	1970.02
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	42	1	42	45591.95	1688.59
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	2	1	2	2171.05	80.41
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	60	1	60	65131.36	2412.27
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	53	1	53	57532.70	2130.84
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	3	1	3	3256.57	120.61
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	2	1	2	2171.05	80.41
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	20	6.9	138	149802.12	5548.23
6266.2-29	M20 Creek	M20-06	1	30-Aug-12	65	1	65	70558.97	2613.30
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	14	1	14	25857.09	923.47
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	27	1	27	49867.25	1780.97
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	1	1	1	1846.94	65.96
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	9	1	9	16622.42	593.66
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	2	1	2	3693.87	131.92
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	155	1	155	286274.94	10224.11
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	55	1	55	101581.43	3627.91
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	7	4.71428571428571	33	60948.86	2176.74
6266.2-30	M20 Creek	M20-06	2	30-Aug-12	36	1	36	66489.66	2374.63
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	19	1	19	12405.75	689.21
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	77	1	77	50275.94	2793.11
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	15	1	15	9794.01	544.11
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	4	1	4	2611.74	145.10
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	78	1	78	50928.87	2829.38
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	37	1	37	24158.57	1342.14
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	1	1	1	652.93	36.27
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	3	3	9	5876.41	326.47
6266.2-31	M20 Creek	M20-06	3	30-Aug-12	69	1	69	45052.46	2502.91

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)															
		MR3	**MR4**	**MR6**	**MR7B**	**MR9**	**MR17-02**	**MR19-01A**	**MR19-02A**	**MR20-04**	**MR20-06**	**MR19-02B**	**MR19-01B**	**M19-01C**	**M19-01D**
Maxxam ID		EK8427	EK8428	EK8429	EK8430	EK8431	EK8432	EK8433	EK8434	EK8435	EK8436	EK8437	EK8438	EK8455	EK8456
Sampling Date		29/08/2012	29/08/2012	29/08/2012	29/08/2012	31/08/2012	30/08/2012	31/08/2012	31/08/2012	28/08/2012	30/08/2012	30/08/2012	31/08/2012	31/08/2012	31/08/2012
Matrix		Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
	UNITS														
Total Metals by ICPMS															
Total Aluminum (Al)	mg/kg	6710	5410	7120	5020	7370	5250	3010	4580	5920	7490	560	2890	3570	3850
Total Antimony (Sb)	mg/kg	0.260	0.241	0.297	0.481	0.238	0.227	0.256	0.243	0.443	0.364	0.0585	0.170	0.220	0.320
Total Arsenic (As)	mg/kg	6.62	5.24	17.4	8.43	5.82	3.81	5.03	3.59	5.67	5.28	1.85	4.07	4.78	5.08
Total Barium (Ba)	mg/kg	150	185	377	198	124	356	304	234	615	483	58.3	313	239	264
Total Beryllium (Be)	mg/kg	0.41	0.33	0.47	0.39	0.37	0.32	0.27	0.33	0.43	0.51	<0.10	0.21	0.22	0.27
Total Bismuth (Bi)	mg/kg	0.11	0.10	0.13	<0.10	0.15	<0.10	<0.25	<0.10	<0.30	<0.15	<0.10	<0.20	<0.10	<0.10
Total Boron (B)	mg/kg	8.2	6.3	12.0	7.2	13.2	9.0	10.4	190	17.2	14.7	2.5	11.5	10.2	12.5
Total Cadmium (Cd)	mg/kg	0.521	0.616	3.27	1.62	0.645	0.759	0.511	0.604	0.965	0.937	0.854	0.482	0.477	0.537
Total Calcium (Ca)	mg/kg	41800	33600	52500	52800	55600	105000	89400	26100	47500	54100	12400	102000	34400	40600
Total Chromium (Cr)	mg/kg	12.6	9.44	13.5	10.9	12.9	9.68	7.07	7.97	11.3	13.4	1.18	5.92	8.00	8.23
Total Cobalt (Co)	mg/kg	6.56	5.43	25.9	15.6	7.57	4.53	5.13	4.78	25.1	15.7	0.797	4.65	5.63	6.40
Total Copper (Cu)	mg/kg	11.2	11.6	14.9	12.1	11.6	13.5	8.29	11.3	16.6	16.2	13.4	7.35	9.15	10.3
Total Iron (Fe)	mg/kg	16300	14500	23900	18000	17400	10500	15900	12200	14200	18100	1800	12700	15900	16900
Total Lead (Pb)	mg/kg	9.29	7.27	9.70	8.43	8.91	5.92	6.35	6.02	9.01	9.23	0.814	4.66	4.75	6.29
Total Magnesium (Mg)	mg/kg	14800	11000	16600	13500	18700	7730	19200	5680	9640	10900	4090	20200	5060	5340
Total Manganese (Mn)	mg/kg	438	363	5510	2690	710	276	1010	452	1060	690	130	1150	1120	1090
Total Mercury (Hg)	mg/kg	0.031	0.039	0.044	0.057	0.036	0.043	0.042	0.062	0.054	0.062	0.146	0.038	0.042	0.044
Total Molybdenum (Mo)	mg/kg	1.20	0.974	1.85	2.05	1.08	0.805	0.76	0.714	1.21	1.27	0.441	0.55	1.02	1.03
Total Nickel (Ni)	mg/kg	19.7	16.5	60.2	29.7	19.7	21.5	14.2	14.8	29.3	31.0	4.25	11.1	15.3	18.7
Total Phosphorus (P)	mg/kg	981	949	1030	946	1000	1020	823	815	1410	1260	2540	802	914	998
Total Potassium (K)	mg/kg	1510	1520	1340	1270	1400	1590	1010	1060	1970	2210	18200	984	993	1050
Total Selenium (Se)	mg/kg	0.475	0.592	1.16	0.983	0.614	1.57	0.95	1.30	2.48	4.28	1.11	1.07	1.18	1.24
Total Silver (Ag)	mg/kg	0.117	0.119	0.100	0.140	0.096	0.098	0.285	0.113	0.175	0.217	0.033	0.163	0.139	0.192
Total Sodium (Na)	mg/kg	80	66	78	86	85	174	140	103	235	192	617	94	94	82
Total Strontium (Sr)	mg/kg	62.1	52.6	78.0	83.5	72.7	143	69.8	38.6	94.1	101	25.5	67.7	45.2	49.3
Total Thallium (Tl)	mg/kg	0.200	0.152	0.233	0.214	0.189	0.170	0.0908	0.0986	0.206	0.244	0.0325	0.0812	0.0872	0.0914
Total Tin (Sn)	mg/kg	0.22	0.22	0.23	0.63	0.22	0.23	0.55	0.18	0.48	0.48	<0.10	0.42	0.45	0.51
Total Titanium (Ti)	mg/kg	60.9	36.3	55.8	28.8	73.7	47.2	37.3	13.8	74.3	58.2	7.5	27.7	31.0	31.6
Total Uranium (U)	mg/kg	0.975	0.669	0.879	0.965	0.865	0.605	0.334	0.455	0.721	0.722	0.113	0.305	0.481	0.459
Total Vanadium (V)	mg/kg	27.8	19.9	34.0	28.3	27.2	20.0	17.1	16.1	25.2	29.6	4.54	12.3	18.5	17.4
Total Zinc (Zn)	mg/kg	62.1	61.8	105	86.5	61.4	65.1	73.7	59.4	118	105	94.5	51.0	67.3	77.1
RDL = Reportable Detection Limit															
EDL = Estimated Detection Limit															

APPENDIX F HILSENHOFF INDEX TABLE

HBI Value	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

Appendix 4-3

Stream Periphyton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010 to 2012

Rescan™
Engineers and Scientists

Appendix 4-3. Stream Periphyton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID	Replicate	Date Sampled	Lab Sample ID	Chlorophyll *a* (µg/sample)	Chlorophyll *a* (µg/cm^2)
MR-REF	1	15-Aug-10	L921573-13	3.57	0.101
	2	15-Aug-10	L921573-14	1.68	0.048
	3	15-Aug-10	L921573-15	4.33	0.123
MR3	1	14-Aug-10	L921573-1	0.851	0.024
	2	14-Aug-10	L921573-2	4.32	0.122
	3	14-Aug-10	L921573-3	2.83	0.080
MR4	1	14-Aug-10	L921573-4	17.7	0.502
	2	14-Aug-10	L921573-5	9.59	0.272
	3	14-Aug-10	L921573-6	12.8	0.363
MR6	1	16-Aug-10	L921573-7	4.68	0.133
	2	16-Aug-10	L921573-8	8.93	0.253
	3	16-Aug-10	L921573-9	1.53	0.043
M20-04	1	14-Aug-10	L921573-10	0.265	0.008
	2	14-Aug-10	L921573-11	1.00	0.028
	3	14-Aug-10	L921573-12	0.429	0.012
REFST	1	16-Aug-10	L921573-16	5.33	0.151
	2	16-Aug-10	L921573-17	1.87	0.053
	3	16-Aug-10	L921573-18	23.8	0.675

Notes:

All samples analyzed by ALS Environmental

Each replicate was a composite of three subsamples

Each subsample had an area of 11.8 cm^2 , therefore the total area of each replicate was 35.4 cm^2

Appendix 4-3. Stream Periphyton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID	Replicate	Date Sampled	Lab Sample ID	Chlorophyll *a* (µg/cm^2)
MR9	1	25-Aug-11	BJ9168	<0.03
	2	25-Aug-11	BJ9169	0.18
	3	25-Aug-11	BJ9170	0.11
	4	25-Aug-11	BJ9171	0.69
	5	25-Aug-11	BJ9172	0.44
	6	25-Aug-11	BJ9173	0.13
MR4	1	27-Aug-11	BJ9243	0.15
	2	27-Aug-11	BJ9244	0.52
	3	27-Aug-11	BJ9245	2.7
	4	27-Aug-11	BJ9246	1.4
	5	27-Aug-11	BJ9247	4.9
	6	27-Aug-11	BJ9248	3.3
MR7	1	24-Aug-11	BJ9174	5.1
	2	24-Aug-11	BJ9175	6.2
	3	27-Aug-11	BJ9176	3.7
	4	27-Aug-11	BJ9177	6.5
	5	27-Aug-11	BJ9178	6.1
	6	27-Aug-11	BJ9179	2.1
M20-03	1	27-Aug-11	BJ9205	3.5
	2	27-Aug-11	BJ9206	4.8
	3	27-Aug-11	BJ9207	4.7
	4	27-Aug-11	BJ9208	3.0
	5	27-Aug-11	BJ9209	4.7
	6	27-Aug-11	BJ9210	1.9
M20-05	1	27-Aug-11	BJ9199	0.38
	2	27-Aug-11	BJ9200	0.36
	3	27-Aug-11	BJ9201	0.63
	4	27-Aug-11	BJ9202	0.10
	5	27-Aug-11	BJ9203	0.31
	6	27-Aug-11	BJ9204	0.38
M20-04	1	27-Aug-11	BJ9249	0.21
	2	27-Aug-11	BJ9250	0.24
	3	27-Aug-11	BJ9251	0.1
	4	27-Aug-11	BJ9252	0.1
	5	27-Aug-11	BJ9253	0.1
	6	27-Aug-11	BJ9254	0.04

Notes:

All samples analyzed by Maxxam Analytical

Each replicate sample had an area of 78.5 cm^2

< = less than the detection limit

When sample results were < detection limit, half the detection limit was used in biomass calculations

Appendix 4-3. Stream Periphyton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID	Replicate	Date Sampled	Lab Sample ID	Chlorophyll *a* (µg/cm^2)
MR9	1	31-Aug-12	EL0924	0.04
	2	31-Aug-12	EL0925	0.07
	3	31-Aug-12	EL0926	0.53
	4	31-Aug-12	EL0927	0.19
	5	31-Aug-12	EL0928	0.06
	6	31-Aug-12	EL0929	0.11
MR3	1	29-Aug-12	EL0900	0.95
	2	29-Aug-12	EL0901	0.55
	3	29-Aug-12	EL0902	0.65
	4	29-Aug-12	EL0903	0.56
	5	29-Aug-12	EL0904	0.79
	6	29-Aug-12	EL0905	0.43
MR4	1	29-Aug-12	EL0906	0.32
	2	29-Aug-12	EL0907	0.04
	3	29-Aug-12	EL0908	0.46
	4	29-Aug-12	EL0909	0.08
	5	29-Aug-12	EL0910	0.06
	6	29-Aug-12	EL0911	0.06
MR7B	1	29-Aug-12	EL0918	<0.03
	2	29-Aug-12	EL0919	<0.03
	3	29-Aug-12	EL0920	0.24
	4	29-Aug-12	EL0921	0.07
	5	29-Aug-12	EL0922	0.20
	6	29-Aug-12	EL0923	0.05
MR6	1	29-Aug-12	EL0912	0.42
	2	29-Aug-12	EL0913	0.54
	3	29-Aug-12	EL0914	0.49
	4	29-Aug-12	EL0915	0.54
	5	29-Aug-12	EL0916	0.58
	6	29-Aug-12	EL0917	0.40
M20-06	1	30-Aug-12	EL0948	0.20
	2	30-Aug-12	EL0949	0.11
	3	30-Aug-12	EL0950	0.18
	4	30-Aug-12	EL0951	0.06
	5	30-Aug-12	EL0952	0.15
	6	30-Aug-12	EL0953	0.08
M20-04	1	28-Aug-12	EL0942	0.23
	2	28-Aug-12	EL0943	0.27
	3	28-Aug-12	EL0944	0.23
	4	28-Aug-12	EL0945	0.18
	5	28-Aug-12	EL0946	0.27
	6	28-Aug-12	EL0947	0.32
M17-02	1	30-Aug-12	EL0930	1.43
	2	30-Aug-12	EL0931	1.30
	3	30-Aug-12	EL0932	0.49
	4	30-Aug-12	EL0933	0.62
	5	30-Aug-12	EL0934	0.10
	6	30-Aug-12	EL0935	1.05
M19-01	1	31-Aug-12	EL0936	0.43
	2	31-Aug-12	EL0937	0.20
	3	31-Aug-12	EL0938	0.33
	4	31-Aug-12	EL0939	0.15
	5	31-Aug-12	EL0940	0.31
	6	31-Aug-12	EL0941	0.43
M19-02	1	30-Aug-12	EL0954	0.53
	2	30-Aug-12	EL0955	0.42
	3	30-Aug-12	EL0956	0.51
	4	30-Aug-12	EL0957	0.72
	5	30-Aug-12	EL0958	0.26
	6	30-Aug-12	EL0959	0.55

Notes:

All samples analyzed by Maxxam Analytical

Each replicate sample had an area of 78.5 cm^2

< = less than the detection limit

When sample results were < detection limit, half the detection limit was used in biomass calculations

Appendix 4-4

Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

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Appendix 4-4. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Sample ID					MR-REF			MR3			MR4			MR6			M20-04			REFST		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					15-Aug-10			14-Aug-10			14-Aug-10			14-Aug-10			14-Aug-10			16-Aug-10		
Lab Sample ID					100237	100238	100239	100225	100226	100227	100228	100229	100230	100231	100232	100233	100234	100235	100236	100240	100241	100242
Area Sampled (cm^2)					35.3			35.3			35.3			35.3			35.3			35.3		
Phylum	Class	Order	Family	Taxa																		
Ochrophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	*Achnanthes flexella*	0	<49	60	<41	<37	0	0	0	<95	80	0	<40	0	0	0	<22	<7	0
				Achnanthes laevis	118	98	60	320	74	674	92	99	<95	1,553	0	0	<9	0	0	0	0	0
				Achnanthes lanceolata	0	0	0	0	0	0	0	0	0	0	0	0	36	162	340	89	13	83
				Achnanthes minutissima	93,360	253,953	92,908	5,447	40,966	6,735	42,513	38,275	76,097	132,457	779,896	43,760	554	314	1,360	6,585	575	20,961
				Achnanthes pusilla	0	0	0	0	0	0	0	0	0	771,368	690,914	21,289	0	0	0	0	0	0
				Achnanthes spp.	5,285	8,757	8,934	961	4,429	2,694	713	4,416	5,637	7,792	5,234	1,183	69	628	113	1,386	52	2,466
			Cocconeidaceae	*Cocconeis placentula*	118	49	<60	<41	<37	<87	184	99	<95	80	0	0	485	1,256	1,246	<22	40	165
		Bacillariales	Bacillariaceae	*Denticula* sp.	236	293	1,078	641	297	174	356	395	1,465	311	2,040	158	0	0	0	<22	0	0
				Nitzschia acicularis	0	<49	0	165	148	1,347	0	99	0	311	175	0	0	0	<15	0	0	0
				Nitzschia angustata	<59	<49	<60	0	<37	0	0	0	<95	<40	<87.7	0	0	0	0	<22	0	0
				Nitzschia spp.	915	2,655	599	2,243	12,179	4,041	5,346	3,825	3,662	1,242	2,720	615	53	2,511	567	178	54	1,922
		Cymbellales	Anomoeoneidaceae	*Anomoeoneis* sp.	0	98	1,857	<41	0	0	46	198	0	80	1,360	79	0	0	0	0	0	0
			Cymbellaceae	*Cymbella affinis*	<59	98	120	0	<37	0	0	0	<95	80	0	<40	0	<41	29	<22	13	0
				Cymbella caespitosa	<59	<49	60	<41	148	2,694	1,426	198	95	<40	88	40	0	0	0	0	0	0
				Cymbella cf. cestaii	59	49	240	<41	0	348	<46	0	<95	0	0	<40	0	0	0	0	<7	0
				Cymbella cistula	236	196	<60	41.3	37	174	<46	49	<95	<40	<88	0	<9	<41	<15	<22	<7	<41
				Cymbella meulleri	0	0	0	0	0	0	0	0	0	<40	0	0	0	0	0	0	0	0
				Cymbella mexicana	0	0	0	0	<37	0	0	0	<95	<40	0	0	0	0	0	0	0	0
				Cymbella cf. microcephala	12,331	11,677	35,734	5,767	17,715	23,327	13,714	6,120	25,366	20,320	26,171	2,458	624	628	793	520	80	248
				Cymbella minuta	3,204	391	3,714	1,602	4,603	10,776	4,633	2,295	7,324	1,864	9,521	475	53	81	117	312	366	11,097
				Cymbella prostrata	<59	<49	<60	<41	297	87	276	494	756	<40	<88	0	0	0	0	0	0	0
				Cymbella sinuata	<59	759	120	<41	223	<87	0	198	567	1,553	2,720	158	693	2,197	1,133	268	67	83
				Cymbella spp.	118	98	359	82.6	371	1,347	552	198	945	241	877	<40	<9	0	0	44.6	0	0
			Gomphonemataceae	*Didymosphenia geminata*	<59	0	<60	<41	148	<87	92	49	95	<40	<88	<40	0	<41	<15	<22	0	<41
				Gomphonema truncatum	0	0	0	0	0	0	0	0	0	0	0	0	0	<41	<15	0	0	0
				Gomphonema angustatum/parvulum	0	0	0	0	0	674	92	0	<95	0	351	<40	0	0	0	1,040	107	2,243
				Gomphonema olivaceum	118	2,276	120	0	2,302	2,021	0	0	0	15,539	12,922	317	0	0	0	0	0	0
				Gomphonema spp.	2,289	17,514	7,891	248	863	0	2,495	765	732	10,758	10,882	922	18	81	146	693	54	961
			Rhoicospheniaceae	*Rhoicosphenia curvata*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<22	0	0
		Eunotiales	Eunotiaceae	*Eunotia* spp.	0	<49	0	0	0	0	<46	<49	<95	0	0	0	0	0	0	0	0	0
		Fragilariales	Fragilariaceae	*Ceratoneis arcus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	134	121	13,563
				Diatoma elongatum	1,831	379	479	961	8,631	5,388	9,266	1,148	5,859	1,242	3,401	238	139	942	113	178	13	0
				Diatoma hiemale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<41
				Diatoma mesodon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<7	413
				Diatoma moniliformis	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	0
				Fragilaria capucina	0	0	0	0	0	0	<46.0	0	0	0	0	0	0	0	0	0	0	0
				Fragilaria construens	<59	0	0	165	0	0	356	0	284	0	0	0	0	0	0	0	0	0
				Fragilaria leptostauron	0	0	<60	83	0	0	0	0	<95	0	0	0	0	0	0	0	0	<41
				Fragilaria pinnata	236	<49	240	0	0	0	<46	0	<95	<40	0	0	0	0	0	0	0	0
				Fragilaria vaucheriae	354	98	120	0	1,151	4,041	4,990	1,530	1,465	621	680	79	0	0	0	0	0	413
				Fragilaria spp.	0	0	0	641	2,302	2,694	2,495	1,148	732	311	526	<40	53	0	0	0	0	0
				Meridion circulare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<7	<41
				Synedra ulna	<59	0	0	<41	74	<87	276	49	<95	<40	<88	<40	<9	<41	<15	<22	0	<41
				Synedra spp.	59	196	<60	0	575	0	356	1,148	1,465	310.6	0	39.6	18	0	<15	0	0	0
		Naviculales	Amphipleuraceae	*Amphipleura pellucida*	<59	<49	0	0	37	174	92	49	189	0	0	<40	0	0	<15	0	0	0
				Frustulia rhomboides	<59	0	0	<41	<37	0	0	0	0	0	0	0	0	0	0	0	0	0
			Diploneidaceae	*Diploneis* sp.	0	0	<60	<41	0	<87	0	0	<95	0	0	0	0	0	0	0	0	0
			Naviculaceae	*Caloneis* spp.	118	49	359	248	519	348	92	296	378	321	351	158.4	18	<41	29	0	<7	0
				Navicula radiosa	59	98	120	165	371	174	276	395	567	160	175	<40	<9	<41	<15	<22	<7	0
				Navicula tripunctata	0	0	0	0	0	0	92	99	<95	<40	0	0	<9	162	88	0	0	0
				Navicula vulpina	<59	0	60	41	74	521	0	0	0	0	0	0	0	0	0	0	<7	0
				Navicula spp.	708	391	2,321	1,922	4,891	4,715	12,118	4,973	10,986	1,553	526	238	36	324	117	22	<7	41
			Neidiaceae	*Neidium* sp.	0	0	0	0	0	0	<46	<49	0	0	0	0	0	0	0	0	0	0
			Pinnulariaceae	*Pinnularia* spp.	0	0	<60	<41	<37	<87	<46	<49	0	0	0	<40	<9	0	0	0	0	0
			Stauroneidaceae	*Stauroneis* sp.	0	0	<60	0	<37	0	<46	0	0	0	<88	<40	0	0	0	0	0	0
		Rhopalodiales	Rhopalodiaceae	*Epithemia* sp.	0	0	0	0	<37	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhopalodia gibba	0	0	0	0	0	0	0	0	0	0	0	0	0	<41	<15	0	0	0
		Surirellales	Surirellaceae	*Cymatopleura solea*	0	0	0	<41	<37	<87	0	0	<95	0	0	0	<9	0	0	0	0	0
				Surirella spp.	0	0	<60	<41	<37	0	0	0	<95	<40	0	<40	<9	<41	<15	0	0	0
	Thalassiophysales		Catenulaceae	*Amphora* spp.	<59	0	<60	<41	<37	<87	0	<49	<95	<40	<88	0	<9	0	<15	0	6.7	0

Appendix 4-4. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Sample ID					MR-REF			MR3			MR4			MR6			M20-04			REFST		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					15-Aug-10			14-Aug-10			14-Aug-10			14-Aug-10			14-Aug-10			16-Aug-10		
Lab Sample ID					100237	100238	100239	100225	100226	100227	100228	100229	100230	100231	100232	100233	100234	100235	100236	100240	100241	100242
Area Sampled (cm^2)					35.3			35.3			35.3			35.3			35.3			35.3		
Phylum	**Class**	**Order**	**Family**	**Taxa**																		
Ochrophyta	Bacillariophyceae	Thalassiosirales	Stephanodiscaceae	*Cyclotella bondanica*	0	<49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Cyclotella sp.	0	0	0	<41	0	0	0	0	0	0	0	0	142	81	58	22	7	0
				UID girdle view	0	0	0	0	0	0	0	0	<95	80	0	0	0	0	0	<22	0	0
				UID bent and deformed diatoms	458	379	1,393	3,845	2,014	8,082	2,138	198	2,197	2,485	2,720	307	139	2,825	113	0	0	83
				UID diatom with frustules invisible	3,204	1,517	2,785	6,088	4,603	17,511	2,495	383	4,394	2,485	5,441	615	69	4,081	1,926	0	13	2,243
	Chrysophyceae	Chromulinales	Chrysococcaceae	*Kephyrion / Pseudokephyrion sp.*	0	0	0	<41	<37	0	0	0	0	160	87.7	<40	0	0	0	0	0	0
		Chrysocapsales	Hydruraceae	*Hydrurus foetidus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	67	<41
		Ochromonadales	Dinobryaceae	*Hyalobryon* sp.	0	98	359	961.2	<37	0	0	98.8	0	80	<88	0	0	0	0	0	0	0
				UID Chrysophyceae colonial	915	759	1,857	0	0	0	0	0	0	0	0	0	6,861	5,650	12,463	62,092	12,078	41,922
				UID Chrysophyceae cyst	0	0	0	0	74	0	0	0	0	0	<88	0	0	0	0	0	0	0
				UID Chrysophyceae unicellular	1,831	1,897	1,393	2,243	1,439	0	1,069	<49	732	1,242	175	0	0	0	0	0	0	<41
Chlorophyta	Chlorophyceae	Chaetophorales	Chaetophoraceae	*Stigeoclonium* sp.	0	0	0	0	0	0	736	0	0	0	0	0	0	0	0	0	0	0
				UID Chaetophorales	3,186	<49	3,474	0	297	0	7,484	198	0	0	<88	0	0	<41	<15	<22	0	0
		Oedogoniales	Oedogoniaceae	*Oedogonium* spp.	0	<49	0	0	0	0	0	<49	0	<40	0	0	0	0	0	0	0	0
		Sphaeropleales	Hydrodictyaceae	*Euastropsis richteri*	0	0	0	0	0	0	0	0	0	<40	0	0	0	0	0	0	0	0
			Scenedesmaceae	*Scenedesmus* spp.	<59	<49	<60	<41	<37	0	<46	0	<95	0	0	<40	36	162	<15	0	<7	<41
			Selenastraceae	*Ankistrodesmus* spp.	<59	48.9	<60	83	74	<87	0	99	0	<40	<88	79.2	53	162	15	0	0	0
				Selenastrum sp.	0	0	0	<41	0	0	0	0	0	0	0	0	0	<41	0	0	0	0
	Trebouxiophyceae	Chlorellales	Oocystaceae	*Oocystis* sp.	0	0	0	<41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ulvophyceae	Ulotrichales	Ulotrichaceae	*Ulothrix zonata*	<59	<49	479	<41	<37	<87	<46	<49	0	<40	<88	0	0	0	<14.6	1,427	536	6,938
				Ulothrix zonata isogamete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,097
				Ulothrix zonata zoospore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,932
				Ulothrix zonata zygote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	268	157	320
				Ulothrix spp.	0	0	<60	0	<37	0	0	0	0	0	0	0	0	<41	0	0	<7	0
				UID Chlorophyta colonial	0	0	240	0	<37	0	3,208	395	0	0	<88	<40	0	0	0	0	0	0
				UID Chlorophyta filamentous	0	0	0	0	0	0	0	0	0	0	0	0	<9	0	0	0	0	0
				UID Chlorophyta flagellate	0	0	0	83	0	0	92	0	0	0	0	<40	0	0	0	0	0	0
				UID Chlorophyta unicellular	118	98	120	165	0	<87	184	99	189	311	1,360	79	0	<41	0	0	0	320
Charophyta	Conjugophyceae	Desmidiales	Closteriaceae	*Closterium* spp.	<59	0.0	0	<41	0	<87	<46	0	0	0	<88	0	<9	<41	<15	<22	<7	<41
			Desmidiaceae	*Cosmarium* spp.	118	<49	120	6,088	14,394	57,022	2,138	99	3,662	11,953	15,642	396	<9	<41	<15	<22	<7	0
				Staurastrum sp.	0	0	0	0	<37	<87	0	0	<95	<40	<88	<40	0	0	0	0	0	0
				Teilingia granulata	0	0	0	0	0	0	0	0	0	0	0	<40	0	0	0	0	0	0
		Zygnematales	Zygnemataceae	*Mougeotia* sp.	0	0	0	0	0	0	0	0	<95	0	0	0	0	<41	0	0	0	0
				Zygnema sp.	0	0	0	0	0	0	<46	0	0	0	0	0	0	0	0	0	0	0
Cryptophyta	Cryptophyceae	Cryptomonadales		UID Cryptomonadales	0	<49	0	0	0	0	0	0	0	0	<88	<40	0	0	0	0	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Cyanobacteriaceae	*Aphanothece* sp.	0	0	0	0	0	0	0	0	0	0	<88	<40	0	0	0	0	0	0
				UID Chroococcales	915	0	928	1,282	1,151	2,021	2,138	0	11,274	0	31,405	922	0	0	0	0	0	0
		Synechococcales	Chamaesiphonaceae	*Chamaesiphon* spp.	26,423	11,676	10,720	0	14,394	4,715	163,197	26,498	262,111	11,953	115,152	603,177	93,895	41,069	113,728	89,365	5,234	318,114
				Clastidium setigerum	12,331	4,379	37,521	0	4,429	3,368	20,571	13,249	14,092	4,781	13,086	8,279	0	0	0	0	0	0
			Merismopediaceae	*Aphanocapsa* sp.	<59	0	<60	0	0	0	<46	0	0	0	<88	0	0	0	0	0	0	0
				Merismopedia spp.	<59	<49	<60	<41	<37	<87	<46	<49	0	0	<88	0	<9	<41	<15	0	0	0
		Nostocales	Nostocaceae	*Anabaena / Nostoc* sp.	<59	0	0	0	0	0	<46	0	0	0	0	0	0	0	0	0	0	0
			Rivulariaceae	*Calothrix / Dichothrix* sp.	0	0	0	0	0	0	<46	0	0	0	<88	0	0	0	0	0	0	0
				UID Nostocales	0	0	0	0	0	0	0	0	<95	0	0	0	0	0	0	0	0	0
		Oscillatoriales	Ammatoideaceae	*Homoeothrix varians*	32,039	43,999	61,739	0	29,921	28,287	53,816	71,145	79,099	49,075	554,825	203,424	106,680	150,988	73,718	290,768	15,098	771,858
			Oscillatoriaceae	*Lyngbya* spp.	<59	<49	<60	0	0	0	920.0	<49	<95	0	0	0	0	0	0	8,838	<7	661
				Oscillatoria spp.	0	0	0	0	0	<87	0	0	0	0	0	0	0	0	0	0	0	0
			Pseudanabaenoidae	*Pseudoanabaena* spp.	2,242	880	4,313	41,011	18,988	22,226	7,128	11,093	16,845	15,841	8,841	4,831	0	648	234	223	0	6,728
			Schizotrichaceae	*Schizothrix* sp.	0	0	<60	0	0	0	0	0	0	0	10,882	12,907	0	0	0	<22	0	0
				UID Oscillatoriales	0	0	<60	<41	<37	0	<46	<49	567.0	1,283	0	0	0	0	0	<22	<7	0
Rhodophyta	Florideophyceae	Acrochaetiales	Acrochaetiaceae	*Audouinella* sp.	0	0	0	0	<37	0	<46	0	0	0	<88	0	0	<41	0	0	0	1,239
		Batrachospermales	Batrachospermaceae	*Batrachospermum* sp.	0	0	0	0	0	0	1,288.0	<49	0	0	0	0	0	0	0	0	0	0
				UID flagellate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83
				UID filamentous	0	0	0	<41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				UID unicellular	458	1,517	928	641	1,439	2,694	356	765	2,930	3,586	5,234	307	208	314	340	520	105	1,233
				TOTAL	**206,577**	**367,833**	**286,520**	**84,745**	**197,049**	**221,828**	**372,267**	**193,192**	**543,849**	**1,075,803**	**2,317,308**	**907,950**	**210,995**	**215,633**	**208,913**	**465,195**	**34,910**	**1,222,635**

Notes:

Samples identified by Fraser Environmental Services

Counts represent the number of cells per sample and have not been standardized by sampling area

Each replicate is a composite of three subsamples, where each subsample was collected from an area of 11.76 cm^2 (total area = 35.3 cm^2)

< = present in sample but inaccurate estimate of number of cells (half < values used for all calculations including the totals)

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013).

UID = unidentified due to size and/or missing morphological characters

cf. = (confertim = close together)

Appendix 4-4. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Sample ID					MR9			MR4			MR7			M20-03						M20-05			M20-04		
Replicate					1	2	3	1	2	3	1	2	3	1	1	2	2	3	3	1	2	3	1	2	3
Community					-	-	-	-	-	-	-	-	-	dominant	sub-dominant	dominant	sub-dominant	dominant	sub-dominant	-	-	-	-	-	-
Date Sampled					25-Aug-11			25-Aug-11			24-Aug-11			26-Aug-11						26-Aug-11			25-Aug-11		
Lab Sample ID					5906.2-7	5906.2-8	5906.2-9	5906.2-1	5906.2-2	5906.2-3	5906.2-4	5906.2-5	5906.2-6	5906.2-13	5906.2-10	5906.2-14	5906.2-11	5906.2-15	5906.2-12	5906.2-19	5906.2-20	5906.2-21	5906.2-16	5906.2-17	5906.2-18
Area Sampled (cm^2)					78.5			78.5			78.5			78.5						78.5			78.5		
Phylum	**Class**	**Order**	**Family**	**Taxa**																					
Ochrophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	*Achnanthes* sp.	5,000	93,750	6,250	20,000	30,000	0	9,091	0	11,111	8,350,000	1,316,667	9,700,000	1,933,333	8,100,000	1,309,091	0	0	0	22,222	57,143	50,000
			Cocconeidaceae	*Cocconeis* sp.	0	0	0	0	0	0	0	0	0	50,000	0	0	66,667	0	0	0	0	0	0	0	0
		Bacillariales	Bacillariaceae	*Nitzschia* sp.	0	0	0	0	0	0	0	0	0	450,000	0	500,000	0	300,000	18,182	0	0	58,333	11,111	7,143	150,000
		Cymbellales	Cymbellaceae	*Cymbella* sp.	0	0	0	0	0	0	0	0	11,111	400,000	100,000	300,000	566,667	800,000	54,545	3,333	10,526	75,000	22,222	21,429	100,000
				Encyonema sp.	0	0	0	0	0	0	0	0	0	1,400,000	0	1,300,000	0	1,500,000	127,273	0	10,526	175,000	66,667	57,143	50,000
			Gomphonemataceae	*Didymosphenia geminata*	0	0	0	0	0	0	0	0	0	200,000	0	100,000	0	100,000	9,091	0	0	0	0	0	0
				Gomphonema sp.	10,000	37,500	62,500	20,000	130,000	7,143	9,091	0	11,111	350,000	233,333	700,000	4,033,333	1,100,000	372,727	6,667	47,368	350,000	711,111	600,000	1,300,000
				Reimeria sp.	0	6,250	0	0	0	0	0	0	0	0	0	0	33,333	0	9,091	3,333	5,263	33,333	200,000	442,857	300,000
		Naviculales	Pinnulariaceae	*Caloneis* sp.	0	0	6,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Fragilariales	Fragilariaceae	*Diatoma* sp.	0	0	0	0	0	0	0	0	0	3,050,000	3,266,667	16,700,000	3,166,667	14,900,000	790,909	3,333	5,263	1,766,667	2,277,778	892,857	12,800,000
				Fragilaria sp.	0	0	0	0	0	0	0	0	0	500,000	0	600,000	0	800,000	0	0	0	0	0	0	0
				Hannaea sp.	0	0	0	0	0	0	0	0	0	0	0	100,000	0	0	9,091	0	0	0	0	0	0
				Meridion sp.	0	0	0	0	0	0	0	0	0	200,000	0	200,000	0	1,200,000	0	0	0	0	0	0	0
				Synedra sp.	0	6,250	0	0	0	0	0	0	0	150,000	0	100,000	0	0	0	0	0	0	33,333	21,429	50,000
		Naviculales	Naviculaceae	*Navicula* sp.	0	0	0	0	0	0	0	0	0	1,650,000	133,333	1,000,000	433,333	1,400,000	81,818	0	31,579	91,667	11,111	35,714	50,000
		Rhopalodiales	Rhopalodiaceae	*Rhopalodia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,111	0	0
		Surirellales	Surirellaceae	*Surirella* sp.	0	0	0	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	0	0
		Tabellariales	Tabellariaceae	*Tabellaria* sp.	0	0	0	0	10,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				UID centric diatom	0	0	0	50,000	35,000	0	0	0	0	0	33,333	100,000	0	0	0	0	0	0	0	7,143	500,000
				UID pennate diatom	5,000	12,500	6,250	10,000	10,000	21,429	18,182	0	0	50,000	50,000	300,000	100,000	200,000	18,182	0	0	0	33,333	7,143	50,000
Cyanophyta	Cyanophyceae	Oscillatoriales	Phormidiaceae	*Phormidium* sp.	0	0	0	0	15,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglenozoa	Euglenophyceae	Eugenales	Eugenaceae	*Euglena* sp.	0	0	0	0	0	0	45,455	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				TOTAL	**20,000**	**156,250**	**81,250**	**100,000**	**230,000**	**28,571**	**81,818**	**0**	**33,333**	**16,800,000**	**5,133,333**	**31,800,000**	**10,333,333**	**30,400,000**	**2,800,000**	**16,667**	**110,526**	**2,550,000**	**3,400,000**	**2,150,000**	**15,400,000**

Notes:

Samples identified by EcoAnalysts

Counts represent the number of cells per sample and have not been standardized by sampling area

Each replicate was collected from an area of 78.5 cm^2

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013)

UID = unidentified due to size and/or missing morphological characters

Appendix 4-4. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Sample ID					MR9			MR3			MR4			MR7b			MR6		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					31-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12		
Lab Sample ID					6266.2-13	6266.2-14	6266.2-15	6266.2-1	6266.2-2	6266.2-3	6266.2-4	6266.2-5	6266.2-6	6266.2-10	6266.2-11	6266.2-12	6266.2-7	6266.2-8	6266.2-9
Area Sampled (cm^2)					78.5			78.5			78.5			78.5			78.5		
Phylum	**Class**	**Order**	**Family**	**Taxa**															
Ochrophyta	Bacillariophyceae	Achanthales	Achnanthaceae	*Achnanthes* sp.	27,075	84,549	40,557	255,664	55,939	704,233	6,574	199,746	11,199	189,280	56,480	41,121	11,959	9,756	16,455
				Cocconeis sp.	0	0	1,843	0	0	0	0	2,378	0	0	11,296	1,645	0	0	0
		Bacillariales	Bacillariaceae	*Nitzschia* sp.	0	6,504	1,843	1,682	1,907	10,060	212	0	0	0	0	0	0	0	0
		Cymbellales	Cymbellaceae	*Cymbella* sp.	0	0	136,418	25,230	29,241	57,009	7,847	14,268	67,194	19,829	29,047	34,542	18,793	17,260	44,664
			Gomphonemataceae	*Gomphonema* sp.	77,753	308,928	276,523	47,096	32,419	80,484	5,514	404,248	172,963	255,979	200,100	189,157	17,084	27,016	43,097
			Rhoicospheniaceae	*Rhoicosphenia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eunotiales	Eunotiaceae	*Eunotia* sp.	6,248	3,252	33,183	16,820	21,613	13,414	212	2,378	3,733	3,605	4,841	1,645	2,733	1,501	3,918
		Fragilariales	Fragilariaceae	*Fragilaria* sp.	4,860	30,893	11,061	13,456	5,085	26,828	3,181	14,268	51,018	7,211	1,614	4,935	4,100	5,628	14,888
				Meridion sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Synedra sp.	30,546	19,511	36,870	63,916	25,427	57,009	32,448	71,338	55,995	164,043	50,025	179,288	27,676	23,263	52,500
		Naviculales	Diploneidaceae	*Diploneis* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	375	0
			Naviculaceae	*Navicula* sp.	9,025	3,252	5,530	87,464	15,256	53,656	4,666	21,401	9,955	9,013	11,296	14,804	4,784	6,754	19,590
			Pinnulariaceae	*Caloneis* sp.	0	0	0	0	636	0	0	0	0	0	0	0	0	0	0
				Pinnularia sp.	694	3,252	7,374	1,682	2,543	16,767	636	0	3,733	45,067	0	3,290	5,467	3,752	5,485
		Rhopalodiales	Rhopalodiaceae	*Epithemia* sp.	0	4,878	0	5,046	0	0	0	0	0	0	0	0	0	0	0
				Rhopalodia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Surirellales	Surirellaceae	*Surirella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	375	0
		Thalassiophysales	Catenulaceae	*Amphora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Chlorophyceae	Chaetophorales	Chaetophoraceae	*Draparnaldiopsis* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Stigeoclonium sp.	0	0	0	16,820	8,264	0	14,209	0	17,421	0	690,668	172,708	3,417	35,270	66,605
		Microsporales	Microsporaceae	*Microspora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Oedogoniales	Oedogoniaceae	*Oedogonium* sp.	0	0	0	0	11,442	0	1,060	0	0	0	0	0	2,050	750	1,567
		Ulotrichales	Ulotrichaceae	*Geminella* sp.	0	0	0	0	0	26,828	6,362	0	0	0	0	0	3,075	0	3,918
				Ulothrix sp.	9,025	0	18,435	0	0	0	2,121	0	0	18,027	4,841	0	0	0	0
		Zygnematales	Desmidiaceae	*Cosmarium* sp.	0	0	0	0	0	0	0	2,378	0	0	0	1,645	0	0	0
				Closterium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Staurastrum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Zygnematales	Zygnemataceae	*Mougeotia* sp.	0	0	7,374	0	0	0	1,060	0	0	0	0	0	0	0	0
				Spirogyra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Merismopediaceae	*Merismopedia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nostocales	Nostocaceae	*Anabaena* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Rivulariaceae	*Calothrix* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	297,761
		Oscillatoriales	Oscillatoriaceae	*Oscillatoria* sp.	0	16,259	0	0	0	0	0	0	0	0	46,798	0	53,644	39,398	200,597
				TOTAL	**165,224**	**481,277**	**577,012**	**534,876**	**209,771**	**1,046,289**	**86,104**	**732,402**	**393,211**	**712,053**	**1,107,005**	**644,777**	**154,782**	**171,098**	**771,045**

Notes:

Samples identified by EcoAnalysts

Counts represent the number of cells per sample and have not been standardized by sampling area

Each replicate was collected from an area of 78.5 cm^2

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013)

UID = unidentified due to size and/or missing morphological characters

Appendix 4-3. Stream Periphyton Taxonomic Results, Murray River Coal Project, 2010 to 2012

Sample ID					M20-06			M20-04			M17-02			M19-01			M19-02			
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4
Date Sampled					30-Aug-12			28-Aug-12			30-Aug-12			31-Aug-12			30-Aug-12			
Lab Sample ID					6266.2-29	6266.2-30	6266.2-31	6266.2-26	6266.2-27	6266.2-27	6266.2-16	6266.2-17	6266.2-18	6266.2-19	6266.2-20	6266.2-21	6266.2-22	6266.2-23	6266.2-24	6266.2-25
Area Sampled (cm^2)					78.5			78.5			78.5			78.5			78.5			
Phylum	**Class**	**Order**	**Family**	**Taxa**																
Ochrophyta	Bacillariophyceae	Achanthales	Achnanthaceae	*Achnanthes* sp.	13,026	25,857	12,406	4,646	47,516	20,947	3,268,128	1,448,707	2,274,032	1,826,249	682,335	57,721	2,077,944	2,859,612	2,729,740	154,529
				Cocconeis sp.	53,191	49,867	50,276	48,008	237,578	216,456	98,044	370,225	49,168	154,529	60,206	26,936	17,316	16,341	73,777	19,316
		Bacillariales	Bacillariaceae	*Nitzschia* sp.	3,257	0	653	1,549	10,559	0	65,363	0	0	0	20,069	3,848	0	0	0	0
		Cymbellales	Cymbellaceae	*Cymbella* sp.	45,592	16,622	9,794	26,327	79,193	11,637	49,022	0	0	0	0	0	1,125,553	653,626	560,703	328,374
			Gomphonemataceae	*Gomphonema* sp.	65,131	286,275	50,929	117,698	295,652	353,777	506,560	1,062,385	614,603	1,418,855	1,756,009	592,599	346,324	375,835	354,128	212,477
			Rhoicospheniaceae	*Rhoicosphenia* sp.	0	0	0	0	0	0	375,835	788,741	344,178	14,048	60,206	7,696	0	16,341	0	0
		Eunotiales	Eunotiaceae	*Eunotia* sp.	2,171	3,694	2,612	0	0	2,327	0	0	0	0	0	0	0	0	0	9,658
		Fragilariales	Fragilariaceae	*Fragilaria* sp.	0	0	0	0	0	0	16,341	64,387	24,584	0	0	0	0	32,681	0	19,316
				Meridion sp.	0	0	0	0	0	0	163,406	0	0	28,096	0	0	0	0	0	173,845
				Synedra sp.	70,559	66,490	45,052	37,168	221,739	48,877	114,384	289,741	49,168	0	50,172	0	69,265	196,088	191,820	1,265,205
		Naviculales	Diploneidaceae	*Diploneis* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Naviculaceae	*Navicula* sp.	57,533	101,581	24,159	43,362	496,273	27,930	179,747	338,032	98,337	42,144	150,515	46,177	1,558,458	800,691	368,884	106,239
			Pinnulariaceae	*Caloneis* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Pinnularia sp.	2,171	0	0	0	0	0	0	0	0	70,240	0	0	121,213	16,341	14,755	38,632
		Rhopalodiales	Rhopalodiaceae	*Epithemia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhopalodia sp.	0	0	0	0	0	0	16,341	0	0	0	0	0	0	0	0	0
		Surirellales	Surirellaceae	*Surirella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thalassiophysales	Catenulaceae	*Amphora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Chlorophyceae	Chaetophorales	Chaetophoraceae	*Draparnaldiopsis* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33,436,169
				Stigeoclonium sp.	149,802	60,949	5,876	6,195	1,673,603	95,427	1,911,855	4,104,671	1,499,632	3,778,932	1,675,734	2,077,944	173,162	310,472	1,298,471	270,425
		Microsporales	Microsporaceae	*Microspora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	212,428	0	2,829,809
		Oedogoniales	Oedogoniaceae	*Oedogonium* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ulotrichales	Ulotrichaceae	*Geminella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Ulothrix sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Zygnematales	Desmidiaceae	*Cosmarium* sp.	0	1,847	0	0	0	0	0	0	0	0	0	0	0	0	0	9,658
				Closterium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,658
				Staurastrum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,658
		Zygnematales	Zygnemataceae	*Mougeotia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67,606
				Spirogyra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19,316
Cyanobacteria	Cyanophyceae	Chroococcales	Merismopediaceae	*Merismopedia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	502,219
		Nostocales	Nostocaceae	*Anabaena* sp.	0	0	0	0	0	0	0	0	0	0	411,408	0	0	0	0	0
			Rivulariaceae	*Calothrix* sp.	0	0	0	0	0	0	0	0	0	0	100,343	0	0	0	0	0
		Oscillatoriales	Oscillatoriaceae	*Oscillatoria* sp.	0	0	0	0	0	0	114,384	0	0	0	0	0	0	0	0	386,322
				TOTAL	**462,433**	**613,182**	**201,757**	**284,953**	**3,062,113**	**777,378**	**6,879,409**	**8,466,890**	**4,953,702**	**7,333,094**	**4,966,997**	**2,812,921**	**5,489,236**	**5,490,455**	**5,592,279**	**39,868,430**

Notes:

Samples identified by EcoAnalysts

Counts represent the number of cells per sample, therefore they were adjusted for subsampling but not for sampling area

Each replicate was collected from an area of 78.5 cm^2

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013).

UID = unidentified due to size and/or missing morphological characters

Appendix 4-5

Stream Periphyton Taxonomy Laboratory Quality Assurance and Quality Control, Murray River Coal Project, 2011 to 2012

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Appendix 4-5. Stream Periphyton Taxonomy Laboratory Quality Assurance and Quality Control, Murray River Coal Project, 2011 to 2012

Sample ID					MR9		M20-05	
Replicate					3	3 QC	1	1 QC
Date Sampled					25-Aug-11		26-Aug-11	
Volume Received (mL)					119		101	
Percent Counted					0.01601%	0.01601%	0.03047%	0.03047%
Lab Sample ID					5906.2-9	5906.2-9 QC	5906.2-19	5906.2-19 QC
Phylum	**Class**	**Order**	**Family**	**Taxa**				
Ochrophyta	Bacillarionphyceae	Achnanthales	Achnanthaceae	*Achnanthes* sp.	1	1	0	1
		Bacillariales	Bacillariaceae	*Nitzschia* sp.	0	1	0	0
		Cymbellales	Cymbellaceae	*Cymbella* sp.	0	1	1	0
			Gomphonemataceae	*Gomphonema* sp.	10	0	2	2
			Gomphonemataceae	*Reimeria* sp.	0	0	1	0
			Rhoicospheniaceae	*Rhoicosphenia* sp.	0	1	0	0
		Fragilariales	Fragilariaceae	*Diatoma* sp.	0	0	1	0
			Fragilariaceae	*Hannaea* sp.	0	0	0	0
		Naviculales	Naviculaceae	*Caloneis* sp.	1	0	0	0
				UID pennate diatom	1	0	0	0
				TOTAL	**13**	**4**	**5**	**3**

Notes: Samples identified by EcoAnalysts

Counts represent natural units and are not adjusted for subsampling

Each replicate was collected from an area of 78.5 cm^2

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013)

UID = unidentified due to lack of size and/or missing morphological characters

Differences between the two taxonomists are mainly due to the sparcity of the sample, the detritus presence as well as the subsampling (no original data was changed as a result of the QA)

Appendix 4-5. Stream Periphyton Taxonomy Laboratory Quality Assurance and Quality Control, Murray River Coal Project, 2011 to 2012

Sample ID					MR9		MR7B		M19-02	
Replicate					2	2 QC	1	1 QC	3	3 QC
Date Sampled					31-Aug-12		29-Aug-12		30-Aug-12	
Volume Received (mL)					28		34		21	
Percent Counted					0.062%	0.062%	0.055%	0.055%	0.007%	0.007%
Lab Sample ID					6266.2-14	6266.2-14	6266.2-10	6266.2-10	6266.2-24	6266.2-24
Phylum	**Class**	**Order**	**Family**	**Taxa**						
Ochrophyta	Bacillariophyceae	Achanthales	Achnanthaceae	*Achnanthes* sp.	52	63	105	114	185	169
		Achanthales	Achnanthaceae	*Cocconeis* sp.	0	0	0	0	5	3
		Bacillariales	Bacillariaceae	*Nitzschia* sp.	4	17	0	3	0	0
		Thalassiophysales	Catenulaceae	*Amphora* sp.	1	0	0	0	0	0
		Cymbellales	Cymbellaceae	*Cymbella* sp.	17	12	11	7	38	43
		Eunotiales	Eunotiaceae	*Eunotia* sp.	2	0	2	4	0	0
		Fragilariales	Fragilariaceae	*Fragilaria* sp.	19	0	4	0	0	0
		Fragilariales	Fragilariaceae	*Synedra* sp.	12	15	25	19	13	7
		Cymbellales	Gomphonemataceae	*Gomphonema sp.*	190	156	142	145	24	13
		Naviculales	Naviculaceae	*Navicula* sp.	2	9	5	3	25	17
		Naviculales	Pinnulariaceae	*Caloneis* sp.	0	0	0	0	0	0
		Naviculales	Pinnulariaceae	*Pinnularia* sp.	2	7	0	0	1	0
		Cymbellales	Rhoicospheniaceae	*Rhoicosphenia* sp.	0	9	0	0	0	0
		Rhopalodiales	Rhopalodiaceae	*Epithemia* sp.	3	0	0	0	0	0
		Surirellales	Surirellaceae	*Surirella* sp.	0	5	0	0	0	0
Chlorophyta	Chlorophyceae	Chaetophorales	Chaetophoraceae	*Stigeoclonium* sp.	0	3	10	8	16	32
		Microsporales	Microsporaceae	*Microspora* sp.	0	3	0	0	0	8
		Ulotrichales	Ulotrichaceae	*Ulothrix* sp.	0	2	1	0	0	0
		Zygnematales	Desmidiaceae	*Cosmarium* sp.	0	0	0	0	0	5
Cyanobacteria	Cyanophyceae	Nostocales	Rivulariaceae	*Calothrix* sp.	0	0	0	0	0	3
		Oscillatoriales	Oscillatoriaceae	*Oscillatoria* sp.	1	0	0	0	0	0
				TOTAL	**305**	**301**	**305**	**303**	**307**	**300**

Notes: Samples identified by EcoAnalysts

Counts represent natural units and are not adjusted for subsampling

Each replicate was collected from an area of 78.5 cm^2

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013)

Differences between the two taxonomists are mainly due to the sparcity of the sample, the detritus presence as well as the subsampling (no original data was changed as a result of the QA)

Appendix 5-1

Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

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Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR-REF										MR4									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110083		110084		110085		110086		110087		110068		110069		110070		110071		110072	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	12.5	100	50	100	37.5	100	100	100	100	100	12.5	50	12.5	50	12.5	50	12.5	50	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Arthropoda	Insecta	Ephemeroptera	Ameletidae	*Ameletus* sp.	nymph	2	1	0	0	0	0	0	1	2	2	3	0	2	1	1	0	0	0	3	2
			Baetidae	*Acentrella* sp.	nymph	1	0	0	1	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0
				Baetis sp.	nymph	6	2	1	4	0	1	0	2	0	6	2	1	3	0	0	0	3	1	10	1
				Baetis bicaudatus	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Baetis tricaudatus	nymph	2	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	2	1
				Baetidae	nymph (juv./dam.)	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
			Ephemerellidae	*Drunella coloradensis*	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Drunella doddsi	nymph	4	0	2	0	0	8	1	3	2	3	0	0	1	0	0	0	0	0	0	0
				Drunella grandis	nymph	20	0	15	0	0	12	8	3	4	1	8	0	5	1	0	0	4	0	11	0
				Ephemerella sp.	nymph	2	0	2	1	0	1	0	0	0	0	3	0	2	0	1	0	0	0	3	0
				Serratella sp.	nymph	7	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0
				Timpanoga hecuba	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Ephemerellidae	nymph (juv./dam.)	18	19	0	65	0	0	0	46	0	33	274	25	147	22	36	30	28	37	103	26
			Heptageniidae	*Cinygmula* sp.	nymph	2	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
				Epeorus sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhithrogena sp.	nymph	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Heptageniidae	nymph (juv./dam.)	31	28	7	68	0	4	2	110	0	59	5	1	3	3	1	1	0	2	6	4
		Plecoptera		Plecoptera	adult	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Plecoptera	nymph (juv./dam.)	0	1	0	0	0	0	0	0	0	2	4		3	1	2	2	0	5	7	3
			Capniidae	*Capnia* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Capniidae	nymph (juv./dam.)	2	10	0	16	0	1	1	5	0	5	26	1	35	11	5	6	2	2	15	3
			Chloroperlidae	*Alloperla* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Suwallia sp.	nymph	0	0	0	3	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				Sweltsa sp.	nymph	31	0	19	1	0	19	12	2	9	2	4	0	5	0	1	0	1	0	8	0
				Chloroperlidae	nymph (juv./dam.)	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Leuctricdae	Leuctricdae	nymph (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Nemouridae	*Visoka* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Zapada sp.	nymph	0	0	0	1	0	0	0	1	0	1	4	0	0	1	0	0	0	0	7	2
				Zapada cinctipes	nymph	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Zapada columbiana	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Zapada oregonensis	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Perlidae	*Claassenia* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hesperoperla sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Perlidae	nymph (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Perlodidae	*Isoperla* sp.	nymph	7	0	4	0	0	1	0	0	0	1	3	0	0	0	2	0	0	0	1	0
				Megarcys sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Skwala sp.	nymph	3	0	3	0	0	1	3	0	1	0	3	0	1	0	0	0	0	0	2	0
				Perlodidae	nymph (juv./dam.)	7	0	0	1	0	3	1	1	0	1	1	0	2	1	2	0	4	0	7	0
			Pteronarcyidae	*Pteronarcella* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Taeniopterygidae	Taeniopterygidae	nymph (juv./dam.)	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera		Trichoptera	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Trichoptera	larvae (juv./dam.)	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	3	0	2	1	0
			Apataniidae	*Apatania* sp.	larvae	3	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
			Brachycentridae	*Brachycentrus* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				Micrasema sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				Brachycentridae	larvae (juv./dam.)	0	0	0	3	0	0	0	0	0	0	0	1	0	2	0	0	0	2	4	4
			Glossosomatidae	*Glossosoma* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydropsychidae	*Arctopsyche* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hydropsyche sp.	larvae	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
				Parapsyche sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hydropsychidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	3	2
			Hydroptilidae	*Hydroptila* sp.	larvae	0	0	0	0	0	0	0	0	0	0	3	0	1	1	1	0	0	0	2	1
			Lepidostomatidae	*Lepidostoma* sp.	larvae	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
			Polycentropodidae	*Polycentropus* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Rhyacophilidae	*Rhyacophila* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
			Uenoidae	Uenoidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR-REF										MR4									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110083		110084		110085		110086		110087		110068		110069		110070		110071		110072	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	12.5	100	50	100	37.5	100	100	100	100	100	12.5	50	12.5	50	12.5	50	12.5	50	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Arthropoda	Insecta	Coleoptera		Coleoptera	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0
			Dytiscidae	*Agabus* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hydroporinae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2	1	0	0	1	1
			Elmidae	*Optioservus*	larvae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Haliplidae	*Brychius* sp.	adult	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Haliplus sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Haliplidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
			Hydraenidae	Hydraenidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Staphylinidae	Staphylinidae	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Collembola	Poduridae	Poduridae	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Diptera		Diptera	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
			Athericidae	*Atherix* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Culicoides sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Mallochohelea sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Probezzia sp.	larvae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Chironomidae	Chironomidae	larvae	18	34	9	56	0	51	1	31	1	29	390	154	270	295	63	169	76	133	185	187
			Empididae	*Chelifera/Metachela* sp.	larvae	1	0	0	0	0	1	0	0	0	1	7	1	4	2	3	0	0	0	9	0
				Clinocera sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				Oreogeton sp.	larvae	0	0	0	0	0	0	0	0	0	0	3	0	3	3	0	0	2	0	0	0
				Empididae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
			Muscidae	*Limnophora* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Psychodidae	*Pericoma* sp.	larvae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
			Simuliidae	*Prosimulium* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Simulium sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Simuliidae	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Simuliidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tanyderidae	*Protoplasa* sp.	larvae	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tipulidae	*Dicranota* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				Hesperoconopa sp.	larvae	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hexatoma sp.	larvae	14	0	7	0	0	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0
				Limnophila sp.	larvae	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhabdomastix sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Tipulidae	larvae (juv./dam.)	2	0	0	3	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0
		Lepidoptera		Lepidoptera	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cycloipoda (Sub-class)			Cycloipoda	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harpactocoida (Sub-class)			Harpactocoida	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Branchiopoda	Diplostraca		Cladocera	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ostracoda			Ostracoda	-	0	3	0	5	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
	Arachnida	Trombidiformes	Aturidae	*Aturus* sp.	adult	0	0	0	0	0	0	0	1	0	5	7	1	2	5	0	9	0	2	2	7
			Feltriidae	*Feltria* sp.	adult	0	2	0	0	0	0	0	0	0	0	10	3	2	10	1	2	0	1	1	6
			Hydrozetidae	Hydrozetidae	adult	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydryphantidae	*Protzia* sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
				Wandesia sp.	adult	1	1	0	2	0	0	0	2	0	2	0	0	0	1	0	0	0	0	0	0
			Hygrobatidae	*Hygrobates* sp.	adult	2	3	0	5	0	0	0	7	0	2	8	0	3	1	0	0	1	1	1	2
			Lebertiidae	*Lebertia* sp.	adult	0	1	0	1	0	0	0	2	0	2	3	1	3	1	1	2	0	2	2	2
			Mideopsidae	*Mideopsis* sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sperchontidae	*Sperchon* sp.	adult	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0
				Sperchonopsis sp.	adult	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Torrenticolidae	*Torrenticola* sp.	adult	0	1	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0
			Unioniculidae	*Neumania* sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Prostigmata (suborder)	deutonymph	0	2	0	6	0	0	0	4	0	4	13	9	7	6	0	13	0	8	3	9
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes	Turbellaria	Tricladida	Planarridae	*Polycelis coronata*	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR-REF										MR4									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110083		110084		110085		110086		110087		110068		110069		110070		110071		110072	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	12.5	100	50	100	37.5	100	100	100	100	100	12.5	50	12.5	50	12.5	50	12.5	50	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Annelida	Oligochaeta (subclass)	Haplotaxida	Enchytraeidae	*Enchytraeus* sp.	-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
			Naididae	*Chaetogaster* sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Nais sp.	-	0	4	0	2	0	0	0	0	0	0	72	7	31	37	8	33	10	22	8	10
				Pristina sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	9
				Stylaria sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Naididae	-	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Nemata				Nemata	-	0	0	0	2	0	0	1	2	0	1	4	0	1	1	2	0	2	0	2	0
				TOTAL		**195**	**117**	**77**	**251**	**0**	**123**	**33**	**232**	**21**	**168**	**869**	**206**	**547**	**411**	**135**	**273**	**137**	**222**	**424**	**283**

Notes: Samples collected using a Hess sampler and identified by Cordillera Consulting

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample area of 0.2880 m^2

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

juv. = juvenile; dam. = damaged

Dashes indicate no stage identified

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes not included in figures of analyses because of exclusion in CABIN protocol

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR6										M20-04									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110073		110074		110075		110076		110077		110078		110079		110080		110081		110082	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	62.5	100	37.5	100	50	100	100	100	100	100	50	100	37.5	100	25	100	25	100	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Arthropoda	Insecta	Ephemeroptera	Ameletidae	*Ameletus* sp.	nymph	1	1	3	2	1	5	0	0	0	7	0	0	4	0	5	1	1	3	1	0
			Baetidae	*Acentrella* sp.	nymph	1	0	0	0	0	1	0	2	0	0	1	0	0	0	0	0	0	1	0	0
				Baetis sp.	nymph	2	9	0	2	1	0	0	6	0	1	4	27	3	8	14	8	2	5	22	8
				Baetis bicaudatus	nymph	0	0	0	0	0	0	0	0	0	0	22	12	10	1	4	1	32	3	24	0
				Baetis tricaudatus	nymph	1	1	6	1	6	5	0	6	0	0	13	8	10	2	11	5	7	2	10	0
				Baetidae	nymph (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ephemerellidae	*Drunella coloradensis*	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				Drunella doddsi	nymph	0	0	0	0	0	1	2	0	0	0	9	0	2	0	4	0	16	0	5	0
				Drunella grandis	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Ephemerella sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Serratella sp.	nymph	1	0	2	0	1	0	1	0	0	0	5	0	0	0	3	0	2	0	3	0
				Timpanoga hecuba	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Ephemerellidae	nymph (juv./dam.)	0	21	2	9	3	17	0	12	0	7	0	6	0	4	0	12	0	6	3	6
			Heptageniidae	*Cinygmula* sp.	nymph	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
				Epeorus sp.	nymph	0	0	1	0	0	0	0	0	0	0	13	0	4	0	10	0	5	0	6	0
				Rhithrogena sp.	nymph	0	0	0	0	2	0	5	0	1	0	5	0	7	0	4	0	17	0	41	0
				Heptageniidae	nymph (juv./dam.)	1	139	10	50	0	66	0	81	0	39	11	55	7	49	7	43	16	51	22	32
		Plecoptera		Plecoptera	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Plecoptera	nymph (juv./dam.)	0	21	2	19	0	30	0	16	0	3	6	22	0	4	1	9	1	5	0	6
			Capniidae	*Capnia* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Capniidae	nymph (juv./dam.)	0	91	15	61	2	78	0	43	0	93	1	14	3	27	0	28	1	14	4	7
			Chloroperlidae	*Alloperla* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Suwallia sp.	nymph	2	5	5	4	1	3	5	12	0	0	4	3	1	2	2	0	2	0	7	0
				Sweltsa sp.	nymph	5	1	6	0	13	0	4	1	2	0	0	0	0	0	5	0	1	0	3	0
				Chloroperlidae	nymph (juv./dam.)	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0
			Leuctricdae	Leuctricdae	nymph (juv./dam.)	0	0	0	0	1	0	0	0	0	0	0	1	1	0	3	1	2	0	0	1
			Nemouridae	*Visoka* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
				Zapada sp.	nymph	0	1	0	0	0	0	0	3	0	0	12	71	7	17	5	23	14	34	27	13
				Zapada cinctipes	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
				Zapada columbiana	nymph	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
				Zapada oregonensis	nymph	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0
			Perlidae	*Claassenia* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hesperoperla sp.	nymph	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
				Perlidae	nymph (juv./dam.)	0	0	1	0	1	0	0	0	0	0	2	1	0	0	0	0	1	0	0	0
			Perlodidae	*Isoperla* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Megarcys sp.	nymph	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0
				Skwala sp.	nymph	4	0	4	0	11	0	3	0	1	0	0	0	1	0	2	0	0	0	1	0
				Perlodidae	nymph (juv./dam.)	0	2	7	1	1	7	0	4	0	0	0	0	1	1	1	0	5	3	2	0
			Pteronarcyidae	*Pteronarcella* sp.	nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Taeniopterygidae	Taeniopterygidae	nymph (juv./dam.)	0	0	2	1	0	0	0	1	0	0	0	6	0	0	0	2	1	0	5	1
		Trichoptera		Trichoptera	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Trichoptera	larvae (juv./dam.)	0	5	0	1	0	2	0	11	0	3	1	1	0	4	0	2	0	2	0	0
			Apataniidae	*Apatania* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
			Brachycentridae	*Brachycentrus* sp.	larvae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Micrasema sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Brachycentridae	larvae (juv./dam.)	0	0	0	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	1
			Glossosomatidae	*Glossosoma* sp.	larvae	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
			Hydropsychidae	*Arctopsyche* sp.	larvae	0	0	0	0	0	0	3	0	0	0	1	0	1	0	0	0	0	0	1	0
				Hydropsyche sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Parapsyche sp.	larvae	0	0	0	0	0	0	0	0	0	0	12	1	0	0	0	0	0	0	0	0
				Hydropsychidae	larvae (juv./dam.)	0	17	15	21	4	14	1	46	0	0	1	6	2	0	0	0	0	1	2	0
			Hydroptilidae	*Hydroptila* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Lepidostomatidae	*Lepidostoma* sp.	larvae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Polycentropodidae	*Polycentropus* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Rhyacophilidae	*Rhyacophila* sp.	larvae	0	0	0	0	1	2	0	0	1	0	0	0	1	0	3	0	1	0	0	0
			Uenoidae	Uenoidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR6																M20-04									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110073		110074		110075		110076		110077		110078		110079		110080		110081		110082	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	62.5	100	37.5	100	50	100	100	100	100	100	50	100	37.5	100	25	100	25	100	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Arthropoda	Insecta	Coleoptera		Coleoptera	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Dytiscidae	*Agabus* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hydroporinae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Elmidae	*Optioservus*	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Haliplidae	*Brychius* sp.	adult	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Haliplus sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Haliplidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydraenidae	Hydraenidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Staphylinidae	Staphylinidae	adult	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
		Collembola	Poduridae	Poduridae	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Diptera		Diptera	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Athericidae	*Atherix* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Culicoides sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Mallochohelea sp.	larvae	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
				Probezzia sp.	larvae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
			Chironomidae	Chironomidae	larvae	1	34	19	15	5	37	1	29	2	58	12	38	19	59	21	87	14	34	17	27
			Empididae	*Chelifera/Metachela* sp.	larvae	6	4	4	0	10	7	3	3	0	6	3	0	3	1	6	2	4	1	1	0
				Clinocera sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Oreogeton sp.	larvae	0	0	0	0	0	0	0	0	0	0	3	0	1	0	2	1	4	1	4	0
				Empididae	larvae (juv./dam.)	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			Muscidae	*Limnophora* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Psychodidae	*Pericoma* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Simuliidae	*Prosimulium* sp.	larvae	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Simulium sp.	larvae	0	0	0	1	0	0	0	0	0	1	0	6	1	1	0	0	0	0	0	0
				Simuliidae	pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Simuliidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tanyderidae	*Protoplasa* sp.	larvae	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
			Tipulidae	*Dicranota* sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
				Hesperoconopa sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hexatoma sp.	larvae	1	0	4	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
				Limnophila sp.	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhabdomastix sp.	larvae	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
				Tipulidae	larvae (juv./dam.)	0	1	0	0	0	1	0	6	0	2	0	0	0	2	0	0	0	1	0	0
		Lepidoptera		Lepidoptera	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cycloipoda (Sub-class)			Cycloipoda	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harpactocoida (Sub-class)			Harpactocoida	-	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Branchiopoda	Diplostraca		Cladocera	-	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ostracoda			Ostracoda	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arachnida	Trombidiformes	Aturidae	*Aturus* sp.	adult	0	3	1	3	0	6	0	5	0	6	0	0	0	0	0	2	0	0	0	1
			Feltriidae	*Feltria* sp.	adult	0	7	0	3	0	13	0	2	0	10	0	2	0	1	0	0	0	1	0	1
			Hydrozetidae	Hydrozetidae	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydryphantidae	*Protzia* sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Wandesia sp.	adult	0	11	3	2	0	1	0	6	0	7	0	1	0	1	0	0	0	0	1	0
			Hygrobatidae	*Hygrobates* sp.	adult	0	0	0	3	0	4	1	0	0	3	0	0	0	0	0	0	0	0	0	0
			Lebertiidae	*Lebertia* sp.	adult	0	1	1	1	1	4	0	0	0	4	0	1	0	0	0	1	0	1	0	0
			Mideopsidae	*Mideopsis* sp.	adult	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sperchontidae	*Sperchon* sp.	adult	0	3	1	1	0	1	0	0	0	0	0	0	1	3	0	2	0	0	1	0
				Sperchonopsis sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
			Torrenticolidae	*Torrenticola* sp.	adult	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Unionicolidae	*Neumania* sp.	adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Prostigmata (suborder)	deutonymph	2	20	1	8	0	10	0	4	0	7	5	18	3	16	1	15	1	18	2	10
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes	Turbellaria	Tricladida	Planarridae	*Polycelis coronata*	-	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						MR6										M20-04									
Replicate						1		2		3		4		5		1		2		3		4		5	
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10		15-Aug-10	
Lab Sample ID						110073		110074		110075		110076		110077		110078		110079		110080		110081		110082	
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine	coarse	fine
Percent Sampled						100	62.5	100	37.5	100	50	100	100	100	100	100	50	100	37.5	100	25	100	25	100	12.5
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288		0.288	
Phylum	Class	Order	Family	Taxa	Stage																				
Annelida	Oligochaeta (subclass)	Haplotaxida	Enchytraeidae	*Enchytraeus* sp.	-	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Naididae	*Chaetogaster* sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Nais sp.	-	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				Pristina sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Stylaria sp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Naididae	-	0	0	0	0	0	10	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Nemata				Nemata	-	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	3	0	2	0	0
				TOTAL		**30**	**403**	**122**	**214**	**71**	**332**	**34**	**310**	**9**	**261**	**157**	**308**	**94**	**206**	**124**	**248**	**156**	**191**	**218**	**115**

Notes: Samples collected using a Hess sampler and identified by Cordillera Consulting

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample area of 0.2880 m^2

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

juv. = juvenile; dam. = damaged

Dashes indicate no stage identified

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes not included in figures of analyses because of exclusion in CABIN protocol

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						REFST								
Replicate						1		2		3		4		5
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10
Lab Sample ID						110088		110089		110090		110091		110092
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	212 microns
Percent Sampled						100	12.5	100	12.5	100	12.5	100	12.5	25
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288
Phylum	Class	Order	Family	Taxa	Stage									
Arthropoda	Insecta	Ephemeroptera	Ameletidae	*Ameletus* sp.	nymph	0	0	0	0	0	0	0	1	0
			Baetidae	*Acentrella* sp.	nymph	0	2	0	0	0	0	0	0	0
				Baetis sp.	nymph	2	5	4	5	11	2	7	4	1
				Baetis bicaudatus	nymph	5	0	1	0	1	0	9	0	9
				Baetis tricaudatus	nymph	9	0	9	0	5	0	12	0	7
				Baetidae	nymph (juv./dam.)	0	0	0	0	0	0	1	0	0
			Ephemerellidae	*Drunella coloradensis*	nymph	7	0	2	0	4	0	3	0	0
				Drunella doddsi	nymph	51	9	43	6	83	10	53	5	31
				Drunella grandis	nymph	0	0	0	1	0	0	2	0	1
				Ephemerella sp.	nymph	0	0	0	0	0	0	0	0	0
				Serratella sp.	nymph	1	0	1	0	4	0	1	0	0
				Timpanoga hecuba	nymph	0	0	0	0	0	0	0	0	0
				Ephemerellidae	nymph (juv./dam.)	0	17	0	8	2	26	1	19	1
			Heptageniidae	*Cinygmula* sp.	nymph	3	0	11	0	6	0	7	0	0
				Epeorus sp.	nymph	81	0	35	0	53	0	105	0	24
				Rhithrogena sp.	nymph	68	0	31	0	97	1	41	1	43
				Heptageniidae	nymph (juv./dam.)	0	27	3	11	4	31	1	13	1
		Plecoptera		Plecoptera	adult	0	0	0	0	0	0	0	0	0
				Plecoptera	nymph (juv./dam.)	1	74	0	8	0	0	0	0	0
			Capniidae	*Capnia* sp.	nymph	0	0	0	0	0	0	0	0	0
				Capniidae	nymph (juv./dam.)	1	10	0	2	5	12	4	10	8
			Chloroperlidae	*Alloperla* sp.	nymph	0	0	1	0	0	0	0	0	1
				Suwallia sp.	nymph	12	1	5	3	10	0	7	0	11
				Sweltsa sp.	nymph	1	0	1	0	1	0	0	0	0
				Chloroperlidae	nymph (juv./dam.)	0	0	0	0	0	0	0	0	0
			Leuctricdae	Leuctricdae	nymph (juv./dam.)	15	1	0	0	1	1	24	2	7
			Nemouridae	*Visoka* sp.	nymph	0	0	0	0	0	0	0	0	0
				Zapada sp.	nymph	97	51	27	21	81	82	1	44	0
				Zapada cinctipes	nymph	0	0	0	0	0	0	0	0	0
				Zapada columbiana	nymph	0	0	0	0	0	0	31	0	30
				Zapada oregonensis	nymph	0	0	0	0	0	0	15	0	3
			Perlidae	*Claassenia* sp.	nymph	0	0	0	0	0	0	0	0	0
				Hesperoperla sp.	nymph	0	0	0	0	0	0	0	0	0
				Perlidae	nymph (juv./dam.)	0	0	0	0	0	0	0	0	0
			Perlodidae	*Isoperla* sp.	nymph	0	0	0	0	0	0	0	0	0
				Megarcys sp.	nymph	1	0	3	0	1	0	0	0	1
				Skwala sp.	nymph	0	0	0	0	1	0	0	0	0
				Perlodidae	nymph (juv./dam.)	0	3	0	1	6	8	2	5	1
			Pteronarcyidae	*Pteronarcella* sp.	nymph	0	0	0	0	0	0	0	0	0
			Taeniopterygidae	Taeniopterygidae	nymph (juv./dam.)	9	116	4	51	71	205	19	53	9
		Trichoptera		Trichoptera	pupae	5	0	9	0	13	0	8	0	1
				Trichoptera	larvae (juv./dam.)	1	21	9	103	6	34	0	30	0
			Apataniidae	*Apatania* sp.	larvae	0	0	0	0	1	0	0	0	0
			Brachycentridae	*Brachycentrus* sp.	larvae	0	0	0	0	0	0	0	0	0
				Micrasema sp.	larvae	0	0	0	0	0	0	0	0	0
				Brachycentridae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0
			Glossosomatidae	*Glossosoma* sp.	larvae	1	0	2	0	4	0	2	0	1
			Hydropsychidae	*Arctopsyche* sp.	larvae	0	0	0	0	0	0	0	0	0
				Hydropsyche sp.	larvae	0	0	0	0	0	0	0	0	0
				Parapsyche sp.	larvae	3	0	3	0	0	0	4	0	1
				Hydropsychidae	larvae (juv./dam.)	1	1	0	0	0	0	0	0	0
			Hydroptilidae	*Hydroptila* sp.	larvae	0	0	0	0	0	0	0	0	0
			Lepidostomatidae	*Lepidostoma* sp.	larvae	0	0	0	0	0	0	0	0	0
			Polycentropodidae	*Polycentropus* sp.	larvae	0	0	0	0	0	0	0	0	0
			Rhyacophilidae	*Rhyacophila* sp.	larvae	19	0	24	1	26	2	19	1	7
			Uenoidae	Uenoidae	larvae (juv./dam.)	0	1	0	0	0	0	0	2	0

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						REFST								
Replicate						1		2		3		4		5
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10
Lab Sample ID						110088		110089		110090		110091		110092
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	212 microns
Percent Sampled						100	12.5	100	12.5	100	12.5	100	12.5	25
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288
Phylum	Class	Order	Family	Taxa	Stage									
Arthropoda	Insecta	Coleoptera		Coleoptera	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0
			Dytiscidae	*Agabus* sp.	larvae	0	0	0	0	0	0	0	0	0
				Hydroporinae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0
			Elmidae	*Optioservus*	larvae	0	0	0	0	0	0	0	0	0
			Haliplidae	*Brychius* sp.	adult	0	0	0	0	0	0	0	0	0
				Haliplus sp.	larvae	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	adult	0	0	0	0	0	0	0	0	0
				Peltodytes sp.	larvae	0	0	0	0	0	0	0	0	0
				Haliplidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0
			Hydraenidae	Hydraenidae	larvae (juv./dam.)	0	0	0	0	0	0	1	0	0
			Staphylinidae	Staphylinidae	adult	0	0	0	0	0	0	0	0	0
		Collembola	Poduridae	Poduridae	larvae	0	0	0	0	0	2	0	0	0
		Diptera		Diptera	pupae	0	0	0	0	0	0	0	0	0
			Athericidae	*Atherix* sp.	larvae	0	0	0	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia* sp.	larvae	0	0	0	0	0	0	0	0	0
				Culicoides sp.	larvae	0	0	0	0	0	0	0	0	0
				Mallochohelea sp.	larvae	0	0	0	1	0	0	0	1	0
				Probezzia sp.	larvae	2	0	8	0	1	0	11	1	1
			Chironomidae	Chironomidae	larvae	130	225	99	168	241	206	282	152	67
			Empididae	*Chelifera/Metachela* sp.	larvae	2	0	1	0	3	0	0	0	2
				Clinocera sp.	larvae	1	0	2	0	0	0	1	0	0
				Oreogeton sp.	larvae	2	0	5	0	1	0	2	0	0
				Empididae	larvae (juv./dam.)	0	0	0	3	0	1	0	1	0
			Muscidae	*Limnophora* sp.	larvae	1	0	0	0	0	0	0	0	0
			Psychodidae	*Pericoma* sp.	larvae	0	3	0	1	2	6	0	4	0
			Simuliidae	*Prosimulium* sp.	larvae	6	1	1	0	2	0	8	0	16
				Simulium sp.	larvae	7	8	0	0	2	0	8	10	26
				Simuliidae	pupae	6	0	0	0	2	0	3	0	0
				Simuliidae	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0
			Tanyderidae	*Protoplasa* sp.	larvae	0	0	0	0	0	0	0	0	0
			Tipulidae	*Dicranota* sp.	larvae	0	0	3	0	5	0	6	0	0
				Hesperoconopa sp.	larvae	0	2	0	0	0	2	1	3	0
				Hexatoma sp.	larvae	0	0	0	0	0	0	0	0	0
				Limnophila sp.	larvae	0	0	0	0	0	0	0	0	0
				Rhabdomastix sp.	larvae	0	0	0	0	0	0	1	0	0
				Tipulidae	larvae (juv./dam.)	0	0	0	1	0	1	0	0	0
		Lepidoptera		Lepidoptera	larvae	0	0	0	0	0	0	0	1	0
	Cycloipoda (Sub-class)			Cycloipoda	-	0	0	0	0	0	0	0	0	0
	Harpactocoida (Sub-class)			Harpactocoida	-	0	0	0	0	0	0	0	0	0
	Branchiopoda	Diplostraca		Cladocera	-	0	0	0	0	0	0	0	0	0
	Ostracoda			Ostracoda	-	0	1	0	0	0	1	0	2	0
	Arachnida	Trombidiformes	Aturidae	*Aturus* sp.	adult	0	1	0	0	0	0	0	1	0
			Feltriidae	*Feltria* sp.	adult	1	1	0	0	0	5	0	1	0
			Hydrozetidae	Hydrozetidae	adult	0	0	0	0	0	0	0	0	0
			Hydryphantidae	*Protzia* sp.	adult	0	0	0	0	0	0	0	0	0
				Wandesia sp.	adult	0	0	0	0	0	0	0	1	0
			Hygrobatidae	*Hygrobates* sp.	adult	0	0	0	0	0	0	0	0	0
			Lebertiidae	*Lebertia* sp.	adult	0	0	0	0	0	0	0	0	0
			Mideopsidae	*Mideopsis* sp.	adult	0	0	0	0	0	0	0	0	0
			Sperchontidae	*Sperchon* sp.	adult	0	0	3	1	0	0	0	0	0
				Sperchonopsis sp.	adult	0	0	0	0	0	0	0	0	0
			Torrenticolidae	*Torrenticola* sp.	adult	0	0	0	0	0	0	0	0	0
			Unionicolidae	*Neumania* sp.	adult	0	0	0	0	0	0	0	0	0
				Prostigmata	deutonymph	1	7	0	9	0	10	0	8	0
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	-	0	0	0	0	0	0	0	0	0
Platyhelminthes	Turbellaria	Tricladida	Planarridae	*Polycelis coronata*	-	39	14	16	4	15	4	51	9	6

Appendix 5-1. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

Sample ID						REFST								
Replicate						1		2		3		4		5
Date Sampled						16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10		16-Aug-10
Lab Sample ID						110088		110089		110090		110091		110092
Fraction						coarse	fine	coarse	fine	coarse	fine	coarse	fine	212 microns
Percent Sampled						100	12.5	100	12.5	100	12.5	100	12.5	25
Area Sampled (cm^2)						0.288		0.288		0.288		0.288		0.288
Phylum	Class	Order	Family	Taxa	Stage									
Annelida	Oligochaeta (subclass)	Haplotaxida	Enchytraeidae	*Enchytraeus* sp.	-	0	0	0	0	1	1	0	0	0
			Naididae	*Chaetogaster* sp.	-	0	0	0	0	0	0	0	4	0
				Nais sp.	-	0	0	0	0	0	0	0	0	0
				Pristina sp.	-	0	0	0	0	0	0	0	0	0
				Stylaria sp.	-	0	0	0	0	0	0	0	0	0
				Naididae	-	0	0	0	0	0	0	0	0	0
Nemata				Nemata	-	0	1	0	0	1	6	2	0	0
				TOTAL		**592**	**603**	**365**	**409**	**773**	**659**	**756**	**389**	**317**

Notes: Samples collected using a Hess sampler and identified by Cordillera Consulting

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample area of 0.2880 m^2

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

juv. = juvenile; dam. = damaged

Dashes indicate no stage identified

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes not included in figures of analyses because of exclusion in CABIN protocol

Appendix 5-2

Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

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Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID				MR9				MR4			MR7			M20-03			M20-05			M20-04		
Replicate				1	2	3	4	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled				25-Aug-11				25-Aug-11			24-Aug-11			26-Aug-11			26-Aug-11			24-Aug-11		
Lab Sample ID				5906.1-7	5906.1-8	5906.1-9	5906.1-10	5906.1-1	5906.1-2	5906.1-3	5906.1-4	5906.1-5	5906.1-6	5906.1-11	5906.1-12	5906.1-13	5906.1-17	5906.1-18	5906.1-19	5906.1-14	5906.1-15	5906.1-16
Percent Subsampled				100	100	100	100	100	100	100	100	100	100	13	16	5	20	30	11	100	100	21
Time Sampled (min)				3				3			3			3			3			3		
Phylum	Class	Order	Family																			
Arthropoda	Insecta	Ephemeroptera	Ameletidae	11	10	18	47	22	15	29	0	0	0	18	42	2	0	14	4	6	0	3
			Baetidae	3	13	32	17	72	146	36	0	0	2	5	3	8	53	113	41	21	59	28
			Ephemerellidae	4	4	10	7	7	18	10	0	0	2	46	123	236	30	12	30	15	9	16
			Heptageniidae	1	3	17	9	5	9	7	0	0	0	26	49	115	135	137	133	41	36	59
			Leptohyphidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Metretopodidae	4	4	0	4	1	0	1	1	3	3	0	0	0	0	0	0	0	0	0
		Plecoptera	Capniidae	7	5	12	7	5	0	0	0	0	0	0	4	6	3	0	3	30	0	5
			Chloroperlidae	14	102	135	69	18	33	28	5	0	2	32	13	14	9	12	12	10	27	23
			Leuctridae	0	0	0	0	0	0	0	0	0	0	7	1	7	0	0	0	0	1	1
			Nemouridae	0	0	1	0	6	5	3	0	0	0	12	3	44	25	8	47	213	37	153
			Perlidae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
			Perlodidae	1	2	7	8	21	12	9	1	1	6	34	2	25	19	22	16	11	4	4
			Taeniopterygidae	2	0	1	0	4	3	0	0	0	1	0	0	8	4	2	4	1	0	7
		Trichoptera	Apataniidae	0	0	0	0	0	0	0	0	0	0	5	1	13	4	1	0	8	0	0
			Brachycentridae	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
			Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
			Hydropsychidae	0	1	0	1	2	1	0	0	0	1	0	0	1	9	12	8	0	0	1
			Lepidostomatidae	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
			Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	1	0	0
			Rhyacophilidae	1	0	0	0	0	0	0	0	0	0	38	4	18	2	7	0	2	2	5
		Coleoptera	Dytiscidae	3	0	3	3	1	4	1	0	6	5	0	6	0	0	0	0	0	4	0
			Elmidae	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1
			Haliplidae	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
		Diptera	Chironomidae	24	20	30	14	8	9	6	8	5	11	68	77	46	12	7	8	87	32	41
			Ceratopogonidae	0	5	0	6	0	0	1	0	0	0	2	3	0	0	0	1	2	2	0
			Empididae	1	2	1	0	0	0	1	1	0	2	8	4	1	1	0	0	3	0	0
			Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			Sciomyzidae	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
			Simuliidae	0	0	1	0	2	4	2	0	0	1	0	0	0	4	16	6	0	3	0
			Tipulidae	0	0	0	0	0	0	0	0	4	0	7	0	5	0	2	2	3	1	1
		Megaloptera	Sialidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Archanida	Trombidiformes	Hygrobatidae	23	6	4	5	23	4	7	14	8	35	1	4	0	0	0	0	0	0	1
			Lebertiidae	0	0	1	1	10	6	3	7	2	3	10	2	3	0	1	0	9	2	4
			Oxidae	1	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
			Sperchontidae	0	0	0	0	0	0	2	0	0	0	7	1	2	1	3	3	5	2	1
			Torrenticolidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Clitellata	Rhynchobdellida	Piscicolidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Oligochaeta	Haplotaxida	Enchytraeidae	0	1	0	0	1	0	1	3	6	1	0	0	0	0	0	0	1	0	1
			Tubificidae	2	0	0	4	0	0	0	12	4	14	0	0	0	0	0	0	0	0	0
			TOTAL	**102**	**180**	**274**	**203**	**211**	**272**	**148**	**55**	**40**	**93**	**327**	**342**	**558**	**315**	**370**	**320**	**469**	**221**	**356**

Notes: Samples collected using a kick-net and identified by EcoAnalysts

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample time of 3 minutes

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes are excluded from CABIN protocol and therefore were not identified

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					MR9			MR3			MR4			MR7b			MR6		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					31-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12		
Lab Sample ID					6266.1-13	6266.1-14	6266.1-15	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-10	6266.1-11	6266.1-12	6266.1-7	6266.1-8	6266.1-9
Percent Subsampled					100	100	100	100	100	100	100	100	100	100	49	100	21	16	14
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Ephemeroptera	Baetidae	*Acentrella sp.*	0	0	0	0	0	0	3	0	0	11	13	21	2	0	1
				Acentrella turbida	0	0	0	0	0	0	0	0	0	0	3	6	0	3	0
			Ameletidae	*Ameletus* sp.	6	3	50	7	6	2	9	3	7	24	4	3	0	0	1
			Baetidae	*Baetis bicaudatus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Baetis flavistriga	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
				Baetis tricaudatus	0	0	0	0	0	0	0	0	0	10	10	60	11	16	10
				Baetis sp.	0	0	0	0	0	0	3	1	1	0	0	0	0	0	0
			Ephemerellidae	*Caudatella edmundsi*	0	0	0	0	0	0	0	0	0	0	0	0	3	5	3
				Drunella coloradensis/flavilinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Drunella doddsii	0	0	0	0	0	0	0	0	0	21	23	57	0	1	0
				Drunella grandis	0	0	0	6	3	0	14	14	6	10	3	6	9	1	12
				Ephemerella aurivillii	1	0	0	0	0	0	0	46	38	0	0	59	134	104	103
				Ephemerella sp.	0	0	0	1	7	1	52	0	0	55	27	0	0	0	0
				Ephemerella tibialis	0	0	0	0	0	0	0	2	1	1	4	2	0	0	1
			Heptageniidae	*Cinygma* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				Cinygmula sp.	1	0	13	0	1	0	4	1	0	0	0	0	0	0	0
				Epeorus deceptivus/hesperus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Epeorus grandis/permagnus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Epeorus longimanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhithrogena sp.	0	0	2	0	0	0	0	0	0	24	85	156	1	6	4
				Heptageniidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
			Leptophlebiidae	Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Metretopodidae	Metretopodidae	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
		Plecoptera	Capniidae	*Eucapnopsis brevicauda*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Capniidae	6	0	20	3	6	1	13	4	0	0	0	0	0	0	1
			Chloroperlidae	*Suwallia* sp.	3	1	40	27	8	6	0	2	0	13	0	4	0	0	0
				Sweltsa sp.	1	0	5	0	2	1	7	7	3	12	2	4	2	2	2
				Chloroperlidae	0	0	1	0	0	0	6	0	1	0	6	6	1	0	0
			Leuctridae	*Paraleuctra* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Leuctridae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
			Nemouridae	*Zapada cinctipes*	1	0	0	2	0	0	0	1	0	0	0	1	5	8	6
				Zapada columbiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Zapada oregonensis gr.	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
				Zapada sp.	0	0	0	1	2	0	2	0	0	0	0	0	0	0	0
			Perlidae	*Claassenia sabulosa*	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0
				Hesperoperla pacifica	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9
			Perlodidae	*Cultus* sp.	0	0	0	0	0	0	3	2	1	6	0	0	0	0	0
				Isoperla sp.	1	0	3	0	0	0	0	0	0	8	0	18	0	0	0
				Megarcys sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Skwala sp.	0	0	0	0	0	0	11	2	5	19	9	20	1	0	2
				Perlodidae	0	0	0	0	0	0	8	6	5	1	3	2	40	41	47
			Pteronarcyidae	*Pteronarcella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Taeniopterygidae	Taeniopterygidae	0	0	0	0	2	0	6	2	0	37	15	7	31	41	21
		Coleoptera	Dytiscidae	*Oreodytes* sp.	0	0	1	0	2	0	0	0	1	0	0	0	0	0	0
			Elmidae	*Heterlimnius corpulentus*	0	0	0	0	0	0	0	3	1	0	0	1	0	2	0
			Haliplidae	*Haliplus* sp.	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
				Haliplidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Diptera	Chironomidae	*Brillia* sp.	0	0	0	0	0	0	5	1	0	0	0	1	0	0	0
				Brundiniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Chaetocladius sp.	1	0	0	0	0	0	2	1	0	3	1	2	0	0	0
				Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Constempellina sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				Corynoneura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Cricotopus bicinctus gr.	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0
				Cricotopus sp.	0	0	0	0	0	0	7	8	1	0	0	0	1	0	0
				Diplocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Eukiefferiella claripennis gr.	0	0	0	0	0	0	0	0	0	2	0	3	0	2	2
				Eukiefferiella coerulescens gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					MR9			MR3			MR4			MR7b			MR6		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					31-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12		
Lab Sample ID					6266.1-13	6266.1-14	6266.1-15	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-10	6266.1-11	6266.1-12	6266.1-7	6266.1-8	6266.1-9
Percent Subsampled					100	100	100	100	100	100	100	100	100	100	49	100	21	16	14
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Diptera	Chironomidae	*Eukiefferiella devonica gr.*	0	0	0	0	0	0	1	0	0	0	0	1	4	6	5
				Eukiefferiella gracei gr.	1	0	0	0	0	0	0	0	0	0	1	3	0	0	10
				Eukiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
				Heleniella sp.	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
				Heterotrissocladius marcidus gr.	1	1	1	2	21	2	0	0	0	0	0	0	0	0	0
				Hydrobaenus sp.	0	0	0	3	1	0	3	0	0	0	0	0	0	0	0
				Limnophyes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Micropsectra sp.	1	0	0	0	0	0	14	0	0	1	0	1	0	3	2
				Monodiamesa sp.	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
				Orthocladius rivicola gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Orthocladius lignicola	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Orthocladius Complex	0	0	0	1	0	0	19	8	3	4	3	1	18	9	16
				Orthocladius sp.	2	1	0	3	0	0	15	6	8	1	0	4	1	0	0
				Pagastia sp.	0	0	0	0	0	0	0	0	0	0	0	2	4	0	2
				Paracladopelma sp.	0	0	0	11	15	11	2	3	0	0	0	0	0	0	0
				Parakiefferiella sp.	0	0	0	3	7	0	10	1	3	0	0	0	0	0	0
				Parametriocnemus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Parorthocladius sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Phaenopsectra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Polypedilum scalaenum gr.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				*Polypedilum tuberculum**	0	0	0	3	2	2	0	0	0	2	0	0	1	**0**	**0**
				Polypedilum sp.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
				Prodiamesa sp.	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0
				Pseudodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rheocricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Rheotanytarsus exiguus gr.	0	0	0	0	0	0	4	0	0	1	0	0	9	2	6
				Stempellinella sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				Stictochironomus sp.	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
				Sublettea sp.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
				Thienemanniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Thienemannimyia gr . sp.	0	0	0	0	0	0	1	1	0	0	0	0	7	2	4
				Tvetenia bavarica gr.	0	0	0	0	0	0	1	0	0	3	0	4	1	6	5
				Eukiefferiella discoloripes gr.	0	0	0	0	0	0	0	0	0	0	0	0	5	4	1
				Zavrelimyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia/Palpomyia* sp.	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0
			Dixidae	*Meringodixa chalonensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Dolichopodidae	Dolichopodidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
			Empididae	*Chelifera/Metachela* sp.	0	0	1	1	2	0	7	7	0	24	14	25	2	8	2
				Hemerodromia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				Neoplasta sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
				Oreogeton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Wiedemannia sp.	0	0	0	0	1	0	3	0	3	0	0	0	0	0	0
				Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ephydridae	Ephydridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Muscidae	Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Psychodinae	*Pericoma/Telmatoscopus* sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			Simuliidae	*Simulium* sp.	0	0	0	1	0	0	0	0	0	3	3	1	0	1	0
			Tanyderidae	*Protanyderus* sp.	0	0	0	1	0	0	2	0	0	1	1	1	0	0	0
			Tipulidae	*Antocha* sp.	0	0	0	0	0	0	0	0	0	0	0	0	3	2	1
				Dicranota sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
				Hesperoconopa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hexatoma sp.	0	0	0	18	18	14	40	34	21	32	22	43	0	0	0
				Limnophila sp.	0	0	0	1	2	2	0	2	0	1	0	0	0	1	0
				Rhabdomastix fascigera gr.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Trichoptera		Apataniidae	*Apatania* sp.	0	0	0	0	0	0	0	2	1	3	0	2	0	0	0
			Brachycentridae	*Brachycentrus americanus*	0	0	0	1	1	0	8	6	0	9	6	10	15	18	7
				Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					MR9			MR3			MR4			MR7b			MR6		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					31-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12		
Lab Sample ID					6266.1-13	6266.1-14	6266.1-15	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-10	6266.1-11	6266.1-12	6266.1-7	6266.1-8	6266.1-9
Percent Subsampled					100	100	100	100	100	100	100	100	100	100	49	100	21	16	14
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Trichoptera	Brachycentridae	*Glossosoma* sp.	0	0	0	0	0	0	0	0	0	3	0	3	0	2	1
			Glossosomatidae	Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
			Hydropsychidae	*Arctopsyche grandis*	0	0	0	0	0	0	0	0	0	2	2	10	2	19	0
				Hydropsyche sp.	0	0	0	0	0	0	1	0	0	3	4	6	14	20	18
				Parapsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydroptilidae	*Hydroptila* sp.	0	0	0	0	0	1	2	0	0	1	0	0	0	2	0
			Limnephilidae	*Ecclisomyia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Limnephilidae	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
			Lepidostomatidae	Lepidostoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Rhyacophilidae	*Rhyacophila angelita gr.*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Rhyacophila arnaudi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				Rhyacophila betteni gr.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila brunnea gr.	1	0	0	0	0	0	0	0	0	0	0	3	2	1	2
				Rhyacophila hyalinata gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila pellisa/valuma	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
				Rhyacophila vofixa gr.	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
				Rhyacophila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Uenoidae	*Oligophlebodes* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arachnida		Acari (subclass)	Acari	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sarcoptiformes	Oribatida (suborder)	Oribatida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trombidiformes	Aturidae	Aturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
			Feltriidae	*Feltria* sp.	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
			Hydryphantidae	Hydryphantidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Protzia sp.	0	0	0	0	0	0	4	1	0	9	2	5	3	5	3
				Wandesia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
			Hygrobatidae	*Atractides* sp.	0	0	0	0	0	0	1	0	1	3	1	3	0	0	1
				Hygrobates sp.	4	1	2	10	13	6	6	1	3	3	0	3	1	0	0
			Lebertiidae	*Lebertia* sp.	0	0	0	28	29	16	45	20	10	35	19	39	16	8	22
			Oxidae	*Oxus* sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
			Sperchontidae	*Sperchon* sp.	0	0	0	0	0	0	4	1	2	15	13	24	4	9	9
				Sperchonopsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	4	4	9
			Stygothrombidiidae	*Stygothrombium* sp.	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0
			Torrenticolidae	*Testudacarus* sp.	0	0	0	0	0	0	2	0	0	3	0	1	4	6	1
				Torrenticola sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Oligochaeta	Haplotaxida	Lumbricina (suborder)	Lumbricina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Enchytraeidae	Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	0	8	3	9
			Naididae	*Nais bretscheri*	0	0	0	0	1	0	1	0	0	0	0	0	4	1	1
				Nais sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Tubificidae	*Tubifex tubifex*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Tubificidae w/ cap setae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
				Tubificidae w/o cap setae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				TOTAL	**33**	**8**	**140**	**137**	**159**	**76**	**358**	**209**	**132**	**426**	**303**	**649**	**388**	**379**	**369**

Notes: Samples collected using a kick-net and identified by EcoAnalysts

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample time of 3 minutes

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

** Species not included in ITIS database*

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes are excluded from CABIN protocol and therefore were not identified

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					M20-06			M20-04			M17-02			M19-01			M19-02		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					30-Aug-12			28-Aug-12			30-Aug-12			31-Aug-12			30-Aug-12		
Lab Sample ID					6266.1-28	6266.1-29	6266.1-30	6266.1-25	6266.1-26	6266.1-27	6266.1-16	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24
Percent Subsampled					30	18	22	6	16	13	21	25	15	20	16	13	18	19	16
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Ephemeroptera	Baetidae	*Acentrella sp.*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Acentrella turbida	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ameletidae	*Ameletus* sp.	0	3	1	0	1	1	22	9	6	18	13	13	7	0	1
			Baetidae	*Baetis bicaudatus*	25	4	22	13	13	32	0	0	0	75	77	92	25	0	0
				Baetis flavistriga	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Baetis tricaudatus	8	13	23	7	0	11	9	5	0	0	0	0	0	0	0
				Baetis sp.	0	0	0	0	0	0	0	0	13	0	0	0	0	20	0
			Ephemerellidae	*Caudatella edmundsi*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Drunella coloradensis/flavilinea	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				Drunella doddsii	3	1	1	3	1	2	0	0	0	0	0	0	0	2	0
				Drunella grandis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
				Ephemerella aurivillii	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0
				Ephemerella sp.	7	2	7	4	6	2	1	4	0	45	88	30	37	0	27
				Ephemerella tibialis	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0
			Heptageniidae	*Cinygma* sp.	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0
				Cinygmula sp.	16	12	8	18	19	22	1	2	2	53	23	22	14	4	0
				Epeorus deceptivus/hesperus	5	0	3	2	2	2	0	0	0	0	1	2	0	0	0
				Epeorus grandis/permagnus	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0
				Epeorus longimanus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Rhithrogena sp.	50	67	58	43	38	47	0	0	0	0	0	0	0	0	0
				Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Leptophlebiidae	Leptophlebiidae	0	0	0	0	0	0	1	1	0	2	6	3	4	4	8
			Metretopodidae	Metretopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Plecoptera	Capniidae	*Eucapnopsis brevicauda*	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				Capniidae	5	2	10	14	4	1	5	8	6	24	13	10	3	0	11
			Chloroperlidae	*Suwallia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Sweltsa sp.	3	7	0	0	1	3	1	2	0	17	16	4	0	0	0
				Chloroperlidae	7	0	3	7	3	2	0	0	0	0	0	3	0	0	0
			Leuctridae	*Paraleuctra* sp.	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0
				Leuctridae	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
			Nemouridae	*Zapada cinctipes*	59	52	41	97	172	65	29	31	25	14	11	8	38	36	17
				Zapada columbiana	6	2	1	7	8	8	0	0	0	0	0	0	0	0	0
				Zapada oregonensis gr.	10	5	7	27	5	10	4	0	0	15	1	0	5	8	1
				Zapada sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
			Perlidae	*Claassenia sabulosa*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Hesperoperla pacifica	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
			Perlodidae	*Cultus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Isoperla sp.	0	0	0	0	0	0	3	0	1	0	0	0	0	2	0
				Megarcys sp.	3	2	0	0	1	1	1	0	1	0	1	0	1	0	0
				Skwala sp.	0	0	0	1	0	0	0	0	0	0	0	1	3	2	0
				Perlodidae	8	1	2	5	2	8	2	4	4	2	0	3	7	8	4
			Pteronarcyidae	*Pteronarcella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Taeniopterygidae	Taeniopterygidae	19	18	7	18	8	5	5	0	1	8	10	4	0	0	0
		Coleoptera	Dytiscidae	*Oreodytes* sp.	0	0	0	0	0	0	2	2	2	0	1	0	0	0	0
			Elmidae	*Heterlimnius corpulentus*	1	0	0	0	0	0	13	19	14	23	21	33	34	15	22
			Haliplidae	*Haliplus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Haliplidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Diptera	Chironomidae	*Brillia* sp.	1	1	2	1	5	0	1	0	1	6	4	1	0	0	0
				Brundiniella sp.	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0
				Chaetocladius sp.	0	0	0	0	0	0	2	0	0	1	0	0	1	0	1
				Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Constempellina sp.	0	0	2	0	0	0	4	8	3	0	1	0	0	0	0
				Corynoneura sp.	2	0	1	2	0	0	11	7	9	1	2	1	0	0	0
				Cricotopus bicinctus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Cricotopus sp.	2	0	1	0	0	0	0	0	0	0	0	0	2	14	3
				Diplocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
				Eukiefferiella claripennis gr.	12	18	10	13	3	13	0	0	1	1	2	2	4	13	2
				Eukiefferiella coerulescens gr.	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					M20-06			M20-04			M17-02			M19-01			M19-02		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					30-Aug-12			28-Aug-12			30-Aug-12			31-Aug-12			30-Aug-12		
Lab Sample ID					6266.1-28	6266.1-29	6266.1-30	6266.1-25	6266.1-26	6266.1-27	6266.1-16	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24
Percent Subsampled					30	18	22	6	16	13	21	25	15	20	16	13	18	19	16
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Diptera	Chironomidae	*Eukiefferiella devonica gr.*	1	3	1	0	0	0	0	1	0	0	0	1	2	2	0
				Eukiefferiella gracei gr.	14	10	5	13	3	16	11	5	0	2	0	2	24	38	1
				Eukiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Heleniella sp.	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0
				Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
				Hydrobaenus sp.	3	0	0	2	1	1	13	6	4	3	2	1	0	0	1
				Limnophyes sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				Micropsectra sp.	4	8	3	4	1	3	88	77	163	14	26	3	5	2	27
				Monodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Orthocladius rivicola gr.	36	0	25	0	0	10	0	0	0	0	0	0	0	0	0
				Orthocladius lignicola	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
				Orthocladius Complex	5	4	3	1	1	5	7	4	0	0	0	6	12	7	7
				Orthocladius sp.	1	15	1	6	0	1	2	1	0	0	0	0	34	42	33
				Pagastia sp.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
				Paracladopelma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Parakiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Parametriocnemus sp.	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0
				Parorthocladius sp.	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0
				Phaenopsectra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Polypedilum scalaenum gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				*Polypedilum tuberculum**	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
				Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Prodiamesa sp.	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
				Pseudodiamesa sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
				Rheocricotopus sp.	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0
				Rheotanytarsus exiguus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Stempellinella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				Sublettea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Thienemanniella sp.	0	2	2	0	0	1	0	0	0	0	1	2	0	1	0
				Thienemannimyia gr . sp.	0	0	0	0	0	0	6	3	10	5	4	1	35	23	101
				Tvetenia bavarica gr.	1	4	3	2	3	5	9	3	0	1	0	3	23	31	0
				Eukiefferiella discoloripes gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Zavrelimyia sp.	0	0	0	0	0	0	3	3	5	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia/Palpomyia* sp.	3	1	2	4	1	0	2	2	7	0	0	1	0	0	0
			Dixidae	*Meringodixa chalonensis*	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0
			Dolichopodidae	Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Empididae	*Chelifera/Metachela* sp.	0	0	1	0	0	3	0	3	0	1	0	0	1	4	0
				Hemerodromia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Neoplasta sp.	1	0	0	2	0	2	0	0	1	0	0	0	2	0	0
				Oreogeton sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
				Wiedemannia sp.	13	11	10	9	4	13	3	6	4	2	0	1	6	0	0
				Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
			Ephydridae	Ephydridae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
			Muscidae	Muscidae	0	0	0	0	0	1	0	0	2	0	0	0	3	10	6
			Psychodinae	*Pericoma/Telmatoscopus* sp.	1	0	1	0	0	1	15	56	48	0	0	0	5	0	1
			Simuliidae	*Simulium* sp.	6	12	27	8	0	30	0	1	0	5	7	10	3	0	0
			Tanyderidae	*Protanyderus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tipulidae	*Antocha* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Dicranota sp.	3	1	1	1	0	2	1	1	0	3	0	1	0	0	0
				Hesperoconopa sp.	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
				Hexatoma sp.	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0
				Limnophila sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				Rhabdomastix fascigera gr.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Trichoptera		Apataniidae	*Apatania* sp.	0	0	1	0	0	1	7	3	1	2	2	0	1	0	3
			Brachycentridae	*Brachycentrus americanus*	0	2	3	6	8	1	0	0	0	0	0	0	0	1	0
				Micrasema sp.	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0

Appendix 5-2. Stream Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2011 and 2012

Sample ID					M20-06			M20-04			M17-02			M19-01			M19-02		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					30-Aug-12			28-Aug-12			30-Aug-12			31-Aug-12			30-Aug-12		
Lab Sample ID					6266.1-28	6266.1-29	6266.1-30	6266.1-25	6266.1-26	6266.1-27	6266.1-16	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24
Percent Subsampled					30	18	22	6	16	13	21	25	15	20	16	13	18	19	16
Time Sampled (min)						3			3			3			3			3	
Phylum	Class	Order	Family	Taxa															
Arthropoda	Insecta	Trichoptera	Brachycentridae	*Glossosoma* sp.	0	0	0	0	0	0	1	0	0	4	3	0	0	0	0
			Glossosomatidae	Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydropsychidae	*Arctopsyche grandis*	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
				Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Parapsyche sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
			Hydroptilidae	*Hydroptila* sp.	0	0	0	0	0	1	9	2	10	0	0	0	2	1	11
			Limnephilidae	*Ecclisomyia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				Limnephilidae	0	0	0	0	0	0	5	8	1	4	14	11	1	1	0
			Lepidostomatidae	Lepidostoma sp.	1	1	0	1	2	0	0	11	6	5	3	3	2	1	3
			Rhyacophilidae	*Rhyacophila angelita gr.*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila arnaudi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila betteni gr.	3	0	0	1	1	0	2	2	1	4	11	5	4	2	0
				Rhyacophila brunnea gr.	3	0	5	3	4	2	0	0	0	2	0	0	0	0	0
				Rhyacophila hyalinata gr.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
				Rhyacophila pellisa/valuma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila vofixa gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Rhyacophila sp.	0	2	0	0	0	0	0	0	1	0	1	1	0	0	0
			Uenoidae	*Oligophlebodes* sp.	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arachnida		Acari (subclass)	Acari	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0
		Sarcoptiformes	Oribatida (suborder)	Oribatida	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
		Trombidiformes	Aturidae	Aturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Feltriidae	*Feltria* sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydryphantidae	Hydryphantidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
				Protzia sp.	0	1	0	0	0	0	0	0	0	1	1	2	0	0	0
				Wandesia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hygrobatidae	*Atractides* sp.	0	0	0	0	0	0	0	1	1	0	2	1	0	1	0
				Hygrobates sp.	0	0	0	0	0	0	0	0	0	0	2	7	0	0	0
			Lebertiidae	*Lebertia* sp.	2	1	0	1	0	4	13	8	17	0	1	1	5	2	1
			Oxidae	*Oxus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sperchontidae	*Sperchon* sp.	5	6	3	3	3	7	2	1	0	1	0	4	0	0	1
				Sperchonopsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Stygothrombidiidae	*Stygothrombium* sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			Torrenticolidae	*Testudacarus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Torrenticola sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Oligochaeta	Haplotaxida	Lumbricina (suborder)	Lumbricina	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1
			Enchytraeidae	Enchytraeidae	0	0	0	0	0	1	1	0	2	0	0	0	0	0	0
			Naididae	*Nais bretscheri*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Nais sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tubificidae	*Tubifex tubifex*	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
				Tubificidae w/ cap setae	0	0	0	0	0	0	0	10	2	0	0	3	0	0	0
				Tubificidae w/o cap setae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				TOTAL	**369**	**304**	**310**	**355**	**330**	**352**	**331**	**331**	**386**	**371**	**379**	**308**	**360**	**312**	**301**

Notes: Samples collected using a kick-net and identified by EcoAnalysts

Counts represent natural units and are not adjusted for subsampling

Each replicate represented a sample time of 3 minutes

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 17 April 2013)

** Species not included in ITIS database*

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes are excluded from CABIN protocol and therefore were not identified

Appendix 5-3

Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2010

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Appendix 5-3. Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2010

Sample ID	MR4		MR4		MR4	
Replicate	1	1	4	4	5	5
Fraction	coarse	fine	coarse	fine	coarse	fine
Original Sort Count	141	312	70	297	91	309
Re-sort Count	142	312	72	298	91	309
Sorting Efficiency (%)	99.29	100	97.14	99.66	100	98.71

Notes:

Sorting Efficiency = [1- (# in QA/QC re-sort / (# sorted originally + # QA/QC re-sort))] × 100

Appendix 5-4

Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2011 and 2012

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Appendix 5-4. Stream Benthic Invertebrate Taxonomic QA/QC Results, Murray River Coal Project, 2011 and 2012

2011

Sample ID	MR9				MR4			MR7		
Replicate	1	2	3	4	1	2	3	1	2	3
Date Sampled	25-Aug-11				25-Aug-11			24-Aug-11		
Lab Sample ID	5906.1-7	5906.1-8	5906.1-9	5906.1-10	5906.1-1	5906.1-2	5906.1-3	5906.1-4	5906.1-5	5906.1-6
1st Sorting Recovery (%)	100	88.73	93.66	97.14	98.69	95.88	98.10	100	100	100
2nd Sorting Recovery (%)	-	98.53	97.99	-	-	-	-	-	-	-

Sample ID	M20-03			M20-05			M20-04		
Replicate	1	2	3	1	2	3	1	2	3
Date Sampled	26-Aug-11			26-Aug-11			24-Aug-11		
Lab Sample ID	5906.1-11	5906.1-12	5906.1-13	5906.1-17	5906.1-18	5906.1-19	5906.1-14	5906.1-15	5906.1-16
1st Sorting Recovery (%)	100	100	100	100	100	100	100	100	100
2nd Sorting Recovery (%)	-	-	-	-	-	-	-	-	-

2012

Sample ID	MR9			MR3			MR4			MR7B		
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	31-Aug-12			29-Aug-12			29-Aug-12			29-Aug-12		
Lab Sample ID	6266.1-13	6266.1-14	6266.1-15	6266.1-1	6266.1-2	6266.1-3	6266.1-4	6266.1-5	6266.1-6	6266.1-10	6266.1-11	6266.1-12
1st Sorting Recovery (%)	100	100	100	97.38	96.37	96.3	79.04	96.41	100	96.36	100	100
2nd Sorting Recovery (%)	-	-	-	-	-	-	98.95	-	-	-	-	-

Sample ID	MR6			MR20-06			MR20-04		
Replicate	1	2	3	1	2	3	1	2	3
Date Sampled	29-Aug-12			30-Aug-12			28-Aug-12		
Lab Sample ID	6266.1-7	6266.1-8	6266.1-9	6266.1-28	6266.1-29	6266.1-30	6266.1-25	6266.1-26	6266.1-27
1st Sorting Recovery (%)	91.27	100	88.94	100	100	100	100	100	100
2nd Sorting Recovery (%)	100	-	96.11	-	-	-	-	-	-

Sample ID	MR17-02			MR19-01			MR19-02		
Replicate	1	2	3	1	2	3	1	2	3
Date Sampled	30-Aug-12			31-Aug-12			30-Aug-12		
Lab Sample ID	6266.1-16	6266.1-17	6266.1-18	6266.1-19	6266.1-20	6266.1-21	6266.1-22	6266.1-23	6266.1-24
1st Sorting Recovery (%)	100	100	100	100	100	100	100	100	100
2nd Sorting Recovery (%)	-	-	-	-	-	-	-	-	-

Notes:

*Sorting Recovery = [(Original Count + QA Count) / (Original Count + ((QC Count * QC Squares) / QT Squares))] × 100*

Shaded cells represent first sorting recoveries less than 95%

Appendix 6-1

Stream Periphyton Tissue Metal Analytical Results, Murray River Coal Project, 2011 and 2012

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Appendix 6-1. Stream Periphyton Tissue Metal Analytical Results, Murray River Coal Project, 2011 and 2012

Sample ID		MR9	MR4	MR7	M20-03			M20-05		M20-04
Replicate		1	1	1	1	2	1	1	2	1
Community		-	-	-	dominant	dominant	subdominant	-	-	-
Lab Sample ID		BJ9345	BJ9342	BJ9346	BJ9339	BJ9340	BJ9341	BJ9344	BJ9347	BJ9343
Date Sampled	Units	25-Aug-11	25-Aug-11	24-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	26-Aug-11	25-Aug-11
Total Metals										
Aluminum (Al)	mg/kg	5,570	4,830	3,150	2,050	2,320	2,940	4,780	5,800	3,440
Antimony (Sb)	mg/kg	0.172	0.198	0.124	0.116	0.141	0.207	0.246	0.291	0.117
Arsenic (As)	mg/kg	5.84	6.60	4.11	3.08	2.88	4.66	5.14	5.59	3.99
Barium (Ba)	mg/kg	126	195	135	187	238	547	434	578	300
Beryllium (Be)	mg/kg	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.3
Bismuth (Bi)	mg/kg	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1
Boron (B)	mg/kg	4	3	5	4	4	6	4	5	3
Cadmium (Cd)	mg/kg	0.64	0.79	0.79	0.59	0.71	0.93	0.95	1.24	0.46
Calcium (Ca)	mg/kg	64,200	34,800	14,700	4,950	8,130	19,000	44,800	55,600	16,700
Chromium (Cr)	mg/kg	10.9	10.7	12.4	5.1	4.6	6.3	10.9	13.3	7.4
Cobalt (Co)	mg/kg	7.70	11.5	3.74	2.80	3.37	7.73	7.65	9.45	4.41
Copper (Cu)	mg/kg	13.0	15.2	11.1	8.18	8.15	11.7	14.4	17.6	10.7
Iron (Fe)	mg/kg	16,100	14,700	8,980	6,890	8,760	13,500	16,000	18,500	10,800
Lead (Pb)	mg/kg	9.24	10.3	5.07	3.44	3.56	6.00	9.01	10.6	6.48
Magnesium (Mg)	mg/kg	18,900	15,800	7,010	1,110	1,460	2,930	13,600	16,400	5,660
Manganese (Mn)	mg/kg	603	1,140	117	289	419	3,060	607	959	202
Mercury (Hg)	mg/kg	0.03	0.05	0.05	0.07	0.06	0.07	0.06	0.07	0.07
Molybdenum (Mo)	mg/kg	1.26	1.18	0.53	0.50	0.54	1.02	1.29	1.52	0.74
Nickel (Ni)	mg/kg	20.1	22.2	15.6	12.4	14.1	20.2	25.3	30.4	15.1
Phosphorus (P)	mg/kg	1,060	1,290	1,020	465	721	1,200	997	1,150	720
Potassium (K)	mg/kg	807	817	722	524	613	651	998	1,260	978
Selenium (Se)	mg/kg	0.38	0.73	0.73	2.02	2.04	1.94	1.26	1.58	0.75
Silver (Ag)	mg/kg	0.23	0.43	0.56	0.18	0.10	0.19	0.36	0.55	0.38
Sodium (Na)	mg/kg	73	67	36	61	125	144	121	474	68
Strontium (Sr)	mg/kg	104	62.9	20.9	24.1	32.6	56.0	72.7	100	34.7
Thallium (Tl)	mg/kg	0.186	0.165	0.087	0.082	0.070	0.083	0.163	0.208	0.138
Tin (Sn)	mg/kg	0.2	0.3	0.1	<0.1	0.1	0.2	0.3	0.3	0.2
Titanium (Ti)	mg/kg	58	43	6	4	4	12	50	66	6
Uranium (U)	mg/kg	0.761	0.770	0.389	0.473	0.387	0.486	0.699	0.832	0.467
Vanadium (V)	mg/kg	21.9	19.9	13.8	8.6	9.8	13.5	21.4	25.6	13.5
Zinc (Zn)	mg/kg	75.9	111	111	38.7	64.5	87.0	105	145	76.9

Notes:

All parameters analyzed by Maxxam Analytics

Values represent mg/kg of dry weight periphyton

Each replicate was collected from an area of 78.5 cm ^{2}

Appendix 6-1. Stream Periphyton Tissue Metal Analytical Results, Murray River Coal Project, 2011 and 2012

Sample ID		MR9	MR3	MR4	MR7B	MR6	MR20-06	MR20-04	MR17-02	MR19-01				MR19-02	
Replicate		1	1	1	1	1	1	1	1	1	2	3	4	1	2
Lab Sample ID		EK8431	EK8427	EK8428	EK8430	EK8429	EK8436	EK8435	EK8432	EK8433	EK8438	EK8455	EK8456	EK8434	EK8437
Date Sampled	Units	31-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	30-Aug-12	28-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
Total Metals															
Aluminum (Al)	mg/kg	7,370	6,710	5,410	5,020	7,120	7,490	5,920	5,250	3,010	2,890	3,570	3,850	4,580	560
Antimony (Sb)	mg/kg	0	0	0	0	0	0	0	0	0	0.170	0.220	0.320	0.243	0.0585
Arsenic (As)	mg/kg	5.82	6.62	5.24	8.43	17.4	5.28	5.67	3.81	5.03	4.07	4.78	5.08	3.59	1.85
Barium (Ba)	mg/kg	124	150	185	198	377	483	615	356	304	313	239	264	234	58.3
Beryllium (Be)	mg/kg	0.37	0.41	0.33	0.39	0.47	0.51	0.43	0.32	0.27	0.21	0.22	0.27	0.33	<0.10
Bismuth (Bi)	mg/kg	0.15	0.11	0.10	<0.10	0.13	<0.15	<0.30	<0.10	<0.25	<0.20	<0.10	<0.10	<0.10	<0.10
Boron (B)	mg/kg	13.2	8.2	6.3	7.2	12.0	14.7	17.2	9.0	10.4	11.5	10.2	12.5	190	2.5
Cadmium (Cd)	mg/kg	0.645	0.521	0.616	1.62	3.27	0.937	0.965	0.759	0.511	0.482	0.477	0.537	0.604	0.854
Calcium (Ca)	mg/kg	55,600	41,800	33,600	52,800	52,500	54,100	47,500	105,000	89,400	102,000	34,400	40,600	26,100	12,400
Chromium (Cr)	mg/kg	13	13	9	11	14	13	11	10	7	5.92	8.00	8.23	7.97	1.18
Cobalt (Co)	mg/kg	7.57	6.56	5.43	15.6	25.9	15.7	25.1	4.53	5.13	4.65	5.63	6.40	4.78	0.797
Copper (Cu)	mg/kg	11.6	11.2	11.6	12.1	14.9	16.2	16.6	13.5	8.29	7.35	9.15	10.3	11.3	13.4
Iron (Fe)	mg/kg	17,400	16,300	14,500	18,000	23,900	18,100	14,200	10,500	15,900	12,700	15,900	16,900	12,200	1,800
Lead (Pb)	mg/kg	9	9	7	8	10	9	9	6	6	4.66	4.75	6.29	6.02	0.814
Magnesium (Mg)	mg/kg	18,700	14,800	11,000	13,500	16,600	10,900	9,640	7,730	19,200	20,200	5,060	5,340	5,680	4,090
Manganese (Mn)	mg/kg	710	438	363	2,690	5,510	690	1,060	276	1,010	1,150	1,120	1,090	452	130
Mercury (Hg)	mg/kg	0	0	0	0	0	0	0	0	0	0.038	0.042	0.044	0.062	0.146
Molybdenum (Mo)	mg/kg	1.08	1.20	0.974	2.05	1.85	1.27	1.21	0.805	0.76	0.55	1.02	1.03	0.714	0.441
Nickel (Ni)	mg/kg	19.7	19.7	16.5	29.7	60.2	31.0	29.3	21.5	14.2	11.1	15.3	18.7	14.8	4.25
Phosphorus (P)	mg/kg	1,000	981	949	946	1,030	1,260	1,410	1,020	823	802	914	998	815	2,540
Potassium (K)	mg/kg	1,400	1,510	1,520	1,270	1,340	2,210	1,970	1,590	1,010	984	993	1,050	1,060	18,200
Selenium (Se)	mg/kg	1	0	1	1	1	4	2	2	1	1.07	1.18	1.24	1.30	1.11
Silver (Ag)	mg/kg	0.096	0.117	0.119	0.140	0.100	0.217	0.175	0.098	0.285	0.163	0.139	0.192	0.113	0.033
Sodium (Na)	mg/kg	85	80	66	86	78	192	235	174	140	94	94	82	103	617
Strontium (Sr)	mg/kg	72.7	62.1	52.6	83.5	78.0	101	94.1	143	69.8	67.7	45.2	49.3	38.6	25.5
Thallium (Tl)	mg/kg	0.189	0.200	0.152	0.214	0.233	0.244	0.206	0.170	0.0908	0.0812	0.0872	0.0914	0.0986	0.0325
Tin (Sn)	mg/kg	0.22	0.22	0.22	0.63	0.23	0.48	0.48	0.23	0.55	0.42	0.45	0.51	0.18	<0.10
Titanium (Ti)	mg/kg	73.7	60.9	36.3	28.8	55.8	58.2	74.3	47.2	37.3	27.7	31.0	31.6	13.8	7.5
Uranium (U)	mg/kg	0.865	0.975	0.669	0.965	0.879	0.722	0.721	0.605	0.334	0.305	0.481	0.459	0.455	0.113
Vanadium (V)	mg/kg	27.2	27.8	19.9	28.3	34.0	29.6	25.2	20.0	17.1	12.3	18.5	17.4	16.1	4.54
Zinc (Zn)	mg/kg	61.4	62.1	61.8	86.5	105	105	118	65.1	73.7	51.0	67.3	77.1	59.4	94.5

Notes:

All parameters analyzed by Maxxam Analytics

Values represent mg/kg of dry weight periphyton

Each replicate was collected from an area of 78.5 cm^2

Appendix 6-2

Stream Benthic Invertebrate Tissue Metal Analytical Results, Murray River Coal Project, 2010 and 2012

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Appendix 6-2. Stream Benthic Invertebrate Tissue Metal Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MRREF	MR4	MR6
Replicate		1	1	1
Lab Sample ID		L921705-1	L921705-2	L921705-3
Date Sampled	Units	15-Aug-10	15-Aug-10	16-Aug-10
Physical Tests				
Moisture	%	93.9	90.3	91.9
Total Metals				
Aluminum (Al)	mg/kg	85.5	313	158
Antimony (Sb)	mg/kg	0.011	<0.010	0.011
Arsenic (As)	mg/kg	0.068	0.277	0.109
Barium (Ba)	mg/kg	2.63	11.3	6.77
Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10
Bismuth (Bi)	mg/kg	<0.030	<0.030	<0.030
Cadmium (Cd)	mg/kg	0.448	0.384	0.339
Calcium (Ca)	mg/kg	543	1,020	731
Chromium (Cr)	mg/kg	0.19	0.67	0.27
Cobalt (Co)	mg/kg	0.192	0.499	0.255
Copper (Cu)	mg/kg	2.24	3.20	4.43
Lead (Pb)	mg/kg	0.076	0.246	0.143
Lithium (Li)	mg/kg	0.12	0.37	0.18
Magnesium (Mg)	mg/kg	133	371	186
Manganese (Mn)	mg/kg	8.84	32.3	25.2
Mercury (Hg)	mg/kg	0.0032	0.0027	0.0044
Molybdenum (Mo)	mg/kg	0.046	0.090	0.060
Nickel (Ni)	mg/kg	0.30	0.87	0.63
Selenium (Se)	mg/kg	0.23	0.30	0.46
Strontium (Sr)	mg/kg	1.17	1.76	1.62
Thallium (Tl)	mg/kg	<0.010	0.010	<0.010
Tin (Sn)	mg/kg	0.258	0.212	0.202
Uranium (U)	mg/kg	0.0265	0.0353	0.0393
Vanadium (V)	mg/kg	0.33	1.80	0.51
Zinc (Zn)	mg/kg	23.7	20.5	32.0

Notes:

All parameters analyzed by ALS Environmental

Samples collected using a Hess sampler

Values represent mg/kg of wet weight of benthic invertebrates

Appendix 6-2. Stream Benthic Invertebrate Tissue Metal Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		M20-03	M20-05	M20-04 A	M20-04 B	MR-4	MR-9	MR-7
Replicate		1	1	1	2	1	1	1
Lab Sample ID		CB5517	CB5518	CB5519	CB5520	CB5521	CB5522	CB5523
Date Sampled	Units	26-Aug-11	26-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	24-Aug-11
Total Metals								
Aluminum (Al)	mg/kg	267	118	42	104	117	243	355
Antimony (Sb)	mg/kg	0.035	0.0150	0.013	0.013	0.025	0.03	0.049
Arsenic (As)	mg/kg	0.46	0.080	<0.06	0.070	0.13	0.200	0.34
Barium (Ba)	mg/kg	27.2	13.2	7.6	14.1	10.6	7.70	9.2
Beryllium (Be)	mg/kg	0.04	<0.02	<0.1	<0.08	<0.06	<0.2	<0.1
Bismuth (Bi)	mg/kg	<0.02	<0.02	<0.1	<0.08	<0.06	<0.2	<0.1
Boron (B)	mg/kg	2.5	3	3	4	4	<4	7
Cadmium (Cd)	mg/kg	0.27	0.22	0.11	0.226	0.351	0.61	0.25
Calcium (Ca)	mg/kg	2,110	1,580	1,500	1,390	2,370	1,350	1,860
Chromium (Cr)	mg/kg	0.64	0.22	<0.2	<0.2	0.3	0.4	0.6
Cobalt (Co)	mg/kg	0.714	0.173	0.19	0.23	0.21	0.37	0.53
Copper (Cu)	mg/kg	3.04	2.01	1.77	1.9	2.68	2.1	1.60
Iron (Fe)	mg/kg	1,940	263	98	191	350	560	958
Lead (Pb)	mg/kg	0.483	0.207	0.12	0.186	0.225	0.34	0.57
Magnesium (Mg)	mg/kg	318	278	111	118	312	270	744
Manganese (Mn)	mg/kg	117	20.3	24	29.4	14.2	13.9	21.9
Mercury (Hg)	mg/kg	0.007	0.011	<0.07	<0.04	<0.03	<0.1	<0.06
Molybdenum (Mo)	mg/kg	0.17	0.080	0.09	0.09	0.12	0.1	0.23
Nickel (Ni)	mg/kg	2.59	0.64	1.28	0.9	0.86	1.4	1.72
Phosphorus (P)	mg/kg	745	801	698	289	1,000	356	154
Potassium (K)	mg/kg	67	43	18	50	37	65	117
Selenium (Se)	mg/kg	1	0.57	0.280	0.34	0.38	0.2	0.13
Silver (Ag)	mg/kg	0.034	0.011	<0.02	<0.02	0.0200	<0.04	<0.02
Sodium (Na)	mg/kg	18	7	<10	<200	<6	<20	<10
Strontium (Sr)	mg/kg	6	5.11	3.4	2.95	4.62	3.2	2.8
Thallium (Tl)	mg/kg	0.0083	0.005	<0.002	0.004	0.007	0.011	0.014
Tin (Sn)	mg/kg	0.03	<0.02	<0.1	<0.08	<0.06	<0.2	<0.1
Titanium (Ti)	mg/kg	1.3	1.5	<1	2.40	1.9	5	7
Uranium (U)	mg/kg	0.117	0.03370	0.025	0.046	0.031	0.049	0.0670
Vanadium (V)	mg/kg	1.69	0.47	0.2	0.4	0.6	1	1.7
Zinc (Zn)	mg/kg	29.7	22.2	28.3	29	24.6	18.8	8.5

Notes:

All parameters analyzed by Maxxam Analytics

Samples collected using a kick-net sampler

Values represent mg/kg of wet weight of benthic invertebrates

Appendix 6-2. Stream Benthic Invertebrate Tissue Metal Analytical Results, Murray River Coal Project, 2010 to 2012

Sample ID		MR9	MR3	MR4	MR7B	MR6	M20-06	M20-04	M17-02	M19-01		M19-02
Replicate		1	1	1	1	1	1	1	1	1	2	1
Lab Sample ID		EJ8133	EJ8129	EJ8130	EJ8132	EJ8131	EJ8138	EJ8137	EJ8134	EJ8136	EJ8139	EJ8135
Date Sampled	Units	31-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	30-Aug-12	28-Aug-12	30-Aug-12	31-Aug-12	31-Aug-12	30-Aug-12
Total Metals												
Aluminum (Al)	mg/kg	75	5	309	27	66	218	256	283	225	400	194
Antimony (Sb)	mg/kg	0.0123	0.0020	0.0174	0.0039	0.0093	0.0126	0.0156	0.0210	0.0109	0.0174	0.0133
Arsenic (As)	mg/kg	<0.065	0.080	0.184	0.060	0.085	0.080	0.169	0.208	0.130	0.219	0.182
Barium (Ba)	mg/kg	6.47	0.302	12.9	2.02	8.46	9.20	12.2	11.0	13.4	23.0	9.02
Beryllium (Be)	mg/kg	<0.13	<0.020	<0.14	<0.020	<0.030	<0.040	<0.030	<0.030	<0.020	<0.040	<0.020
Bismuth (Bi)	mg/kg	<0.13	<0.020	<0.14	<0.020	<0.030	<0.040	<0.030	<0.030	<0.020	<0.040	<0.020
Boron (B)	mg/kg	<2.6	<0.40	<2.8	<0.40	<0.60	<0.80	<0.60	<0.60	0.41	<0.80	0.47
Cadmium (Cd)	mg/kg	0.252	0.135	1.08	0.823	0.297	0.525	0.673	0.639	1.09	1.53	0.274
Calcium (Ca)	mg/kg	2,480	168	2,100	612	1,340	1,030	990	1,450	1,180	1,810	1,230
Chromium (Cr)	mg/kg	<0.26	<0.040	0.62	0.051	0.125	0.358	0.431	0.488	0.404	0.722	0.383
Cobalt (Co)	mg/kg	0.076	0.488	0.759	0.217	0.237	1.45	2.13	0.436	0.450	0.628	0.267
Copper (Cu)	mg/kg	6.81	4.95	7.04	6.48	5.86	6.28	7.10	5.93	7.24	7.02	4.24
Iron (Fe)	mg/kg	127	448	623	65	171	269	385	576	476	834	463
Lead (Pb)	mg/kg	0.103	0.0748	0.381	0.0557	0.101	0.191	0.254	0.342	0.213	0.380	0.252
Magnesium (Mg)	mg/kg	538	115	719	285	491	476	502	609	407	606	398
Manganese (Mn)	mg/kg	10.2	5.33	37.7	16.7	33.8	15.4	20.2	21.2	31.8	54.5	13.9
Mercury (Hg)	mg/kg	0.019	0.0029	0.022	0.0027	0.0045	0.0105	0.0055	0.0066	0.0147	0.0290	0.0079
Molybdenum (Mo)	mg/kg	0.122	0.010	0.224	0.065	0.078	0.103	0.112	0.116	0.129	0.171	0.092
Nickel (Ni)	mg/kg	0.155	0.305	1.02	0.287	0.366	0.716	1.33	1.13	0.510	0.905	0.818
Phosphorus (P)	mg/kg	2,230	453	1,330	1,070	1,730	1,380	1,560	1,180	1,120	1,390	1,160
Potassium (K)	mg/kg	285	623	261	126	387	372	1,080	478	196	301	322
Selenium (Se)	mg/kg	0.696	0.288	0.680	0.587	0.515	1.17	1.33	0.780	0.660	0.752	1.17
Silver (Ag)	mg/kg	0.029	<0.0040	<0.028	0.0382	0.0270	0.0238	0.0271	0.0239	0.0243	0.0283	0.0234
Sodium (Na)	mg/kg	82	590	78	69	141	155	466	190	64	76	114
Strontium (Sr)	mg/kg	5.21	0.289	3.52	1.47	2.67	2.62	2.39	2.83	2.26	3.52	2.15
Thallium (Tl)	mg/kg	0.0033	0.0146	0.0146	0.00249	0.00349	0.00909	0.0118	0.0136	0.00757	0.0130	0.00678
Tin (Sn)	mg/kg	<0.13	0.023	0.90	<0.020	0.168	0.113	0.086	<0.030	0.098	<0.040	0.239
Titanium (Ti)	mg/kg	1.8	<0.20	8.8	0.50	1.17	3.83	4.29	4.64	5.69	7.26	2.23
Uranium (U)	mg/kg	0.0108	0.00090	0.0314	0.00468	0.0118	0.0214	0.0220	0.0483	0.0225	0.0394	0.0236
Vanadium (V)	mg/kg	<0.26	<0.040	1.09	0.095	0.218	0.783	0.948	1.17	0.832	1.55	0.803
Zinc (Zn)	mg/kg	46.9	19.8	43.7	64.8	95.9	51.9	53.9	49.6	39.1	47.8	29.7

Notes:

All parameters analyzed by Maxxam Analytics

Samples collected using a kick-net sampler

Values represent mg/kg of wet weight of benthic invertebrates

Appendix 6-3

Stream Periphyton Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

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Appendix 6-3. Stream Periphyton Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				M20-03				M20-05			
Replicate				1	2			1	2		
Lab Sample ID		2011 DL		BJ9339	BJ9340	>5x DL?		BJ9344	BJ9347	>5x DL?	
Date Sampled	Units	min. DL	5x min. DL	26-Aug-11	26-Aug-11	Y/N/<DL	RPD	26-Aug-11	26-Aug-11	Y/N/<DL	RPD
Total Metals											
Aluminum (Al)	mg/kg	1	5	2,050	2,320	Y	3%	4,780	5,800	Y	5%
Antimony (Sb)	mg/kg	0.01	0.025	0.116	0.141	Y	5%	0.246	0.291	Y	4%
Arsenic (As)	mg/kg	0.05	0.25	3.08	2.88	Y	2%	5.14	5.59	Y	2%
Barium (Ba)	mg/kg	0.10	0.5	187	238	Y	6%	434	578	Y	7%
Beryllium (Be)	mg/kg	0.1	0.5	0.2	0.2	N	-	0.4	0.4	N	-
Bismuth (Bi)	mg/kg	0.1	0.5	<0.1	<0.1	<DL	-	0.1	0.1	N	-
Boron (B)	mg/kg	2	10	4	4	N	-	4	5	N	-
Cadmium (Cd)	mg/kg	0.01	0.05	0.59	0.71	Y	5%	0.95	1.24	Y	7%
Calcium (Ca)	mg/kg	10	50	4,950	8,130	Y	12%	44,800	55,600	Y	5%
Chromium (Cr)	mg/kg	0.2	1	5.1	4.6	Y	3%	10.9	13.3	Y	5%
Cobalt (Co)	mg/kg	0.02	0.1	2.80	3.37	Y	5%	7.65	9.45	Y	5%
Copper (Cu)	mg/kg	0.05	0.25	8.18	8.15	Y	0%	14.4	17.6	Y	5%
Iron (Fe)	mg/kg	10	50	6,890	8,760	Y	6%	16,000	18,500	Y	4%
Lead (Pb)	mg/kg	0.01	0.05	3.44	3.56	Y	1%	9.01	10.6	Y	4%
Magnesium (Mg)	mg/kg	10	50	1,110	1,460	Y	7%	13,600	16,400	Y	5%
Manganese (Mn)	mg/kg	0.1	0.5	289	419	Y	9%	607	959	Y	11%
Mercury (Hg)	mg/kg	0.01	0.05	0.07	0.06	Y	4%	0.06	0.07	Y	4%
Molybdenum (Mo)	mg/kg	0.05	0.25	0.50	0.54	Y	2%	1.29	1.52	Y	4%
Nickel (Ni)	mg/kg	0.1	0.25	12.4	14.1	Y	3%	25.3	30.4	Y	5%
Phosphorus (P)	mg/kg	10	50	465	721	Y	11%	997	1,150	Y	4%
Potassium (K)	mg/kg	10	50	524	613	Y	4%	998	1,260	Y	6%
Selenium (Se)	mg/kg	0.1	0.25	2.02	2.04	Y	0%	1.26	1.58	Y	6%
Silver (Ag)	mg/kg	0.02	0.1	0.18	0.10	Y	14%	0.36	0.55	Y	10%
Sodium (Na)	mg/kg	10	50	61	125	Y	17%	121	474	Y	30%
Strontium (Sr)	mg/kg	0.1	0.5	24.1	32.6	Y	7%	72.7	100	Y	8%
Thallium (Tl)	mg/kg	0.002	0.01	0.082	0.070	Y	4%	0.163	0.208	Y	6%
Tin (Sn)	mg/kg	0.1	0.5	<0.1	0.1	<DL	-	0.3	0.3	N	-
Titanium (Ti)	mg/kg	1	5	4	4	N	-	50	66	N	-
Uranium (U)	mg/kg	0.002	0.01	0.473	0.387	Y	5%	0.699	0.832	Y	4%
Vanadium (V)	mg/kg	0.2	1	8.6	9.8	Y	3%	21.4	25.6	Y	4%
Zinc (Zn)	mg/kg	0.2	1	38.7	64.5	Y	13%	105	145	Y	8%

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 6-3. Stream Periphyton Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

Sample ID				MR19-01								MR19-02			
Replicate				1	2			3	4			1	2		
Lab Sample ID		2012 DL		EK8433	EK8438	>5x DL?		EK8455	EK8456	>5x DL?		EK8434	EK8437	>5x DL?	
Date Sampled	Units	min. DL	5x min. DL	31-Aug-12	31-Aug-12	Y/N/<DL	RPD	31-Aug-12	31-Aug-12	Y/N/<DL	RPD	31-Aug-12	30-Aug-12	Y/N/<DL	RPD
Total Metals															
Aluminum (Al)	mg/kg	1 - 3	5	3,010	2,890	Y	1%	3,570	3,850	Y	2%	4,580	560	Y	39%
Antimony (Sb)	mg/kg	0.005 - 0.015	0.025	0.256	0.170	Y	10%	0.220	0.320	Y	9%	0.243	0.0585	Y	31%
Arsenic (As)	mg/kg	0.05 - 0.15	0.25	5.03	4.07	Y	5%	4.78	5.08	Y	2%	3.59	1.85	Y	16%
Barium (Ba)	mg/kg	0.1 - 0.3	0.5	304	313	Y	1%	239	264	Y	2%	234	58.3	Y	30%
Beryllium (Be)	mg/kg	0.1 - 0.3	0.5	0.27	0.21	N	-	0.22	0.27	N	-	0.33	<0.10	N	-
Bismuth (Bi)	mg/kg	0.1 - 0.3	0.5	<0.25	<0.20	<DL	-	<0.10	<0.10	<DL	-	<0.10	<0.10	<DL	-
Boron (B)	mg/kg	2 - 6	10	10.4	11.5	N	-	10.2	12.5	Y	5%	190	2.5	Y	49%
Cadmium (Cd)	mg/kg	0.01 - 0.03	0.05	0.511	0.482	Y	1%	0.477	0.537	Y	3%	0.604	0.854	Y	9%
Calcium (Ca)	mg/kg	10 - 30	50	89,400	102,000	Y	3%	34,400	40,600	Y	4%	26,100	12,400	Y	18%
Chromium (Cr)	mg/kg	0.2 - 0.6	1	7.07	5.92	Y	4%	8.00	8.23	Y	1%	7.97	1.18	Y	37%
Cobalt (Co)	mg/kg	0.02 - 0.06	0.1	5.13	4.65	Y	2%	5.63	6.40	Y	3%	4.78	0.797	Y	36%
Copper (Cu)	mg/kg	0.05 - 0.15	0.25	8.29	7.35	Y	3%	9.15	10.3	Y	3%	11.3	13.4	Y	4%
Iron (Fe)	mg/kg	10 - 30	50	15,900	12,700	Y	6%	15,900	16,900	Y	2%	12,200	1,800	Y	37%
Lead (Pb)	mg/kg	0.01 - 0.03	0.05	6.35	4.66	Y	8%	4.75	6.29	Y	7%	6.02	0.814	Y	38%
Magnesium (Mg)	mg/kg	10 - 30	50	19,200	20,200	Y	1%	5,060	5,340	Y	1%	5,680	4,090	Y	8%
Manganese (Mn)	mg/kg	0.1 - 0.3	0.5	1,010	1,150	Y	3%	1,120	1,090	Y	1%	452	130	Y	28%
Mercury (Hg)	mg/kg	0.01 - 0.03	0.05	0.042	0.038	N	-	0.042	0.044	N	-	0.062	0.146	Y	20%
Molybdenum (Mo)	mg/kg	0.05 - 0.15	0.25	0.76	0.55	Y	8%	1.02	1.03	Y	0%	0.714	0.441	Y	12%
Nickel (Ni)	mg/kg	0.05 - 0.15	0.25	14.2	11.1	Y	6%	15.3	18.7	Y	5%	14.8	4.25	Y	28%
Phosphorus (P)	mg/kg	10 - 30	50	823	802	Y	1%	914	998	Y	2%	815	2,540	Y	26%
Potassium (K)	mg/kg	10 - 30	50	1,010	984	Y	1%	993	1,050	Y	1%	1,060	18,200	Y	44%
Selenium (Se)	mg/kg	0.05 - 0.15	0.25	0.95	1.07	Y	3%	1.18	1.24	Y	1%	1.30	1.11	Y	4%
Silver (Ag)	mg/kg	0.02 - 0.06	0.1	0.285	0.163	Y	14%	0.139	0.192	Y	8%	0.113	0.033	Y	27%
Sodium (Na)	mg/kg	10 - 30	50	140	94	Y	10%	94	82	Y	3%	103	617	Y	36%
Strontium (Sr)	mg/kg	0.1 - 0.3	0.5	69.8	67.7	Y	1%	45.2	49.3	Y	2%	38.6	25.5	Y	10%
Thallium (Tl)	mg/kg	0.002 - 0.006	0.01	0.0908	0.0812	Y	3%	0.0872	0.0914	Y	1%	0.0986	0.0325	Y	25%
Tin (Sn)	mg/kg	0.1 - 0.3	0.5	0.55	0.42	N	-	0.45	0.51	Y	3%	0.18	<0.10	N	-
Titanium (Ti)	mg/kg	1 - 3	5	37.3	27.7	N	-	31.0	31.6	N	-	13.8	7.5	Y	15%
Uranium (U)	mg/kg	0.002 - 0.006	0.01	0.334	0.305	Y	2%	0.481	0.459	Y	1%	0.455	0.113	Y	30%
Vanadium (V)	mg/kg	0.2 - 0.6	1	17.1	12.3	Y	8%	18.5	17.4	Y	2%	16.1	4.54	Y	28%
Zinc (Zn)	mg/kg	0.2 - 0.6	1	73.7	51.0	Y	9%	67.3	77.1	Y	3%	59.4	94.5	Y	11%

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 6-4

Stream Benthic Invertebrate Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011 and 2012

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Appendix 6-4. Stream Benthic Invertebrate Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2011

Sample ID				M20-04			
Replicate				1	2		
Lab Sample ID		2011 DL		CB5519	CB5520	>5x DL?	
Date Sampled	Units	min. DL	5x min. DL	25-Aug-11	25-Aug-11	Y/N/<DL	RPD
Total Metals							
Aluminum (Al)	mg/kg	0.5 - 5	2.5	42	104	Y	21%
Antimony (Sb)	mg/kg	0.001 - 0.01	0.005	0.013	0.013	Y	0%
Arsenic (As)	mg/kg	0.01 - 0.1	0.05	<0.06	0.07	<DL	-
Barium (Ba)	mg/kg	0.02 - 0.2	0.1	7.6	14.1	Y	15%
Beryllium (Be)	mg/kg	0.02 - 0.2	0.1	<0.1	<0.08	<DL	-
Bismuth (Bi)	mg/kg	0.02 - 0.2	0.1	<0.1	<0.08	<DL	-
Boron (B)	mg/kg	0.4 - 4	2	3	4	Y	7%
Cadmium (Cd)	mg/kg	0.002 - 0.02	0.01	0.11	0.226	Y	17%
Calcium (Ca)	mg/kg	2 - 20	10	1,500	1,390	Y	2%
Chromium (Cr)	mg/kg	0.04 - 0.4	0.2	<0.2	<0.2	<DL	-
Cobalt (Co)	mg/kg	0.004 - 0.04	0.02	0.190	0.23	Y	5%
Copper (Cu)	mg/kg	0.01 - 0.8	0.05	1.77	1.9	Y	2%
Iron (Fe)	mg/kg	2 - 20	10	98	191	Y	16%
Lead (Pb)	mg/kg	0.002 - 0.02	0.01	0.12	0.186	Y	11%
Magnesium (Mg)	mg/kg	2 - 20	10	111	118	Y	2%
Manganese (Mn)	mg/kg	0.02 - 0.2	0.1	24	29.4	Y	5%
Mercury (Hg)	mg/kg	0.004 - 0.1	0.02	<0.07	<0.04	<DL	-
Molybdenum (Mo)	mg/kg	0.01 - 0.1	0.05	0.09	0.0900	Y	0%
Nickel (Ni)	mg/kg	0.01 - 0.1	0.05	1.28	0.9	Y	9%
Phosphorus (P)	mg/kg	2 - 20	10	698.000	289	Y	21%
Potassium (K)	mg/kg	2 - 20	10	18	50	Y	24%
Selenium (Se)	mg/kg	0.01 - 0.1	0.05	0.28	0.34	Y	5%
Silver (Ag)	mg/kg	0.004 - 0.04	0.02	<0.02	<0.02	<DL	-
Sodium (Na)	mg/kg	2 - 200	10	<10	<200	<DL	-
Strontium (Sr)	mg/kg	0.02 - 0.2	0.1	3.4	2.95	Y	4%
Thallium (Tl)	mg/kg	0.0004 - 0.004	0.002	<0.002	0.004	<DL	-
Tin (Sn)	mg/kg	0.02 - 0.2	0.1	<0.1	<0.08	<DL	-
Titanium (Ti)	mg/kg	0.2 - 2	1	<1	2.4	<DL	-
Uranium (U)	mg/kg	0.0004 - 0.004	0.002	0.025	0.046	Y	15%
Vanadium (V)	mg/kg	0.04 - 0.4	0.2	0.2	0.4	Y	17%
Zinc (Zn)	mg/kg	0.04 - 3	0.2	28.3	29	Y	1%

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = one or both replicates were below detection limit

Appendix 6-4. Stream Benthic Invertebrate Tissue Metal Analytical Results of Replicates, Murray River Coal Project, 2012

Sample ID				M19-01			
Replicate				1	2		
Lab Sample ID		2012 DL		EJ8136	EJ8139	>5x DL?	
Date Sampled	Units	min. DL	5x min. DL	31-Aug-12	31-Aug-12	Y/N/<DL	RPD
Total Metals							
Aluminum (Al)	mg/kg	0.2 - 1.4	1	225	400	Y	14%
Antimony (Sb)	mg/kg	0.001 - 0.007	0.005	0.0109	0.0174	Y	11%
Arsenic (As)	mg/kg	0.01 - 0.07	0.05	0.130	0.219	Y	13%
Barium (Ba)	mg/kg	0.02 - 0.14	0.1	13.4	23.0	Y	13%
Beryllium (Be)	mg/kg	0.02 - 0.14	0.1	<0.020	<0.040	<DL	-
Bismuth (Bi)	mg/kg	0.02 - 0.14	0.1	<0.020	<0.040	<DL	-
Boron (B)	mg/kg	0.4 - 2.8	2	0.41	<0.80	<DL	-
Cadmium (Cd)	mg/kg	0.002 - 0.014	0.01	1.09	1.53	Y	8%
Calcium (Ca)	mg/kg	2 - 14	10	1,180	1,810	Y	11%
Chromium (Cr)	mg/kg	0.04 - 0.28	0.2	0.404	0.722	Y	14%
Cobalt (Co)	mg/kg	0.004 - 0.028	0.02	0.450	0.628	Y	8%
Copper (Cu)	mg/kg	0.01 - 0.07	0.05	7.24	7.02	Y	1%
Iron (Fe)	mg/kg	2 - 14	10	476	834	Y	14%
Lead (Pb)	mg/kg	0.002 - 0.014	0.01	0.213	0.380	Y	14%
Magnesium (Mg)	mg/kg	2 - 14	10	407	606	Y	10%
Manganese (Mn)	mg/kg	0.02 - 0.14	0.1	31.8	54.5	Y	13%
Mercury (Hg)	mg/kg	0.002 - 0.014	0.01	0.0147	0.0290	Y	16%
Molybdenum (Mo)	mg/kg	0.01 - 0.07	0.05	0.129	0.171	Y	7%
Nickel (Ni)	mg/kg	0.01 - 0.07	0.05	0.510	0.905	Y	14%
Phosphorus (P)	mg/kg	2 - 14	10	1,120	1,390	Y	5%
Potassium (K)	mg/kg	2 - 14	10	196	301	Y	11%
Selenium (Se)	mg/kg	0.01 - 0.07	0.05	0.660	0.752	Y	3%
Silver (Ag)	mg/kg	0.004 - 0.028	0.02	0.0243	0.0283	Y	4%
Sodium (Na)	mg/kg	2 - 14	10	64.1	76.3	Y	4%
Strontium (Sr)	mg/kg	0.02 - 0.14	0.1	2.26	3.52	Y	11%
Thallium (Tl)	mg/kg	0.0004 - 0.0028	0.02	0.00757	0.0130	N	-
Tin (Sn)	mg/kg	0.02 - 0.14	0.1	0.098	<0.040	<DL	-
Titanium (Ti)	mg/kg	0.02 - 0.14	0.1	5.69	7.26	Y	6%
Uranium (U)	mg/kg	0.0004 - 0.0028	0.02	0.0225	0.0394	Y	14%
Vanadium (V)	mg/kg	0.04 - 0.28	0.2	0.832	1.55	Y	15%
Zinc (Zn)	mg/kg	0.04 - 0.28	0.2	39.1	47.8	Y	5%

Notes:

All parameters analyzed by Maxxam Analytical

DL = detection limit; RPD = relative percent difference

< indicate the value was less than the detection limited indicated

Dashes indicate RPD not calculated because values <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = one or both replicates were below detection limit

Appendix 7-1

Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

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Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		REF		LW4	LW11	RW3
Date Sampled		17-Aug-10	17-Aug-10	17-Aug-10	18-Aug-10	19-Aug-10
Lab Sample ID	Units	L922661-2	L922661-40	L922661-1	L922661-3	L922661-6
Physical Tests						
Colour, True	CU	18.1	23.7	25.6	13.1	31.7
Conductivity	µS/cm	483	481	390	1660	381
Hardness (as $CaCO_3$)	mg/L	263	259	205	827	196
pH	pH	8.10	8.07	8.05	8.06	8.13
Total Suspended Solids	mg/L	6.8	20.3	94.8	6.7	4.3
Total Dissolved Solids	mg/L	278	271	225	1360	236
Turbidity	NTU	5.89	15.0	7.19	1.52	1.74
Anions and Nutrients						
Acidity (as $CaCO_3$)	mg/L	4.9	4.9	4.9	6.1	3.8
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	282	285	217	232	219
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	282	285	217	232	219
Ammonia (as N)	mg/L	0.0100	0.0206	0.0199	0.0253	0.167
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	3.39	2.20	<0.50
Fluoride (F)	mg/L	0.070	0.107	0.061	0.292	0.082
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.230	0.200	3.09	0.360	0.640
Total Nitrogen	mg/L	0.230	0.200	3.09	0.360	0.640
Orthophosphate-Dissolved (as P)	mg/L	-	-	-	-	-
Phosphorus-Total Dissolved	mg/L	-	-	-	-	-
Phosphorus-Total	mg/L	0.0232	0.0336	0.171	0.0247	0.0285
Sulphate (SO_4)	mg/L	<0.50	<0.50	0.68	798	2.80
Cyanides						
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	-	0.0011	<0.0010	0.0010
Cyanide, Total	mg/L	0.0052	-	0.0181	0.0053	0.0083
Organic Carbon						
Total Organic Carbon	mg/L	8.12	8.19	41.2	6.27	16.2

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		REF		LW4	LW 11	RW3
Date Sampled		17-Aug-10	17-Aug-10	17-Aug-10	18-Aug-10	19-Aug-10
Lab Sample ID	Units	L922661-2	L922661-40	L922661-1	L922661-3	L922661-6
Total Metals						
Aluminum (Al)	mg/L	0.771	0.151	0.178	0.129	0.0046
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00013	<0.00010
Arsenic (As)	mg/L	0.00119	0.00087	0.00052	0.00073	0.00017
Barium (Ba)	mg/L	0.265	0.242	0.346	0.0484	0.136
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.017	0.017	0.013	0.070	0.014
Cadmium (Cd)	mg/L	0.000048	<0.000010	0.000064	0.000039	<0.000010
Calcium (Ca)	mg/L	70.6	65.4	58.0	139	52.6
Chromium (Cr)	mg/L	0.00107	0.00019	0.00042	0.00025	<0.00010
Cobalt (Co)	mg/L	0.00065	0.00022	0.00033	0.00084	<0.00010
Copper (Cu)	mg/L	0.00164	0.00055	0.00100	0.00059	<0.00030
Iron (Fe)	mg/L	1.77	0.838	3.73	0.554	0.171
Lead (Pb)	mg/L	0.000720	0.000227	0.000471	0.000187	<0.000050
Lithium (Li)	mg/L	0.0113	0.0110	0.0059	0.118	0.0061
Magnesium (Mg)	mg/L	25.1	23.6	19.5	121	16.1
Manganese (Mn)	mg/L	0.132	0.0856	0.102	0.230	0.0473
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.00110	0.00108	0.000387	0.00246	0.000093
Nickel (Ni)	mg/L	0.00290	0.00125	0.00177	0.00532	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	1.05	0.825	0.330	4.40	0.587
Selenium (Se)	mg/L	0.00017	0.00014	0.00042	0.00036	<0.00010
Silicon (Si)	mg/L	4.78	4.18	4.93	2.61	2.86
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	6.3	6.5	2.9	86.4	6.5
Strontium (Sr)	mg/L	0.314	0.322	0.150	1.52	0.146
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.015	0.010	<0.010	0.012	<0.010
Uranium (U)	mg/L	0.000261	0.000252	0.000127	0.00374	0.000039
Vanadium (V)	mg/L	0.0020	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0055	0.0014	0.0076	0.0040	<0.0010

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		REF		LW4	LW 11	RW3
Date Sampled		17-Aug-10	17-Aug-10	17-Aug-10	18-Aug-10	19-Aug-10
Lab Sample ID	Units	L922661-2	L922661-40	L922661-1	L922661-3	L922661-6
Dissolved Metals						
Aluminum (Al)	mg/L	0.0015	0.0011	0.0011	<0.0010	<0.0010
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00066	0.00059	0.00020	0.00061	0.00013
Barium (Ba)	mg/L	0.223	0.226	0.225	0.0404	0.133
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.015	0.016	<0.010	0.069	0.013
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	0.000011	<0.000010
Calcium (Ca)	mg/L	66.8	65.7	51.2	137	52.0
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	0.00017	<0.00010
Copper (Cu)	mg/L	<0.00040	<0.00030	<0.00040	<0.00020	<0.00010
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	0.036
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0107	0.0110	0.0061	0.116	0.0060
Magnesium (Mg)	mg/L	23.4	23.1	18.7	118	16.0
Manganese (Mn)	mg/L	0.0205	0.0102	0.000607	0.158	0.0274
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.00116	0.00116	0.000202	0.00235	0.000086
Nickel (Ni)	mg/L	0.00152	0.00107	0.00110	0.00371	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.793	0.778	0.143	4.45	0.577
Selenium (Se)	mg/L	0.00012	0.00011	0.00011	0.00020	<0.00010
Silicon (Si)	mg/L	3.80	3.78	4.47	2.31	2.80
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	6.4	6.2	2.8	87.3	6.4
Strontium (Sr)	mg/L	0.313	0.319	0.132	1.52	0.143
Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000240	0.000244	0.000057	0.00369	0.000040
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0010	<0.0010	0.0020	<0.0010	<0.0010

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.0						
Date Sampled		28-May-12	26-Jun-12	23-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	28-Dec-12
Lab Sample ID	Units	L1154387-7	L1169751-13	L1184612-13	L1197851-6	L1228768-6	L1243937-12	L1251738-5
Physical Tests								
Colour, True	CU	10.7	12.5	17.0	18.5	14.9	13.0	36.5
Conductivity	µS/cm	405	390	378	339	385	484	535
Hardness (as $CaCO_3$)	mg/L	212	209	213	198	203	276	294
pH	pH	8.22	8.30	8.22	8.26	8.27	7.86	7.74
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	8.0	9.0
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-
Turbidity	NTU	0.31	0.44	0.48	0.85	1.15	4.58	11.8
Anions and Nutrients								
Acidity (as $CaCO_3$)	mg/L	2.3	<1.0	2.2	1.1	2.1	5.9	11.4
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	224	219	226	207	213	282	301
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	224	219	226	207	213	282	301
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0067	<0.0050	0.111	0.474
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.054
Chloride (Cl)	mg/L	2.61	2.50	2.66	3.24	7.54	8.45	8.57
Fluoride (F)	mg/L	0.070	0.073	0.078	0.078	0.079	0.089	0.077
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.496
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0029
Total Kjeldahl Nitrogen	mg/L	<0.050	0.100	0.090	0.340	0.220	0.762	1.32
Total Nitrogen	mg/L	<0.050	0.100	0.090	0.340	0.220		1.22
Orthophosphate-Dissolved (as P)	mg/L	0.0016	<0.0010	<0.0010	<0.0010	0.0021	0.0010	0.0083
Phosphorus-Total Dissolved	mg/L	0.0033	0.0033	0.0043	0.0046	0.0045	0.0026	0.0278
Phosphorus-Total	mg/L	0.0059	0.0055	0.0076	0.0113	0.0129	0.0354	0.111
Sulphate (SO_4)	mg/L	8.79	7.52	2.68	1.74	5.32	1.55	1.13
Cyanides								
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon								
Total Organic Carbon	mg/L	3.66	3.84	5.03	5.94	5.86	6.65	15.4

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.0						
Date Sampled		28-May-12	26-Jun-12	23-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	28-Dec-12
Lab Sample ID	Units	L1154387-7	L1169751-13	L1184612-13	L1197851-6	L1228768-6	L1243937-12	L1251738-5
Total Metals								
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0061	0.0074	0.0033	0.0058	0.0071
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.00011	<0.00010	0.00014	0.00016	0.00011	0.00016	0.00016
Barium (Ba)	mg/L	0.203	0.215	0.245	0.227	0.198	0.260	0.310
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.012	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000018	<0.000010
Calcium (Ca)	mg/L	62.5	59.0	56.4	50.7	58.9	73.2	80.3
Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	0.00078	0.00012
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00105	0.00057
Iron (Fe)	mg/L	0.050	0.044	0.159	0.154	0.103	1.07	3.28
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	0.000150	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00425	0.00433	0.00427	0.00488	0.00658	0.00678	0.00734
Magnesium (Mg)	mg/L	14.8	15.8	15.2	17.1	16.5	21.7	19.0
Manganese (Mn)	mg/L	0.00414	0.00283	0.0201	0.0114	0.00457	0.181	0.405
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000608	0.000481	0.000392	0.000251	0.000396	0.000178	0.000094
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.501	0.281	0.298	0.304	1.60	1.44	2.17
Selenium (Se)	mg/L	0.00012	<0.00010	0.00013	0.00012	<0.00010	<0.00010	0.00013
Silicon (Si)	mg/L	2.35	2.39	3.46	4.01	5.69	7.12	8.43
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000293
Sodium (Na)	mg/L	2.5	2.6	2.7	2.9	4.2	5.0	5.1
Strontium (Sr)	mg/L	0.119	0.118	0.129	0.117	0.123	0.148	0.147
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	0.010
Uranium (U)	mg/L	0.000287	0.000192	0.000104	0.000073	0.000117	0.000073	0.000027
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0059	<0.0030

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.0						
Date Sampled		28-May-12	26-Jun-12	23-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12	28-Dec-12
Lab Sample ID	Units	L1154387-7	L1169751-13	L1184612-13	L1197851-6	L1228768-6	L1243937-12	L1251738-5
Dissolved Metals								
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0032	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	0.00011	0.00011	<0.00010	0.00012	0.00016
Barium (Ba)	mg/L	0.213	0.212	0.244	0.215	0.195	0.236	0.378
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010
Calcium (Ca)	mg/L	58.8	57.9	59.7	51.7	54.4	74.5	82.8
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0138	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	0.00011
Copper (Cu)	mg/L	0.00062	<0.00050	0.00062	<0.00050	<0.00050	0.00132	0.00056
Iron (Fe)	mg/L	<0.030	<0.030	0.086	0.065	<0.030	1.07	3.03
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000066	0.000073	0.000050	<0.000050
Lithium (Li)	mg/L	0.00416	0.00421	0.00482	0.00533	0.00644	0.00709	0.00771
Magnesium (Mg)	mg/L	15.7	15.6	15.6	16.7	16.3	21.8	21.1
Manganese (Mn)	mg/L	0.00450	0.00235	0.0178	0.00675	0.00307	0.178	0.485
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000540	0.000453	0.000367	0.000223	0.000365	0.00489	<0.000050
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00110	<0.00050
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.577	0.276	0.312	0.284	1.54	1.49	2.28
Selenium (Se)	mg/L	0.00011	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	0.00023
Silicon (Si)	mg/L	2.29	2.37	3.43	4.14	5.54	7.18	8.84
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	3.7	2.6	3.7	3.7	4.2	6.5	6.5
Strontium (Sr)	mg/L	0.114	0.110	0.126	0.118	0.110	0.144	0.152
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000264	0.000170	0.000099	0.000059	0.000091	0.000069	0.000023
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010
Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0031	0.0067	0.0032

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Shaded cells indicate the dissolved concentration exceeded the total concentration (confirmed by re-analysis)

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.3					
Date Sampled		28-May-12	26-Jun-12	24-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12
Lab Sample ID	Units	L1154387-6	L1169751-14	L1184612-12	L1197851-5	L1228768-5	L1243937-13
Physical Tests							
Colour, True	CU	<5.0	5.4	6.6	10.4	16.5	29.2
Conductivity	µS/cm	411	398	361	315	254	464
Hardness (as $CaCO_3$)	mg/L	214	216	188	178	132	260
pH	pH	8.19	8.31	8.36	8.41	8.34	7.76
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	7.4	20.7
Total Dissolved Solids	mg/L	-	-	-	-	-	-
Turbidity	NTU	0.36	0.62	0.62	1.36	4.22	12.8
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	3.1	<1.0	<1.0	<1.0	<1.0	7.6
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	225	226	220	184	140	272
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	<1.0	<1.0	<1.0	2.6	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	225	226	220	185	143	272
Ammonia (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0082	0.0078	0.794
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	2.15	2.13	1.95	1.95	2.05	2.48
Fluoride (F)	mg/L	0.067	0.071	0.068	0.070	0.067	0.041
Nitrate (as N)	mg/L	0.0232	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	0.095	0.070	0.390	0.320	2.34
Total Nitrogen	mg/L	0.050	0.100	0.070	0.390	0.320	
Orthophosphate-Dissolved (as P)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010
Phosphorus-Total Dissolved	mg/L	<0.0020	0.0024	0.0037	0.0035	0.0055	0.0190
Phosphorus-Total	mg/L	0.0031	0.0042	0.0052	0.0076	0.0206	0.161
Sulphate (SO_4)	mg/L	10.2	9.38	8.54	6.01	3.97	1.75
Cyanides							
Cyanide, Weak Acid Dissociable	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon							
Total Organic Carbon	mg/L	2.63	3.14	3.75	5.41	7.46	28.1

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.3					
Date Sampled		28-May-12	26-Jun-12	24-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12
Lab Sample ID	Units	L1154387-6	L1169751-14	L1184612-12	L1197851-5	L1228768-5	L1243937-13
Total Metals							
Aluminum (Al)	mg/L	0.0054	0.0156	0.0107	0.0363	0.0701	0.0667
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011
Arsenic (As)	mg/L	0.00011	<0.00010	0.00011	0.00019	0.00030	0.00043
Barium (Ba)	mg/L	0.188	0.211	0.192	0.196	0.108	0.225
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.010	<0.010	0.011	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000012	0.000014	<0.000010	0.000027	0.000010	0.000068
Calcium (Ca)	mg/L	62.6	61.1	52.5	47.4	31.2	67.3
Chromium (Cr)	mg/L	0.00012	0.00014	0.00012	0.00014	0.00017	0.00022
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	0.00117	<0.00050	0.00094
Iron (Fe)	mg/L	0.037	0.061	0.049	0.156	0.143	0.695
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000078	0.000342	0.000179
Lithium (Li)	mg/L	0.00369	0.00376	0.00321	0.00375	0.00389	0.00423
Magnesium (Mg)	mg/L	15.5	16.4	14.6	17.2	15.6	21.5
Manganese (Mn)	mg/L	0.00680	0.00789	0.00626	0.00724	0.00488	0.234
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000522	0.000556	0.000492	0.000516	0.000664	0.000304
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00054	<0.00050	0.00070
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.541	0.546	0.459	0.759	0.462	1.48
Selenium (Se)	mg/L	0.00039	0.00036	0.00024	0.00024	0.00032	0.00064
Silicon (Si)	mg/L	2.20	2.24	2.41	4.15	8.82	11.3
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000012
Sodium (Na)	mg/L	2.4	2.5	2.4	2.6	2.8	3.5
Strontium (Sr)	mg/L	0.115	0.112	0.113	0.107	0.0830	0.135
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.012	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000352	0.000338	0.000306	0.000290	0.000374	0.000330
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0035	<0.0030	0.0057

Appendix 7-1. Wetland Water Quality Analytical Results, Murray River Coal Project, 2010 and 2012

Sample ID		W9.3					
Date Sampled		28-May-12	26-Jun-12	24-Jul-12	20-Aug-12	22-Oct-12	28-Nov-12
Lab Sample ID	Units	L1154387-6	L1169751-14	L1184612-12	L1197851-5	L1228768-5	L1243937-13
Dissolved Metals							
Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0035	<0.0030	<0.0030	0.0035
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	<0.00010	<0.00010	0.00013	0.00013	0.00027	0.00034
Barium (Ba)	mg/L	0.188	0.199	0.186	0.181	0.104	0.212
Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	0.000011
Calcium (Ca)	mg/L	59.6	60.8	50.9	44.8	27.6	68.7
Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010
Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00085	0.00071	0.00069	<0.00050	<0.00050	0.00108
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.402
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000060
Lithium (Li)	mg/L	0.00376	0.00395	0.00373	0.00397	0.00345	0.00451
Magnesium (Mg)	mg/L	15.8	15.7	14.9	16.1	15.4	21.5
Manganese (Mn)	mg/L	0.00681	0.00685	0.00222	0.00268	0.00179	0.227
Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000506	0.000545	0.000457	0.000482	0.000555	0.000225
Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00069
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.618	0.546	0.480	0.448	0.415	1.48
Selenium (Se)	mg/L	0.00040	0.00032	0.00025	0.00024	0.00033	0.00061
Silicon (Si)	mg/L	2.18	2.14	2.45	3.97	8.60	11.1
Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	3.9	3.4	3.5	3.0	2.8	5.8
Strontium (Sr)	mg/L	0.111	0.113	0.112	0.105	0.0735	0.143
Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	<0.010	0.011	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000300	0.000309	0.000278	0.000233	0.000266	0.000278
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0043	<0.0030	<0.0030	<0.0030	0.0034	0.0046

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 7-2

Wetland Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010

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Appendix 7-2. Wetland Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010

Sample ID		TRAVEL BLANK	FIELD BLANK
Date Sampled		17-Aug-10	17-Aug-10
Lab Sample ID	Units	L922661-4	L922661-5
Physical Tests			
Colour, True	CU	<5.0	-
Conductivity	µS/cm	<2.0	-
Hardness (as $CaCO_3$)	mg/L	-	<0.50
pH	pH	5.87	-
Total Suspended Solids	mg/L	<3.0	-
Total Dissolved Solids	mg/L	<10	-
Turbidity	NTU	<0.10	-
Anions and Nutrients			
Acidity (as $CaCO_3$)	mg/L	2.7	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<2.0	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<2.0	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	<2.0	-
Alkalinity, Total (as $CaCO_3$)	mg/L	<2.0	-
Ammonia (as N)	mg/L	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	-
Chloride (Cl)	mg/L	<0.50	-
Fluoride (F)	mg/L	<0.020	-
Nitrate (as N)	mg/L	<0.0050	-
Nitrite (as N)	mg/L	<0.0010	-
Total Kjeldahl Nitrogen	mg/L	<0.050	-
Total Nitrogen	mg/L	<0.050	<0.050
Phosphorus-Total	mg/L	<0.0020	-
Sulphate (SO_4)	mg/L	<0.50	-
Cyanides			
Cyanide, Weak Acid Dissociable	mg/L	-	<0.0010
Cyanide, Total	mg/L	-	<0.0010
Organic Carbon			
Total Organic Carbon	mg/L	<0.50	1.71
Total Metals			
Aluminum (Al)	mg/L	-	<0.0010
Antimony (Sb)	mg/L	-	<0.00010
Arsenic (As)	mg/L	-	<0.00010
Barium (Ba)	mg/L	-	<0.000050
Beryllium (Be)	mg/L	-	<0.00050
Bismuth (Bi)	mg/L	-	<0.00050
Boron (B)	mg/L	-	<0.010
Cadmium (Cd)	mg/L	-	<0.000010
Calcium (Ca)	mg/L	-	<0.020
Chromium (Cr)	mg/L	-	<0.00010
Cobalt (Co)	mg/L	-	<0.00010
Copper (Cu)	mg/L	-	<0.00010
Iron (Fe)	mg/L	-	<0.030
Lead (Pb)	mg/L	-	<0.000050
Lithium (Li)	mg/L	-	<0.0050
Magnesium (Mg)	mg/L	-	0.0056
Manganese (Mn)	mg/L	-	<0.000050
Mercury (Hg)	mg/L	-	<0.000010
Molybdenum (Mo)	mg/L	-	<0.000050
Nickel (Ni)	mg/L	-	<0.00050
Phosphorus (P)	mg/L	-	<0.30

Appendix 7-2. Wetland Water Quality Analytical Results of Travel and Field Blanks, Murray River Coal Project, 2010

Sample ID		TRAVEL BLANK	FIELD BLANK
Date Sampled		17-Aug-10	17-Aug-10
Lab Sample ID	Units	L922661-4	L922661-5
Total Metals (cont'd)			
Potassium (K)	mg/L	-	<0.050
Selenium (Se)	mg/L	-	<0.00010
Silicon (Si)	mg/L	-	<0.050
Silver (Ag)	mg/L	-	<0.000010
Sodium (Na)	mg/L	-	<2.0
Strontium (Sr)	mg/L	-	<0.00010
Thallium (Tl)	mg/L	-	<0.00010
Tin (Sn)	mg/L	-	<0.00010
Titanium (Ti)	mg/L	-	<0.010
Uranium (U)	mg/L	-	<0.000010
Vanadium (V)	mg/L	-	<0.0010
Zinc (Zn)	mg/L	-	<0.0010
Dissolved Metals			
Aluminum (Al)	mg/L	-	<0.0010
Antimony (Sb)	mg/L	-	<0.00010
Arsenic (As)	mg/L	-	<0.00010
Barium (Ba)	mg/L	-	<0.000050
Beryllium (Be)	mg/L	-	<0.00050
Bismuth (Bi)	mg/L	-	<0.00050
Boron (B)	mg/L	-	<0.010
Cadmium (Cd)	mg/L	-	<0.000010
Calcium (Ca)	mg/L	-	<0.020
Chromium (Cr)	mg/L	-	<0.00010
Cobalt (Co)	mg/L	-	<0.00010
Copper (Cu)	mg/L	-	<0.00010
Iron (Fe)	mg/L	-	<0.030
Lead (Pb)	mg/L	-	<0.000050
Lithium (Li)	mg/L	-	<0.0050
Magnesium (Mg)	mg/L	-	<0.0050
Manganese (Mn)	mg/L	-	<0.000050
Mercury (Hg)	mg/L	-	<0.000010
Molybdenum (Mo)	mg/L	-	<0.000050
Nickel (Ni)	mg/L	-	<0.00050
Phosphorus (P)	mg/L	-	<0.30
Potassium (K)	mg/L	-	<0.050
Selenium (Se)	mg/L	-	<0.00010
Silicon (Si)	mg/L	-	<0.050
Silver (Ag)	mg/L	-	<0.000010
Sodium (Na)	mg/L	-	<2.0
Strontium (Sr)	mg/L	-	<0.00010
Thallium (Tl)	mg/L	-	<0.00010
Tin (Sn)	mg/L	-	<0.00010
Titanium (Ti)	mg/L	-	<0.010
Uranium (U)	mg/L	-	<0.000010
Vanadium (V)	mg/L	-	<0.0010
Zinc (Zn)	mg/L	-	<0.0010

Notes:

All parameters analyzed by ALS Environmental

< = less than the detection limit

Dashes indicate parameter not analyzed

Appendix 7-3

Wetland Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010

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Appendix 7-3. Wetland Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010

Sample ID				REF			
Date Sampled		2010 DL		17-Aug-10	17-Aug-10	>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L922661-2	L922661-40	Y/N/<DL	RPD
Physical Tests							
Colour, True	CU	5	25	18.1	23.7	N	-
Conductivity	µS/cm	2	10	483	481	Y	0%
Hardness (as $CaCO_3$)	mg/L	0.5	2.5	263	259	Y	0%
pH	pH	0.1	0.5	8.10	8.07	Y	0%
Total Suspended Solids	mg/L	3 - 5	15	6.8	20.3	Y	25%
Total Dissolved Solids	mg/L	10 - 20	50	278	271	Y	1%
Turbidity	NTU	0.1	0.5	5.89	15.0	Y	22%
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	1	5	4.9	4.9	N	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	2	10	282	285	Y	0%
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	2	10	<2.0	<2.0	<DL	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	2	10	<2.0	<2.0	<DL	-
Alkalinity, Total (as $CaCO_3$)	mg/L	2	10	282	285	Y	0%
Ammonia (as N)	mg/L	0.005	0.025	0.0100	0.0206	N	-
Bromide (Br)	mg/L	0.05	0.25	<0.050	<0.050	<DL	-
Chloride (Cl)	mg/L	0.5	2.5	<0.50	<0.50	<DL	-
Fluoride (F)	mg/L	0.02	0.1	0.070	0.107	Y	10%
Nitrate (as N)	mg/L	0.005	0.025	<0.0050	<0.0050	<DL	-
Nitrite (as N)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-
Total Kjeldahl Nitrogen	mg/L	0.05 - 0.5	0.25	0.230	0.200	N	-
Total Nitrogen	mg/L	0.05 - 0.5	0.25	0.230	0.200	N	-
Phosphorus-Total	mg/L	0.002	0.01	0.0232	0.0336	Y	9%
Sulphate (SO_4)	mg/L	0.5 - 5	2.5	<0.50	<0.50	<DL	-
Cyanides							
Cyanide, Weak Acid Dissociable	mg/L	0.001	0.005	<0.0010	-	<DL	-
Cyanide, Total	mg/L	0.001	0.005	0.0052	-	Y	-
Organic Carbon							
Total Organic Carbon	mg/L	0.5	2.5	8.12	8.19	Y	0%
Total Metals							
Aluminum (Al)	mg/L	0.001	0.005	0.771	0.151	Y	34%
Antimony (Sb)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.0001	0.0005	0.00119	0.00087	Y	8%
Barium (Ba)	mg/L	0.00005	0.00025	0.265	0.242	Y	2%
Beryllium (Be)	mg/L	0.00005	0.00025	<0.00050	<0.00050	<DL	-
Bismuth (Bi)	mg/L	0.0005	0.0025	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01	0.05	0.017	0.017	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	0.000048	<0.000010	N	-
Calcium (Ca)	mg/L	0.02	0.1	70.6	65.4	Y	2%
Chromium (Cr)	mg/L	0.0001	0.0005	0.00107	0.00019	Y	35%
Cobalt (Co)	mg/L	0.0001	0.0005	0.00065	0.00022	Y	25%
Copper (Cu)	mg/L	0.0001 - 0.0003	0.0005	0.00164	0.00055	Y	25%
Iron (Fe)	mg/L	0.03	0.15	1.77	0.838	Y	18%
Lead (Pb)	mg/L	0.00005	0.00025	0.000720	0.000227	Y	26%
Lithium (Li)	mg/L	0.005	0.025	0.0113	0.0110	N	-
Magnesium (Mg)	mg/L	0.005	0.025	25.1	23.6	Y	2%
Manganese (Mn)	mg/L	0.00005	0.00025	0.132	0.0856	Y	11%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.00110	0.00108	Y	0%
Nickel (Ni)	mg/L	0.0005	0.0025	0.00290	0.00125	Y	20%
Phosphorus (P)	mg/L	0.3	1.5	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05	0.25	1.05	0.825	Y	6%
Selenium (Se)	mg/L	0.0001	0.0005	0.00017	0.00014	N	-
Silicon (Si)	mg/L	0.05	0.25	4.78	4.18	Y	3%

Appendix 7-3. Wetland Water Quality Replication Percent Difference Results, Murray River Coal Project, 2010

Sample ID				REF			
Date Sampled		2010 DL		17-Aug-10	17-Aug-10	>5x DL?	
Lab Sample ID	Units	min. DL	5x min. DL	L922661-2	L922661-40	Y/N/<DL	RPD
Total Metals (cont'd)							
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	2	10	6.3	6.5	N	-
Strontium (Sr)	mg/L	0.0001	0.0005	0.314	0.322	Y	1%
Thallium (Tl)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Tin (Sn)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01	0.05	0.015	0.010	N	-
Uranium (U)	mg/L	0.00001	0.00005	0.000261	0.000252	Y	1%
Vanadium (V)	mg/L	0.001	0.005	0.0020	<0.0010	N	-
Zinc (Zn)	mg/L	0.001	0.005	0.0055	0.0014	Y	30%
Dissolved Metals							
Aluminum (Al)	mg/L	0.001	0.005	0.0015	0.0011	N	-
Antimony (Sb)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Arsenic (As)	mg/L	0.0001	0.0005	0.00066	0.00059	Y	3%
Barium (Ba)	mg/L	0.00005	0.00025	0.223	0.226	Y	0%
Beryllium (Be)	mg/L	0.00005	0.00025	<0.00050	<0.00050	<DL	-
Bismuth (Bi)	mg/L	0.0005	0.0025	<0.00050	<0.00050	<DL	-
Boron (B)	mg/L	0.01	0.05	0.015	0.016	N	-
Cadmium (Cd)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-
Calcium (Ca)	mg/L	0.02	0.1	66.8	65.7	Y	0%
Chromium (Cr)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Cobalt (Co)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Copper (Cu)	mg/L	0.0001 - 0.0004	0.0005	<0.00040	<0.00030	<DL	-
Iron (Fe)	mg/L	0.03	0.15	<0.030	<0.030	<DL	-
Lead (Pb)	mg/L	0.00005	0.00025	<0.000050	<0.000050	<DL	-
Lithium (Li)	mg/L	0.005	0.025	0.0107	0.0110	N	-
Magnesium (Mg)	mg/L	0.005	0.025	23.4	23.1	Y	0%
Manganese (Mn)	mg/L	0.00005	0.00025	0.0205	0.0102	Y	17%
Mercury (Hg)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-
Molybdenum (Mo)	mg/L	0.00005	0.00025	0.00116	0.00116	Y	0%
Nickel (Ni)	mg/L	0.0005	0.0025	0.00152	0.00107	N	-
Phosphorus (P)	mg/L	0.3	1.5	<0.30	<0.30	<DL	-
Potassium (K)	mg/L	0.05	0.25	0.793	0.778	Y	0%
Selenium (Se)	mg/L	0.0001	0.0005	0.00012	0.00011	N	-
Silicon (Si)	mg/L	0.05	0.25	3.80	3.78	Y	0%
Silver (Ag)	mg/L	0.00001	0.00005	<0.000010	<0.000010	<DL	-
Sodium (Na)	mg/L	2	10	6.4	6.2	Y	1%
Strontium (Sr)	mg/L	0.0001	0.0005	0.313	0.319	Y	0%
Thallium (Tl)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Tin (Sn)	mg/L	0.0001	0.0005	<0.00010	<0.00010	<DL	-
Titanium (Ti)	mg/L	0.01	0.05	<0.010	<0.010	<DL	-
Uranium (U)	mg/L	0.00001	0.00005	0.000240	0.000244	Y	0%
Vanadium (V)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-
Zinc (Zn)	mg/L	0.001	0.005	<0.0010	<0.0010	<DL	-

Notes:

All parameters analyzed by ALS Environmental

DL = detection limit; RPD = relative percent difference

< indicate at least one value was less than the DL or values were below DL

Dashes indicate parameter not analyzed or RPD not calculated because values are <5 DL

Y = yes at least one replicate is greater than five times the minimum detection limit; N = no replicates are greater than five times the minimum detection limit; <DL = both replicates were below detection limit

Shaded values indicate RPD greater than 20%

Appendix 8-1

Wetland Sediment Quality Analytical Results, Murray River Coal Project, 2010

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Appendix 8-1. Wetland Sediment Quality Analytical Results, Murray River Coal Project, 2010

Sample ID		REF			LW11			RW3		
Replicate		SED 01	SED 02	SED 03	SED 01	SED 02	SED 03	SED 01	SED 02	SED 03
Date Sampled		17-Aug-10	17-Aug-10	17-Aug-10	18-Aug-10	18-Aug-10	18-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10
Lab Sample ID	Units	L922661-7	L922661-8	L922661-9	L922661-10	L922661-11	L922661-12	L922661-13	L922661-14	L922661-15
Particle Size										
Gravel (>2mm)	%	11.9	<0.10	3.14	<0.10	5.66	<0.10	-	-	-
Sand (2.0mm - 0.063mm)	%	44.6	46.4	27.6	14.7	30.4	11.3	-	-	-
Silt (0.063mm - 4µm)	%	36.7	46.7	64.3	82.6	60.9	73.7	-	-	-
Clay (<4µm)	%	6.78	6.89	5.03	2.65	3.05	15.0	-	-	-
Leachable Nutrients										
Total Nitrogen	%	0.122	0.216	0.320	0.678	0.520	0.566	2.28	2.14	2.16
Organic Carbon										
Total Organic Carbon	%	2.30	4.18	6.63	8.96	7.35	8.01	39.3	39.0	37.5
Plant Available Nutrients										
Available Phosphate	mg/kg	<2.0	<2.0	<2.0	<8.0	<2.7	<2.0	59.2	32.9	<10
Available Sulphate	mg/kg	26.1	30.6	36.2	2220	3030	2900	522	334	372
Metals										
Aluminum (Al)	mg/kg	8900	9750	7650	5000	3530	3570	690	1400	1270
Antimony (Sb)	mg/kg	0.49	0.35	0.32	1.02	0.74	0.86	0.18	0.20	0.19
Arsenic (As)	mg/kg	8.88	6.57	5.38	3.88	2.97	2.82	1.12	1.22	1.03
Barium (Ba)	mg/kg	198	305	253	193	253	260	217	183	226
Beryllium (Be)	mg/kg	0.63	0.64	0.56	0.34	0.27	0.25	<0.10	<0.10	<0.10
Bismuth (Bi)	mg/kg	0.19	0.19	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)	mg/kg	0.705	1.06	0.891	1.53	1.53	1.19	0.252	0.333	0.249
Calcium (Ca)	mg/kg	25400	22300	15600	181000	251000	217000	58100	34700	38800
Chromium (Cr)	mg/kg	16.8	17.6	14.6	9.4	6.8	6.5	1.6	2.8	3.6
Cobalt (Co)	mg/kg	10.7	9.88	7.92	25.9	23.0	23.1	1.36	1.57	1.26
Copper (Cu)	mg/kg	24.7	24.9	20.5	14.5	12.2	11.1	4.04	5.36	6.84
Iron (Fe)	mg/kg	27300	23600	19200	13100	11600	10000	7560	7550	7400
Lead (Pb)	mg/kg	17.2	13.7	11.2	6.37	5.19	4.81	2.93	2.51	2.97
Magnesium (Mg)	mg/kg	7390	6410	4880	9840	9210	8610	2940	2870	2830
Manganese (Mn)	mg/kg	432	637	326	938	1000	947	349	245	244
Mercury (Hg)	mg/kg	0.0499	0.0785	0.0726	0.0428	0.0344	0.0305	0.0694	0.0638	0.0610
Molybdenum (Mo)	mg/kg	1.34	0.76	0.73	9.48	4.41	6.63	1.30	1.37	0.99
Nickel (Ni)	mg/kg	30.9	31.0	26.3	66.9	50.5	61.6	5.35	6.40	6.01
Phosphorus (P)	mg/kg	734	852	730	736	644	573	1110	906	956

Appendix 8-1. Wetland Sediment Quality Analytical Results, Murray River Coal Project, 2010

Sample ID		REF			LW11			RW3		
Replicate		SED 01	SED 02	SED 03	SED 01	SED 02	SED 03	SED 01	SED 02	SED 03
Date Sampled		17-Aug-10	17-Aug-10	17-Aug-10	18-Aug-10	18-Aug-10	18-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10
Lab Sample ID	Units	L922661-7	L922661-8	L922661-9	L922661-10	L922661-11	L922661-12	L922661-13	L922661-14	L922661-15
Metals *(cont'd)*										
Potassium (K)	mg/kg	1140	1270	1020	1150	890	870	290	250	330
Selenium (Se)	mg/kg	0.59	1.06	0.94	6.57	5.89	5.41	1.31	1.77	1.16
Silver (Ag)	mg/kg	0.193	0.297	0.242	0.138	0.103	0.101	<0.050	0.055	0.053
Sodium (Na)	mg/kg	240	120	<100	1270	720	590	250	190	410
Strontium (Sr)	mg/kg	56.0	67.3	51.8	712	976	888	99.5	68.8	80.0
Sulfur (S)-Total	mg/kg	350	490	730	8700	8400	8500	20600	14100	12100
Thallium (Tl)	mg/kg	<0.10	<0.10	<0.10	0.27	0.22	0.21	<0.10	<0.10	<0.10
Tin (Sn)	mg/kg	0.39	0.26	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	0.30
Titanium (Ti)	mg/kg	45.4	35.3	30.3	32.6	18.2	23.6	8.2	18.0	21.9
Uranium (U)	mg/kg	0.614	0.569	0.536	9.58	4.11	6.74	0.489	0.613	0.338
Vanadium (V)	mg/kg	30.5	30.1	25.7	18.9	14.0	14.3	2.7	4.5	3.9
Zinc (Zn)	mg/kg	91.8	96.3	83.4	119	118	96.5	32.6	40.4	32.7

Notes:

All parameters analyzed by ALS Environmental

< indicate the value was less than the detection limit

Dashes indicate parameter not analyzed

Appendix 8-2

Wetland Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

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Appendix 8-2. Wetland Sediment Quality Analytical Results of Laboratory Replicates, Murray River Coal Project, 2010

Lab Sample ID	ALS ID	Analyte	Units	Replicate 1	Replicate 2	RPD	RPD Limit	Diff	Diff Limit	Qualifier
Particle Size										
L922661-7	WG1162935-1	% Gravel (>2mm)	%	11.9	11.9	0.0	25	-	-	-
L922661-7	WG1162935-1	% Sand (2.0mm - 0.063mm)	%	44.6	46.8	-	-	2.17	6.3	J
L922661-7	WG1162935-1	% Silt (0.063mm - 4µm)	%	36.7	34.9	-	-	1.81	5	J
L922661-7	WG1162935-1	% Clay (<4µm)	%	6.78	6.42	-	-	0.36	5	J
Organic / Inorganic Carbon										
L922661-11	WG1154898-1	Total Organic Carbon	%	7.35	7.45	1.4	30	-	-	-
Metals										
L922661-10	WG1154723-8	Aluminum (Al)	mg/kg	5000	4970	0.64	39	-	-	-
L922661-10	WG1154723-8	Antimony (Sb)	mg/kg	1.02	1.02	0.56	39	-	-	-
L922661-10	WG1154723-8	Arsenic (As)	mg/kg	3.88	3.76	3.1	39	-	-	-
L922661-10	WG1154723-8	Barium (Ba)	mg/kg	193	234	19	39	-	-	-
L922661-10	WG1154723-8	Beryllium (Be)	mg/kg	0.34	0.34	-	-	0.00	0.4	J
L922661-10	WG1154723-8	Bismuth (Bi)	mg/kg	<0.10	<0.10	N/A	39	-	-	RPD-NA
L922661-10	WG1154723-8	Cadmium (Cd)	mg/kg	1.53	1.60	4.4	39	-	-	-
L922661-10	WG1154723-8	Calcium (Ca)	mg/kg	181000	193000	6.9	39	-	-	-
L922661-10	WG1154723-8	Chromium (Cr)	mg/kg	9.4	9.6	-	-	0.2	4	J
L922661-10	WG1154723-8	Cobalt (Co)	mg/kg	25.9	27.4	5.4	39	-	-	-
L922661-10	WG1154723-8	Copper (Cu)	mg/kg	14.5	15.3	5.3	39	-	-	-
L922661-10	WG1154723-8	Iron (Fe)	mg/kg	13100	13700	3.9	39	-	-	-
L922661-10	WG1154723-8	Lead (Pb)	mg/kg	6.37	6.46	1.5	39	-	-	-
L922661-10	WG1154723-8	Magnesium (Mg)	mg/kg	9840	10200	3.1	39	-	-	-
L922661-10	WG1154723-8	Manganese (Mn)	mg/kg	938	1000	6.7	39	-	-	-
L922661-10	WG1154723-8	Mercury (Hg)	mg/kg	0.0428	0.0410	-	-	0.0018	0.02	J
L922661-10	WG1154723-8	Molybdenum (Mo)	mg/kg	9.48	9.65	1.7	39	-	-	-
L922661-10	WG1154723-8	Nickel (Ni)	mg/kg	66.9	70.5	5.3	39	-	-	-
L922661-10	WG1154723-8	Phosphorus (P)	mg/kg	736	697	5.6	39	-	-	-
L922661-10	WG1154723-8	Potassium (K)	mg/kg	1150	1130	1.3	39	-	-	-
L922661-10	WG1154723-8	Selenium (Se)	mg/kg	6.57	6.74	2.6	39	-	-	-
L922661-10	WG1154723-8	Silver (Ag)	mg/kg	0.138	0.134	-	-	0.004	0.2	J
L922661-10	WG1154723-8	Sodium (Na)	mg/kg	1270	1280	1.1	39	-	-	-
L922661-10	WG1154723-8	Strontium (Sr)	mg/kg	712	732	2.8	39	-	-	-
L922661-11	WG1161643-1	Sulfur (S)-Total	mg/kg	8400	8400	0.59	30	-	-	-
L922661-10	WG1154723-8	Thallium (Tl)	mg/kg	0.27	0.27	-	-	0.00	0.4	J
L922661-10	WG1154723-8	Tin (Sn)	mg/kg	<0.20	<0.20	N/A	39	-	-	RPD-NA
L922661-10	WG1154723-8	Titanium (Ti)	mg/kg	32.6	31.7	2.7	39	-	-	-
L922661-10	WG1154723-8	Uranium (U)	mg/kg	9.58	9.76	1.8	39	-	-	-
L922661-10	WG1154723-8	Vanadium (V)	mg/kg	18.9	19.3	-	-	0.4	8	J
L922661-10	WG1154723-8	Zinc (Zn)	mg/kg	119	125	5.4	39	-	-	-

Notes:

Samples analyzed by ALS Environmental

RPD = relative percent difference calculated when values were >10x DL

N/A = at least one value <DL

Diff = difference between the replicate values in concentration units, used where replicate 1 value is <10x DL

RPD-NA = relative percent difference not available due to results being less than DL

J = duplicate results and limits are expressed in terms of absolute difference

Appendix 9-1

Wetland Phytoplankton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010

Rescan™
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Appendix 9-1. Wetland Phytoplankton Biomass (as chl *a*) Analytical Results, Murray River Coal Project, 2010

Sample ID	Replicate	Date Sampled	Lab Sample ID	Chlorophyll *a* (µg/L)
REF	1	17-Aug-10	L922661-19	8.61
	2	17-Aug-10	L922661-20	9.84
	3	17-Aug-10	L922661-21	6.88
LW4	1	17-Aug-10	L922661-16	13.50
	2	17-Aug-10	L922661-17	19.30
	3	17-Aug-10	L922661-18	51.70
LW11	1	18-Aug-10	L922661-22	4.14
	2	18-Aug-10	L922661-23	2.59
	3	18-Aug-10	L922661-24	3.59
RW3	1	19-Aug-10	L922661-25	3.80
	2	19-Aug-10	L922661-26	2.22
	3	19-Aug-10	L922661-27	3.08

Notes:

All samples analyzed by ALS Environmental

Each replicate was analyzed from a 1L sample

Appendix 9-2

Wetland Phytoplankton Taxonomic Results, Murray River Coal Project, 2010

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Appendix 9-2. Wetland Phytoplankton Taxonomic Results, Murray River Coal Project, 2010

Sample ID					REF			LW4			LW11			RW3		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					17-Aug-10			17-Aug-10			18-Aug-10			19-Aug-10		
Lab Sample ID					100246	100247	100248	100243	100244	100245	100249	100250	100251	100252	100253	100254
Phylum	Class	Order	Family	Taxa												
Ochrophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	*Achnanthes minutissima*	0	0	0	28.4	<28.4	0	0	0	0	0	0	0
				Achnanthes spp.	<1.4	<1.4	0	28.4	0	<28.4	0	0	0	0	<2.8	0
			Cocconeidaceae	*Cocconeis placentula*	0	0	0	<28.4	0	<28.4	12.6	5.6	9.8	<2.8	0	<2.8
				Cocconeis spp.	0	0	0	<28.4	0	0	<1.4	0	<1.4	0	0	0
		Bacillariales	Bacillariaceae	*Nitzschia* spp.	<1.4	<1.4	0	<28.4	<28.4	<28.4	2.8	<1.4	1.4	<2.8	8.4	<2.8
				Nitzschia ?	<1.4	0	0	0	<28.4	0	0	0	0	0	0	0
		Cymbellales	Cymbellaceae	*Cymbella* spp.	<1.4	<1.4	<1.4	85.2	56.8	28.4	<1.4	<1.4	<1.4	<2.8	<2.8	<2.8
			Gomphonemataceae	*Gomphonema olivaceum*	0	0	0	0	0	0	0	<1.4	0	0	0	0
				Gomphonema spp.	<1.4	<1.4	<1.4	113.6	28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
			Rhoicospheniaceae	*Rhoicosphenia curvata*	0	0	0	0	0	0	<1.4	7.0	<1.4	0	0	0
		Eunotiales	Eunotiaceae	*Eunotia* spp.	0	0	0	<28.4	<28.4	0	0	<1.4	0	<2.8	<2.8	<2.8
		Fragilariales	Fragilariaceae	*Ceratoneis*	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Diatoma elongatum	0	0	0	0	0	0	<1.4	0	0	0	0	0
				Diatoma spp.	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Fragilaria crotonensis	0	0	0	28.4	113.6	198.8	16.8	57.4	29.4	0	0	<2.8
				Fragilaria spp.	0	0	0	227.2	0	0	0	<1.4	<1.4	<2.8	<2.8	0
				Synedra ulna	0	0	0	<28.4	28.4	<28.4	<1.4	0	0	0	0	0
				Synedra spp.	0	0	0	<28.4	<28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
			Stauroneidaceae	*Stauroneis* spp.	<1.4	0	0	<28.4	0	0	0	1.4	<1.4	0	0	<2.8
		Naviculales	Amphipleuraceae	*Amphipleura pellucida*	<1.4	<1.4	0	113.6	<28.4	56.8	0	0	0	<2.8	0	<2.8
				Frustulia spp.	0	0	0	<28.4	0	0	0	<1.4	0	0	0	<2.8
			Naviculaceae	*Navicula spp.*	<1.4	<1.4	<1.4	113.6	28.4	28.4	<1.4	<1.4	<1.4	<2.8	<2.8	<2.8
			Pinnulariaceae	*Pinnularia* spp.	<1.4	0	0	28.4	85.2	<28.4	0	1.4	0	0	0	0
			Pleurosigmataceae	*Pleurosigma / Gyrosigma* spp.	<1.4	<1.4	<1.4	0	0	0	0	0	0	0	0	0
		Rhopalodiales	Rhopalodiaceae	*Epithemia* spp.	<1.4	<1.4	<1.4	28.4	<28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
				Epithemia turgida	<1.4	<1.4	<1.4	85.2	56.8	28.4	<1.4	<1.4	<1.4	<2.8	0	<2.8
				Rhopalodia spp.	4.2	1.4	<1.4	28.4	<28.4	28.4	0	1.4	0	0	0	0
		Surirellales	Surirellaceae	*Cymatopleura* spp.	<1.4	0	0	0	0	0	0	0	0	0	0	0
				Surirella spp.	0	0	0	0	0	0	0	0	0	0	0	<2.8
		Tabellariales	Tabellariaceae	*Tabellaria fenestrata*	0	0	0	0	0	0	0	0	0	0	<2.8	0
		Thalassiophysales	Catenulaceae	*Amphora ovalis*	0	0	<1.4	0	0	0	0	0	0	0	0	0
				Amphora spp.	<1.4	<1.4	0	<28.4	0	<28.4	0	<1.4	0	<2.8	<2.8	<2.8
		Thalassiosirales	Stephanodiscaceae	*Cyclotella* spp.	0	0	0	0	<28.4	0	0	0	0	0	0	0
	Chrysophyceae	Chromulinales	Chrysococcaceae	*Kephyrion / Pseudokephyrion* spp.	19.6	<1.4	14.0	<28.4	0	<28.4	0	0	0	0	<2.8	<2.8
		Ochromonadales	Dinobryaceae	*Dinobryon cf sertularia*	16.8	12.6	9.8	0	1,988.0	284.0	0	0	0	0	0	0
				Dinobryon spp.	8.4	5.6	2.8	0	0	<28.4	0	0	0	0	0	0
	Synurophyceae	Synurales	Mallomonadaceae	*Synura* spp.	0	0	0	0	0	0	<1.4	0	0	0	<2.8	0
	Xanthohyceae	Mischococcales	Ophiocytaceae	*Ophiocytium* spp.	0	0	0	0	<28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
				UID Bacillariophyceae	4.2	2.8	<1.4	28.4	28.4	28.4	<1.4	7.0	4.2	<2.8	<2.8	<2.8
Chlorophyta	Chlorophyceae	Chaetophorales	Selenastraceae	*Ankistrodesmus* spp.	0	0	<1.4	85.2	170.4	28.4	<1.4	2.8	2.8	78.4	53.2	109.2
				Selenastrum spp.	0	0	0	0	0	0	0	0	0	0	0	<2.8
		Chlorococcales	Chlorococcaceae	*Schroederia* spp.	0	0	0	0	0	0	0	0	0	0	<2.8	0
				Tetraedron caudatum	0	0	0	0	0	28.4	0	0	0	0	0	<2.8
				Tetraedron minimum	0	0	0	0	<28.4	0	0	0	0	0	0	0
				Tetraedron spp.	0	0	0	28.4	<28.4	0	0	0	0	<2.8	<2.8	0
			Coccomyxaceae	*Gloeocystis cf. ampla*	0	0	0	681.6	681.6	<28.4	0	0	0	<2.8	<2.8	<2.8

Appendix 9-2. Wetland Phytoplankton Taxonomic Results, Murray River Coal Project, 2010

Sample ID					REF			LW4			LW11			RW3		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					17-Aug-10			17-Aug-10			18-Aug-10			19-Aug-10		
Lab Sample ID					100246	100247	100248	100243	100244	100245	100249	100250	100251	100252	100253	100254
Phylum	Class	Order	Family	Taxa												
Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	*Botryococcus braunii*	0	0	0	<28.4	<28.4	<28.4	<1.4	0	<1.4	<2.8	<2.8	<2.8
		Oedogoniales	Oedogoniaceae	*Bulbochaete* spp.	0	0	0	<28.4	<28.4	<28.4	0	0	0	0	0	0
				Oedogonium spp.	0	0	0	170.4	<28.4	<28.4	<1.4	2.8	<1.4	<2.8	<2.8	<2.8
		Sphaeropleales	Hydrodictyaceae	*Pediastrum duplex*	0	0	0	0	<28.4	0	0	0	0	0	0	0
				Pediastrum spp.	0	0	0	<28.4	0	<28.4	0	0	0	<2.8	<2.8	22.4
				Pediastrum tetras	0	0	0	0	0	<28.4	0	0	0	0	0	0
		Sphaeropleales	Scenedesmaceae	*Crucigenia quadrata*	0	0	0	0	0	0	0	0	0	0	0	22.4
				Crucigenia rectangularis	0	0	0	0	1,817.6	<28.4	<1.4	<1.4	<1.4	0	0	0
				Elakatothrix gelatinosa	0	0	0	0	28.4	<28.4	0	<1.4	<1.4	0	0	0
				Scenedesmus cf denticulatus	<1.4	<1.4	11.2	284.0	113.6	113.6	11.2	11.2	11.2	11.2	0	11.2
				Scenedesmus quadricauda	0	0	0	<28.4	<28.4	0	0	0	0	0	<2.8	<2.8
				Scenedesmus spp.	0	0	0	<28.4	113.6	<28.4	<1.4	2.8	5.6	<2.8	<2.8	<2.8
		Tetrasporales	Palmellopsidiaceae	*Sphaerocystis schroeteri*	0	0	0	340.8	<28.4	<28.4	0	0	0	44.8	246.4	112.0
		Volvocales	Volvocaceae	*Volvox* spp.	0	0	0	0	170.4	<28.4	0	0	0	0	0	0
	Trebouxiophyceae	Oocystales	Oocystaceae	*Closteriopsis longissima*	0	0	0	<28.4	<28.4	<28.4	<1.4	1.4	<1.4	<2.8	<2.8	0
				Closteriopsis spp.	0	0	<1.4	0	0	0	0	0	0	0	0	0
				Closteriopsis ?	<1.4	<1.4	0	0	0	28.4	<1.4	<1.4	<1.4	<2.8	<2.8	<2.8
				Nephrocytium limneticum	0	0	0	0	<28.4	0	0	0	0	0	0	0
				Nephrocytium spp.	0	0	0	0	<28.4	0	0	<1.4	0	<2.8	<2.8	0
				Oocystis spp.	0	0	0	0	<28.4	0	0	0	0	<2.8	<2.8	22.4
				Quadrigula closterioides	0	0	0	0	<28.4	0	0	0	0	0	0	0
	Ulvophyceae	Ulotrichales	Ulotrichaceae	*Ulothrix* spp.	0	0	<1.4	0	0	<28.4	0	0	0	0	0	0
				UID Ulotrichales	0	0	0	0	<28.4	<28.4	0	0	0	0	0	<2.8
Charophyta	Conjugophyceae	Desmidiales	Closteriaceae	*Closterium* spp.	<1.4	<1.4	<1.4	28.4	56.8	<28.4	2.8	<1.4	1.4	<2.8	<2.8	<2.8
			Desmidiaceae	*Arthrodesmus* spp.	0	0	0	28.4	<28.4	<28.4	0	0	0	0	<2.8	0
				Cosmarium spp.	0	0	0	56.8	28.4	<28.4	0	<1.4	<1.4	<2.8	<2.8	<2.8
				Euastrum spp.	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Pleurotaenium spp.	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Spondylosium planum	0	0	0	0	28.4	<28.4	0	0	0	<2.8	<2.8	<2.8
				Staurastrum cf. paradoxum	0	0	0	0	<28.4	28.4	0	0	0	0	0	0
				Staurastrum spp.	0	0	0	56.8	0	<28.4	0	0	0	<2.8	<2.8	<2.8
				Xanthidium spp.	0	0	0	0	0	0	0	0	0	0	0	<2.8
			Gonatozygaceae	*Gonatozygon*	<1.4	0	0	<28.4	28.4	<28.4	0	0	0	0	0	0
		Zygnematales	Zygnemataceae	*Mougeotia ?*	0	<1.4	0	0	<28.4	28.4	<1.4	0	<1.4	0	0	0
				Mougeotia spp.	0	0	<1.4	85.2	28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
				Spirogyra spp.	0	0	0	<28.4	312.4	28.4	0	5.6	2.8	0	0	0
				Zygnema spp.	0	0	0	0	0	0	<1.4	0	0	0	0	0
				UID Zygnematales	<1.4	0	0	0	<28.4	<28.4	<1.4	0	<1.4	0	<2.8	0
Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas ovata / erosa*	179.2	141.4	114.8	56.8	85.2	539.6	197.4	172.2	184.8	61.6	70.0	106.4
				Cryptomonas spp.	8.4	<1.4	<1.4	28.4	<28.4	56.8	<1.4	4.2	4.2	<2.8	<2.8	2.8
		Pyrenomonadales	Chroomonadaceae	*Chroomonas acuta*	33.6	33.6	26.6	0	170.4	113.6	113.4	46.2	84.0	428.4	380.8	543.2
Cyanobacteria	Cyanophyceae	Chroococcales	Gomphospaeriaceae	*Gomphosphaeria aponina*	0	0	0	0	<28.4	0	0	0	0	0	0	0
				Anacystis aeruginosa	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Anacystis cf. limneticus	0	0	0	227.2	0	0	0	0	0	0	0	0
				Anacystis elachista	0	0	0	0	<28.4	0	0	<1.4	0	0	0	0
				Anacystis spp.	0	0	0	<28.4	<28.4	<28.4	<1.4	<1.4	<1.4	<2.8	0	<2.8

Appendix 9-2. Wetland Phytoplankton Taxonomic Results, Murray River Coal Project, 2010

Sample ID					REF			LW4			LW11			RW3		
Replicate					1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled					17-Aug-10			17-Aug-10			18-Aug-10			19-Aug-10		
Lab Sample ID					100246	100247	100248	100243	100244	100245	100249	100250	100251	100252	100253	100254
Phylum	Class	Order	Family	Taxa												
Cyanobacteria	Cyanophyceae	Chroococcales	Stichosiphonaceae	*Stichosiphon* spp.	0	0	0	0	0	0	0	0	0	0	0	<2.8
		Nostocales	Nostocaceae	*Anabaena* spp.	<1.4	<1.4	<1.4	<28.4	284.0	0	176.4	260.4	224.0	<2.8	84.0	0
				UID Nostocales	0	0	0	0	0	0	0	<1.4	0	0	0	0
		Oscillatoriales	Oscillatoriaceae	*Lyngbya birgei*	<1.4	<1.4	0	852.0	<28.4	<28.4	0	0	0	<2.8	210.0	33.6
				Lyngbya limnetica	<1.4	<1.4	<1.4	<28.4	852.0	454.4	64.4	154.0	91.0	<2.8	14.0	42.0
				Lyngbya spp.	0	0	0	<28.4	0	0	0	0	0	0	0	0
				Oscillatoria cf tenuis	0	0	<1.4	0	<28.4	1,278.0	<1.4	<1.4	<1.4	<2.8	<2.8	<2.8
				Oscillatoria spp.	0	<1.4	0	<28.4	<28.4	<28.4	<1.4	25.2	<1.4	<2.8	<2.8	<2.8
		Oscillatoriales	Pseudanabaenoidae	*Pseudanabaena* spp.	0	0	0	0	0	<28.4	<1.4	<1.4	<1.4	0	0	0
				Spirulina spp.	0	0	0	56.8	<28.4	0	<1.4	2.8	<1.4	0	0	<2.8
		Synechococcales	Chamaesiphonaceae	*Chaemosiphon* spp.	0	0	0	<28.4	<28.4	0	0	0	0	0	0	0
		Synechococcales	Merismopediaceae	*Agmenellum* spp.	0	0	0	<28.4	0	0	0	0	0	0	0	0
				UID Synechoccales	0	0	0	0	<28.4	0	0	0	0	0	0	0
Pyrrhophyta	Dinophyceae	Dinotrichales	Dinotrichaceae	*Gymnodinium* spp.	47.6	44.8	47.6	<28.4	<28.4	113.6	<1.4	1.4	1.4	0	<2.8	0
		Gonyaulacales	Ceratiaceae	*Ceratium hirundinella*	0	0	0	<28.4	<28.4	<28.4	0	0	0	0	0	0
				Ceratium spp.	0	0	0	0	<28.4	<28.4	0	0	0	0	0	0
		Peridiniales	Peridiniaceae	*Peridinium / Glenodinium* spp.	2.8	5.6	1.4	28.4	28.4	<28.4	<1.4	<1.4	<1.4	0	0	0
				Peridinium cf inconspicuum	5.6	0	0	0	28.4	28.4	14.0	2.8	9.8	0	0	0
				UID Dinophyceae	310.8	231.0	170.8	<28.4	<28.4	28.4	0	0	0	0	0	0
Euglenophyta	Euglenophyceae	Euglenales	Euglenaceae	*Euglena ?*	0	0	0	0	28.4	0	0	0	0	<2.8	<2.8	<2.8
			Euglenaceae	*Euglena* spp.	11.2	9.8	8.4	<28.4	<28.4	28.4	2.8	<1.4	1.4	0	0	0
				Trachelomonas spp.	4.2	5.6	<1.4	28.4	28.4	56.8	0	0	0	0	0	0
			Phacaceae	*Phacus* spp.	<1.4	<1.4	0	28.4	<28.4	0	0	0	0	0	0	0
				UID colonial algae	0	0	0	227.2	<28.4	<28.4	0	0	0	0	0	0
				UID filamentous algae	<1.4	0	0	0	<28.4	0	<1.4	0	<1.4	<2.8	0	<2.8
				UID branched filamentous algae	0	0	0	0	<28.4	0	0	0	0	0	0	0
				UID unicellular algae	0	0	0	0	0	0	<1.4	0	<1.4	<2.8	0	<2.8
				UID cyst	0	0	0	0	0	<28.4	0	0	0	0	0	0

Note: Samples were identified by Fraser Environmental Services

Counts were standardized as cells/mL

Taxonomic names were confirmed using algaebase (AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 15 April 2013)

UID = unidentified

Appendix 10-1

Wetland Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

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Appendix 10-1. Wetland Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

					Sample ID	REF			LW11				RW3		
					Replicate	1	2	3	1	2		3	1	2	
					Date Sampled	17-Aug-10			18-Aug-10				19-Aug-10		
					Lab Sample ID	110093	110094	110095	110096	110097		110098	110099	110100	
					Fraction	212 µm	212 µm	212 µm	212 µm	4 mm	212 µm	212 µm	212 µm	2 mm	212 µm
					Percent Sampled	100	100	100	19	100	25	100	100	100	62.5
					Area Sampled (m^2)	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675
Phylum	**Class**	**Order**	**Family**	**Taxa**	**Stage**										
Arthropoda	Insecta	Ephemeroptera	Baetidae	*Callibaetis* sp.	nymph	0	0	1	5	2	9	17	2	0	0
				Baetidae	nymph (juv./dam.)	0	0	0	1	0	0	0	0	0	0
			Caenidae	*Caenis* sp.	nymph	0	0	0	3	0	11	9	54	3	17
			Heptageniidae	*Rhithrogena sp.*	nymph	0	1	0	0	0	0	0	0	0	0
			Leptophlebiidae	*Paraleptophlebia* sp.	nymph	0	1	0	0	0	0	1	0	0	0
				Leptophlebiidea	nymph (juv./dam.)	0	0	2	3	0	0	0	0	0	0
		Plecoptera	Capniidae	*Capnia* sp.	nymph	0	0	0	0	0	0	0	0	0	0
				Capniidae	nymph (juv./dam.)	1	0	0	0	0	0	0	0	0	0
			Leuctricdae	Leuctricdae	nymph (juv./dam.)	1	0	0	0	0	0	0	0	0	0
			Taeniopterygidae	Taeniopterygidae	nymph (juv./dam.)	2	0	0	0	0	0	0	0	0	0
		Trichoptera		Trichoptera	pupae	0	0	0	0	0	0	1	0	0	0
				Trichoptera	larvae (juv./dam.)	0	0	0	0	0	0	0	0	0	1
			Limnephilidae	*Glyphopsyche irrorata*	larvae	0	0	1	0	0	1	0	0	0	0
				Nemotaulius sp.	larvae	0	0	0	0	0	0	0	2	1	0
			Polycentropodidae	*Polycentropus* sp.	larvae	1	0	0	3	0	1	1	2	1	1
		Coleoptera	Dytiscidae	*Agabus* sp.	larvae	0	0	0	0	0	1	1	0	0	0
			Haliplidae	*Haliplus* sp.	larvae	0	0	0	6	2	6	19	3	0	1
				Peltodydes sp.	adult	0	0	0	0	1	0	0	0	0	0
				Peltodydes sp.	larvae	0	0	0	2	0	0	7	0	0	0
				Haliplidae	larvae (juv./dam.)	0	0	0	0	1	3	0	0	0	0
		Diptera		UID Diptera	larvae (juv./dam.)	0	1	0	0	0	0	0	0	0	0
			Ceratopogonidae	*Bezzia* sp.	larvae	1	0	0	5	0	7	12	1	1	3
				Culicoides sp.	larvae	0	0	0	0	0	0	0	2	0	17
				Probezzia sp.	larvae	1	2	0	0	0	0	1	2	1	0
			Chironomidae	Chironomidae	larvae	25	20	19	192	40	144	214	137	45	109
		Odonata	Aeshnidae	*Aeshna* sp.	larvae	0	0	0	1	0	0	1	0	0	0
			Corudliidae	Corudliidae	larvae	0	0	0	0	0	0	0	8	1	1
			Libellulidae	*Leucorrhinia* sp.	larvae	0	0	0	1	0	0	0	0	0	0
			Coenagrionidae	*Coenagrion / Enallagma* sp.	larvae	0	0	0	0	0	0	0	0	1	0
				Coenagrionidae	larvae	0	0	0	1	0	2	2	1	1	0
	Maxillopoda	Cyclopoida		Cycloipoda	-	0	0	0	2	0	0	0	0	0	0
	Malacostraca	Amphipoda	Gammaridae	*Gammarus* sp	-	0	0	0	3	0	0	4	0	0	0
			Hyalellidae	*Hyalella* sp.	-	0	0	0	6	2	21	40	107	29	27
	Branchiopoda	Diplostraca	Daphniidae	*Daphnia* spp.	-	0	0	0	2	0	4	4	2	0	0
	Ostracoda			Ostracoda	-	0	0	0	29	0	4	22	0	1	0
	Arachnida	Trombidiformes	Unioniculidae	*Neumania* sp.	adult	0	0	0	1	0	0	0	0	0	0
				Prostigmata	deutonymph	0	0	0	0	0	0	1	0	0	0
Mollusca	Bivalvia	Veneroida	Sphaeriidae	*Pisidium* sp.	-	0	0	0	0	0	0	0	12	5	6
				Sphaeriidae	-	2	2	2	0	0	1	2	19	0	14
	Gastropoda	Basommatophora	Physidae	*Physa* sp.	-	0	0	0	2	0	4	4	0	0	0
			Planorbidae	*Promenetus umbilicatellus*	-	0	0	0	19	0	30	45	1	1	0
				Planorbidae	-	0	0	1	13	0	0	9	0	1	1
		Heterostropha	Valvatidae	*Valvata sincera*	-	0	0	0	0	0	0	0	6	6	8
				Valvatidae	-	0	0	0	0	0	0	0	7	0	7
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	*Hydra* sp.	-	0	0	0	3	0	1	7	0	0	2

Appendix 10-1. Wetland Benthic Invertebrate Taxonomic Results, Murray River Coal Project, 2010

					Sample ID	REF			LW11				RW3		
					Replicate	1	2	3	1	2		3	1	2	
					Date Sampled	17-Aug-10			18-Aug-10				19-Aug-10		
					Lab Sample ID	110093	110094	110095	110096	110097		110098	110099	110100	
					Fraction	212 µm	212 µm	212 µm	212 µm	4 mm	212 µm	212 µm	212 µm	2 mm	212 µm
					Percent Sampled	100	100	100	19	100	25	100	100	100	62.5
					Area Sampled (m^2)	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675
Phylum	**Class**	**Order**	**Family**	**Taxa**	**Stage**										
Annelida	Hirudinea (subclass)	Rhynchobdellida	Glossiphoniidae	*Glossiphonia complanata*	-	0	1	0	0	0	0	0	0	0	0
				Placobdella sp.	-	66	0	0	0	0	0	0	0	0	0
				Glossiphoniidae	-	0	0	0	0	0	2	0	1	1	0
	Oligochaeta (subclass)	Haplotaxida	Enchytraeidae	*Enchytraeus* sp.	-	0	0	0	0	0	0	0	0	0	1
			Naididae	*Stylaria* sp.	-	0	0	0	0	0	3	27	0	0	0
				Naididae	-	0	0	0	0	0	0	5	4	1	3
	Oligochaeta (subclass)	Lumbriculida	Lumbriculidae	Lumbriculidae	-	0	0	0	23	5	9	20	3	2	0
Nemata				Nemata	-	0	0	0	0	0	0	0	1	0	0
				TOTAL		**100**	**28**	**26**	**326**	**53**	**264**	**476**	**377**	**102**	**219**

Notes: Samples collected using a Ekman grab and identified by Cordillera Consulting

Counts represent natural units and are not adjusted for subsampling

Each replicate was a composite of three subsamples. Total sampling area was 0.0225 m^2

Taxonomic names were confirmed using Integrated Taxonomic Information System (ITIS. World-wide electronic publication. http://www.itis.gov; searched on 25 April 2013)

juv. = juvenile; dam. = damaged

Dashes indicate no stage identified

Nemata, Cladocera, Copepoda, Ostracoda (Cycloipoda and Harpactocoida), and Platyhelminthes not included in figures or analyses

Appendix 11-1

Wetland Sedge Tissue Metal Analytical Results, Murray River Coal Project, 2010

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Appendix 11-1. Wetland Sedge Tissue Metal Analytical Results, Murray River Coal Project, 2010

Sample ID		REF			LW4			LW11			RW3		
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Lab Sample ID		L922661-28	L922661-29	L922661-30	L922661-37	L922661-38	L922661-39	L922661-31	L922661-32	L922661-33	L922661-34	L922661-35	L922661-36
Date Sampled	Units	17-Aug-10			19-Aug-10			18-Aug-10			19-Aug-10		
Physical Tests													
Moisture	%	69.2	71.0	69.7	62.8	64.0	63.4	54.3	61.6	58.4	64.6	65.8	65.7
Total Metals													
Aluminum (Al)	mg/kg	26.2	21.3	52.0	18.8	18.0	19.6	8.2	5.6	3.7	20.0	4.1	2.9
Antimony (Sb)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)	mg/kg	0.112	0.091	0.108	0.011	<0.010	<0.010	0.021	0.025	0.023	<0.010	<0.010	<0.010
Barium (Ba)	mg/kg	12.4	7.15	10.5	49.2	33.6	60.5	16.7	3.14	2.14	15.6	14.2	19.3
Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)	mg/kg	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)	mg/kg	0.0068	<0.0050	0.0082	<0.0050	<0.0050	<0.0050	0.0085	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)	mg/kg	1590	1060	991	2860	2260	2920	2090	868	946	2790	3180	2560
Chromium (Cr)	mg/kg	0.40	0.45	0.89	1.11	1.07	1.35	0.46	0.26	0.26	0.28	0.39	0.28
Cobalt (Co)	mg/kg	0.031	0.030	0.048	0.022	0.021	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)	mg/kg	0.408	0.430	4.41	0.802	0.698	1.38	4.37	0.744	0.672	1.21	0.447	0.409
Lead (Pb)	mg/kg	0.060	0.042	0.159	0.165	0.152	0.175	0.146	0.145	0.084	0.149	0.102	0.060
Lithium (Li)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.54	0.54	0.77	<0.10	<0.10	<0.10
Magnesium (Mg)	mg/kg	579	453	442	729	702	745	1100	576	578	1670	1620	1810
Manganese (Mn)	mg/kg	33.0	25.4	31.6	61.4	65.6	56.5	59.9	25.4	24.7	88.3	81.7	97.8
Mercury (Hg)	mg/kg	0.0012	0.0017	0.0015	0.0022	0.0020	0.0017	0.0025	0.0018	0.0020	0.0020	0.0022	0.0015
Molybdenum (Mo)	mg/kg	0.670	0.558	0.375	0.148	0.138	0.273	0.497	0.045	0.044	0.097	0.079	0.153
Nickel (Ni)	mg/kg	0.38	0.60	0.53	0.52	0.51	0.60	0.40	0.16	0.16	0.16	0.20	0.14
Selenium (Se)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.95	0.38	0.38	<0.20	<0.20	<0.20
Strontium (Sr)	mg/kg	5.77	3.81	4.26	5.36	4.12	5.63	17.6	8.03	6.96	9.66	10.4	9.42
Thallium (Tl)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)	mg/kg	0.12	<0.10	0.20	0.13	0.13	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)	mg/kg	3.94	4.51	3.24	5.65	4.46	7.30	15.6	5.34	4.77	8.52	6.56	9.75

Notes:

All parameters analyzed by ALS Environmental

Values represent milligrams of metal per kilogram (wet weight) of sedge tissue