TEC COAL PTY LTD

31 JANUARY 2019

CONFIDENTIAL

ENVIRONMENTAL INVESTIGATION REPORT

RESPONSE TO NOTICE REQUESTING FURTHER INFORMATION

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Environmental Investigation Report
Response to Notice Requesting Further Information

TEC Coal Pty Ltd

WSP
Level 3, Northbank Plaza,
69 Ann Street
Brisbane QLD 4000
GPO Box 2907
Brisbane QLD 4001

Tel: +61 7 3854 6200
Fax: +61 7 3854 6500
wsp.com

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GLOSSARY OF TERMS AND ACRONYMS

AMD	Acid and metalliferous drainage from mine waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity.
ANC	Acid-neutralising capacity: A measure of a sample's maximum potential ability to neutralise acid. Expressed as kg H_2SO_4 equivalent per tonne of sample
Appropriately qualified person	As defined in the Notice, a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relating to the subject matter using the relevant protocols, standards, methods or literature.
CHPP	Coal handling and preparation plant
Circum-neutral	A pH value that is close to neutral.
CRS	Chromium reducible sulfur
DES	Department of Environment and Science (Queensland)
DNRM	Department of Natural Resources and Mines (Queensland) (former)
DNRME	Department of Natural Resources, Mines and Energy (Queensland)
EA	Environmental Authority
EC	Electrical conductivity: The ability of water or soil solution to conduct an electrical current; a measure of salinity. Expressed as µS/cm.
EHP	Department of Environment and Heritage Protection (Queensland) (former)
EIR	Environmental Investigation Report
EP Act	*Environmental Protection Act 1994* (EP Act)
ESP	Ecological Service Professionals Pty Ltd
EV	Environmental Value: a) A quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation (Section 9: *Environmental Protection Act 1994*)
H_2SO_4	Sulfuric acid
HEV	High ecological value
KLC	Kinetic leach column: Procedure used to measure the geochemical / weathering behaviour of a sample of mine material over time.
LOR	Limit of reporting
NAF	Non-acid forming: Geochemical classification criterion for a sample that will not generate acid conditions.

NAG	Net acid generation
NAPP	Net acid producing potential: Calculated by subtracting the ANC from the MPA. Expressed as kg H_2SO_4 per tonne.
NPR	Neutralisation potential ratio
PAF	Potentially acid forming
PAF-LC	Potentially acid forming – Low capacity: material which has the potential to produce minor acid
pH	A measure of hydrogen ion (H^+) concentration; generally expressed as pH.
REMP	Receiving Environment Monitoring Program
S	Sulfur
TDS	Total dissolved solids
TEC	TEC Coal Pty Ltd, holder of the Meandu Mine Environmental Authority and wholly owned subsidiary of Stanwell Corporation Limited (Stanwell)
TSF	Tailings storage facility
WQIP	Water Quality Improvement Plan
WQOs	Water Quality Objectives: Long-term goals for water quality management. They are measures, levels or narrative statements of particular indicators of water quality that protect EVs. They define what the water quality should be to protect the Environmental Values – after consideration of the socio-economic assessment of protecting the water quality.

1 PROJECT BACKGROUND

1.1 INTRODUCTION

On 21 December 2016, the then Department of Environment and Heritage Protection (EHP) (now Department of Environment and Science (DES)) issued TEC Coal Pty LTD with a notice (DES reference CA34208) to conduct or commission an environmental evaluation under Section 326B of the *Environmental Protection Act 1994* (EP Act) (the Notice). TEC Coal Pty Ltd is a wholly owned subsidiary of Stanwell Corporation Limited (Stanwell). Stanwell is a Queensland Government Owned Corporation under the *Government Owned Corporations Act 1993* and registered under the *Corporations Act 2001*.

The grounds for the environmental evaluation related to the identification of acid and metalliferous drainage (AMD) at Meandu Mine and the potential for this AMD to cause environmental harm. As the full cause and extent of the AMD was unknown, EHP required that an environmental investigation be undertaken to determine whether environmental harm has resulted from AMD at the Meandu Mine.

To address the requirements of the Notice, Stanwell commissioned an Environmental and Engineering Evaluation into AMD at the Meandu Mine site (Environmental Investigation). The Environmental Investigation Report (EIR) was submitted to DES on 14 September 2014 (WSP Australia Ref: PS102396-ENV-REP-001 REV B (the EIR)) and incorporated studies across a range of technical disciplines and by appropriately qualified technical specialists being:

— mine planning including life of mine (future) – Xenith Consulting

— material classification assessments (geochemical) – RGS Environmental Pty Ltd

— hydrogeological assessments – JBT Consulting Pty Ltd

— surface water quality, sediment and aquatic ecology investigations – Ecological Service Professionals Pty Ltd (ESP)

— water modelling and development of engineering solutions – Golder Associates Pty Ltd.

On 28 September 2018 DES issued a notice to TEC seeking an extension of time to assess the EIR under Section 326G(7) of the EP Act.

On 9 November 2018, DES issued TEC with a notice requesting further information (DES reference CA34208 STAT1118) (RFI Notice). A copy of this RFI Notice is included as Appendix A.

The further information requirements were identified in Section C of the RFI Notice and related to:

— characterising the environmental values (EVs) and water quality objectives (WQOs) for surface water and groundwater around Meandu Mine

— the geochemical assessment of tailing material that has been deposited in the North-West Backfilled Pit

— assessing whether AMD has impact on or has the potential to impact on groundwater and/or surface waters including Meandu Creek.

This further information is required to be submitted to DES by 31 January 2019.

1.2 RESPONSE TO REQUEST FOR INFORMATION SUMMARY

This report provides TEC's responses to the RFI Requirements as outlined in Section C of the RFI Notice (CA34208 STAT1118). These responses do not alter the overall findings as presented in the EIR that:

— There are no discernible negative impacts to the environmental values of Meandu Creek as a result of AMD from Meandu Mine. Overall, aquatic ecological communities in the vicinity of the mine are resilient and in moderate to good health, particularly in Meandu Creek downstream of Meandu Creek Dam. Water quality conditions downstream of Meandu Creek Dam, including hardness and pH, are likely to be reducing the toxicity of metals in water. Further, metals in sediments in some areas of Meandu Creek downstream of Meandu Creek Dam are likely to be immobilised by the availability of sulfides and unlikely to cause acute or chronic toxicity to aquatic flora and fauna.

— Where water quality conditions remain unchanged (i.e. remain within the historical range and/or comply with WQOs where applicable, and are monitored and managed in accordance with the current Environmental Authority (EA) (EPML00709113) and/or Meandu Creek Receiving Environment Monitoring Program (REMP)), no further lines of investigation are considered necessary to prevent environmental harm on aquatic environmental values occurring from AMD at Meandu Mine.

While all information presented in this response document is consistent with that presented in the EIR, further technical review undertaken to address RFI Requirements 2 and 5 has resulted in two new commitments:

— To adopt the Dunlop et al. (2016) toxicity-based WQO for sulfate as an interim guideline for the receiving environment downstream of Meandu Creek Dam when the Meandu Creek REMP is updated (refer further to Section 3.4). The updated REMP will focus on monitoring trends in water quality results at the release points (particularly at compliance point CP3), in Meandu Creek Dam and in Meandu Creek downstream of Meandu Creek Dam.

— As part of the REMP implement trigger values for dissolved manganese, nickel and zinc at CP3 based on the ANZECC highly disturbed (80% protection) for aquatic ecosystems. The location CP3 has been selected for mine release trigger values as it is an established compliance site with the most direct connectivity to Meandu Creek Dam and is most representative of mine impacted water releases. Manganese, nickel and zinc have been chosen as the three most reliable AMD indicators that have a published guideline trigger value. Along with ongoing monitoring and other controls, this will form part of the ongoing proactive management of AMD. This will also provide a level of protection to aquatic ecology to the highly disturbed section of Meandu Creek between CP3 release point and Meandu Creek Dam (refer further to Section 3.1).

1.3 CONSULTATION WITH DES

TEC sought clarification on aspects of the RFI Notice from DES at a teleconference held on 16 November 2018. Specifically, DES was asked to:

— provide a summary of the assessment process undertaken resulting in the RFI Notice

— clarify aspects of the RFI Notice with key areas of discussion focussing on:

  — environmental values (EVs) and water quality objectives (WQOs) for Meandu Creek as presented in the EIR

  — presentation of graphs (particularly box plots) and raw data files

  — groundwater information in particular, environmental values and presentation of matters relating to electrical conductivity

— clarify the response format and timing, particularly the process following submission on 31 January 2019.

Following this teleconference, five additional questions were forwarded to DES via email on 26 November 2018. A response was received from DES to these questions on 4 December 2018.

1.4 STRUCTURE OF RFI RESPONSE REPORT

As clarified with DES during 16 November 2018 teleconference, the intent of this RFI Response report is not to reproduce the information presented in the EIR documentation but to provide direct responses to each RFI Requirement in Section C of the RFI Notice. For each RFI Notice Requirement the following has been provided:

— the RFI Notice Requirement (as presented in Section C Requirements of the Further Information Notice)

— the relevant section of the EIR (September 2018)

— the appropriately qualified persons who prepared the response to the RFI Requirement

— the response to the RFI Requirement.

An overview of the structure of the RFI Response report is provided in Table 1.1.

Table 1.1 RFI Response report structure

SECTION	INFORMATION COVERED
Section 1: Project background	Provides the background to the Project and information relevant to preparation of this RFI Response report.
Section 2: AMD source and extent	Provides the response to RFI Notice Requirement 1
Section 3: Characterisation of the receiving environment (surface waters)	Provides responses to RFI Notice Requirements 2 to 6
Section 4: Characterisation of the receiving environment (groundwater)	Provides responses to RFI Notice Requirements 7 and 8
Section 5: Surface water investigations	Provides responses to RFI Notice Requirements 9 to 14
Section 6: Impacts to the receiving environment	Provides responses to RFI Notice Requirements 15 to 17
Section 7: Appendix F: Contaminant Hydrogeological Assessment	Provides the response to RFI Notice Requirement 18
Section 8: Appendix G: Mine and environmental investigation – surface water	Provides responses to RFI Notice Requirements 19 and 20

1.5 APPROPRIATELY QUALIFIED PERSONS

As with the environmental investigation and EIR, the information in this RFI Response report has been prepared by appropriately qualified persons.

Table 1.3 of the EIR identified the appropriately qualified persons involved in the environmental investigation and compilation of the EIR. Statutory Declarations (EM494) signed by the appropriate representatives were provided in Appendix C of the EIR.

The RFI response and compilation of information for this report have been undertaken by the same appropriately qualified persons and no additional Statutory Declarations are required. Key authors of this RFI Response report are:

— WSP Australia – responsible for compilation of this report

— Ecological Service Professionals Pty Ltd (ESP) – water quality and aquatic ecology

— JBT Consulting Pty Ltd – groundwater.

RESPONSE TO FURTHER INFORMATION REQUIREMENTS

2 AMD SOURCE AND EXTENT

RFI Notice Requirement 1 is addressed in this section of the RFI Response report. This RFI relates to tailings not being a source of AMD as presented in Section 5.1.1.2: *Source of AMD* of the EIR.

2.1 RFI REQUIREMENT 1:

RFI REQUIREMENT:

Additional information for the testing of the sample of tailings from the North West A Tailings Storage Facility (TSF) collected by Environmental Geochemistry International (EGi) in 2007 and subject to kinetic leach column testing. This information should support the claim made in section 5.1.1.2 that this material is not contributing to AMD.

RELEVANT SECTION EIR (SEPTEMBER 2018):

The results from the EGi sampling program were presented in Section 3.2.3.1: *EGi 2015 Sampling Program* of the EIR.

Results from the static and kinetic leach column (KLC) testing program undertaken by RGS were presented in Sections 3.2.4 to 3.2.6 of the EIR. The KLC test results were based on 14 months of sampling (commencing November 2016).

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was obtained from EGi (2008 and 2016) and RGS.

2.1.1 RESPONSE

This section provides information for the testing of the sample tailings from the North-West A tailings storage facility (TSF) collected by EGi in 2007 to support the conclusion in Section 5.1.1.2 of the EIR that tailings are not the source of AMD at the Meandu Mine.

The results from column leach testing on a composite tailings sample undertaken by EGi in 2007 as part of a study into the geochemical characterisation of washery tailings (EGi 2008) concurred with sulfur speciation test results from the same study, suggesting the sample was non-acid forming (NAF).

The results from a static geochemical assessment undertaken by EGi in 2015 indicated that tailings were likely to be Potentially Acid Forming – Low Capacity (PAF-LC). The study concluded that while previous geochemical assessments had shown no direct evidence of AMD from tailings, this was based on limited samples and kinetic leach column testing was recommended.

Kinetic leach testing was undertaken as part of the geochemical assessment by RGS to inform the EIR. Commencing in November 2016, this study indicated that while tailing samples had a PAF-LC classification based on static testing, kinetic leach column testing undertaken over a 14-month period found that acidic drainage was unlikely from tailings within this time-period under laboratory-controlled conditions. Since the 14 September 2018 EIR submission to DES, RGS has provided further results to Stanwell from ongoing kinetic leach column testing (over 23 months). The results from this ongoing kinetic leach column testing indicated that the 100% tailings sample (KLC#3) retains circum-neutral pH conditions (between pH 5 and 7) after 23 months but there is a gentle decrease in pH value over time. In addition, the RGS assessment also noted that the 30 years of water quality data from King 2 TSF, North-West A TSF and North-West B TSF showed little evidence that there was or is an acidity production issue associated with tailings.

While it was initially thought that water being squeezed out of tailings that has been deformed vertically during backfilling of the North-West A Pit was the primary source of AMD from the North-West Backfilled Pit, this has been discounted by RGS for the following reasons:

- there is no evidence of acid drainage in tailings from the King 2 TSF that operated early in the mine life
- kinetic leach column testing over a 12-month period of exposed tailings (at least 2-years) from the North-West A TSF (collected in 2007 by EGi), showed that the tailings retained neutral pH over 12 months
- there is no evidence from kinetic leach column testing (undertaken by RGS both over a 14-month period for the EIR investigation and ongoing over 23 months) that acidic drainage is likely from tailings within these time-periods under laboratory-controlled conditions
- the low sulfide content and fine-grained and low-permeability physical nature of the tailings encourages moisture retention and limits sulfide oxidation.

While the sampling undertaken by EGi in 2007 may not have been representative of the whole tailings deposit on its own, the combination of the kinetic leach testing of tailings, from EGi 2008 and RGS 2016-2018, together with the observations by RGS of water quality data from the North-West A and North-West B TSFs and detailed geochemical assessment by RGS supports the fact that tailings are non-acid forming and not the source of AMD in the North-West Backfilled Pit at Meandu Mine.

Supporting information is provided below.

2.1.2 SUPPORTING INFORMATION

A timeline of events enabling the conclusions presented in Section 5.1.1.2 of the EIR to be drawn are presented below.

PREVIOUS GEOCHEMICAL ASSESSMENTS (1990 TO 2008)

In 2016, EGi finalised a report into a geochemical assessment of the Meandu Mine. The report *Geochemical Assessment of the Meandu Mine, Queensland* (EGi, August 2016) provided a summary of previous geotechnical assessments at the Meandu Mine. With respect to these previous geotechnical assessments EGi noted that:

- Available tailings test results were limited to 19 samples analyses from 1990 to 2008.
- Despite the small sample size, the geochemistry was consistent across the different data sets with relatively low total sulfur (S) values (between 0.2%S to 0.6%S), and low acid-neutralising capacity (ANC) (up to 11 kg H_2SO_4/t).
- The EGi geochemical characterisation work (2007/2008) included a range of standard and specialised test methods, but results did not allow confident classification of the samples. EGi (2007/2008) carried out leach column testing on a composite tailings sample with 0.2%S and an ANC of 5 kg H_2SO_4/t for 1 year, and results indicated that materials represented by this sample would be unlikely to generate significant acid or dissolved metals/metalloids.

Further information on the EGi geochemical characterisation work from 2007/2008 is presented below.

EGI GEOCHEMICAL CHARACTERISATION WORK (2007/2008)

The geochemical characterisation work on tailings undertaken by EGi in 2007/2008 was based on six (6) coal washery tailing samples, collected from the decommissioned Meandu tailings facility (North-West A TSF). The samples were collected from the top 0.5 m of the tailings in relatively dry areas that were accessible by foot. While the six (6) samples did not fully represent the tailings deposited they were expected to provide an indication of the acid rock drainage and leaching potential of these materials.

The samples were dried, riffle split and pulverised (75µm). A composite sample was prepared for leach column testing from equal proportions of the six (6) individual samples.

The following tests were carried out on the six (6) individual samples and the composite sample:

— $pH_{1:2}$ and electrical conductivity $(EC)_{1:2}$ on deionised water extracts
— Leco total sulfur
— acid neutralising capacity (ANC)
— standard single addition net acid generation (NAG) test.

The following additional testing was carried out on the composite sample:

— acid buffering characteristic curve test
— sulfur speciation testing
— multi-element scans of solids
— leach column testing.

The results of the characterisation indicated:

— $pH_{1:2}$ values ranged from pH 5.8 to 7.2 indicating a lack of existing acidity.
— $EC_{1:2}$ values were non-saline to slightly saline, ranging from 0.26 to 0.71 dS/m.
— Total sulfur was relatively low and consistent, ranging from 0.21 to 0.29%S.
— ANC was also low, ranging from 4 to 11 kg H_2SO_4/t.
— Five of the samples (including the composite) plot in the net acid producing potential (NAPP) positive domain (i.e. indicating that the material may be acid generating), but are only marginally NAPP positive, with a maximum of 4 kg H_2SO_4/t.
— Standard NAG results showed low pH and high acidities, but indicated effects of organic acid generation, overestimating the acid potential. To help identify and quantify any effects of organic acid generation in the NAG-test results, extended boiling and NAG solution assay (calculated NAG) testing was carried out on three (3) selected individual samples and the composite sample. The calculated NAG values for all four (4) samples are marginally positive at 0.4 to 2 kg H2SO4/t, indicating that the samples may have a low capacity to generate acid.
— Sulfur speciation results for the composite sample indicated that the bulk of the total sulfur measured is likely to be present in non-acid generating forms, with the pyritic portion estimated to be low at 0.02 %S.
— An adjusted NAPP value for the composite sample was calculated using estimated acid producing sulfur portion (pyritic and acid sulfate sulfur) and the readily available ANC for the composite sample. The adjusted NAPP value was -3 kg H_2SO_4/t, indicating the tailings composite is marginally NAF. By contrast, the calculated NAG indicates a marginally potentially acid forming (PAF) classification. However, Australian Coal Association Research Program (ACARP) investigations indicated that the calculated NAG value may overestimate the acid potential on samples with low pyritic S.

Leach column testing was carried out on the tailings composite sample for 52 weeks. Over this period the pH remained circum-neutral (refer Figure 2.1).

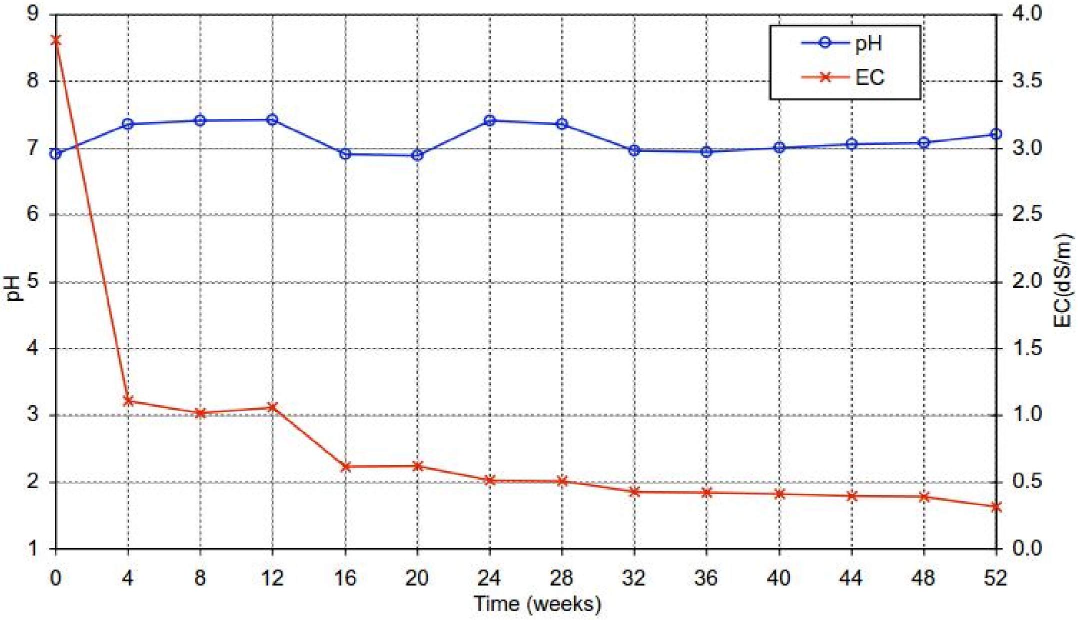

Figure 2.1 Leach column pH and electrical conductivity trends (EGi 2008)

The electrical conductivity value was initially high (3.8 dS/m) but declined to low values of less than 0.5 dS/m by week 32 (refer Figure 2.1). Chlorine and sulfate trends indicated that the initial high electrical conductivity was likely to be mainly due to the combination of chlorine and sulfate salts with chlorine salts contributing most to the electrical conductivity value. As the samples were collected from the top 0.5 m of the deposited rejects the initial high electrical conductivity was likely to be the result of accumulated salts at the surface which were readily flushed out in the first collection. After the initial peak, sulfate trends declined gradually from 371 mg/L at week 4 to low concentrations of less than 100 mg/L by week 40. Chlorine was more rapidly flushed decreasing to 100 mg/L by week 12 (refer Figure 2.2).

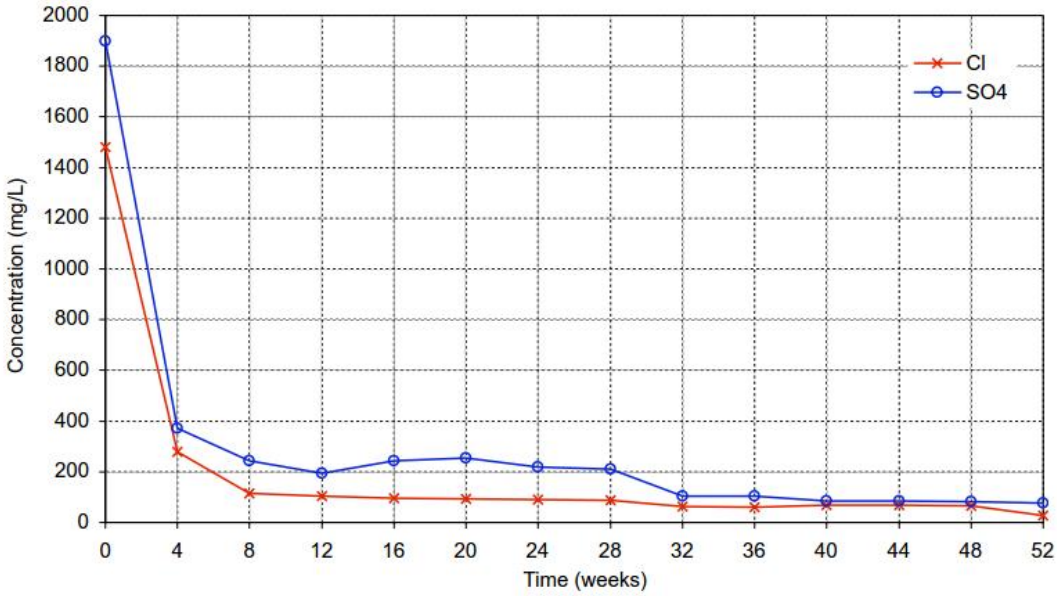

Figure 2.2 Leach column chlorine and sulfate trends (EGi, 2008)

Figure 2.3 plots the sulfate release rate, CO_3 dissolution rate (assuming all calcium (Ca) and magnesium (Mg) released to leachates is due to dissolution of Ca-Mg carbonates), and CO_3/SO_4 molar ratio trends for column leachates. The sulfate release and CO_3 dissolution trends closely match throughout the testing period, with very low sulfate release rates of 3 mg/kg/week by week 52. The results suggest that long-term sulfate release rates will be low from materials represented by this sample, and at these rates background silicates are generally capable of neutralising any associated acid.

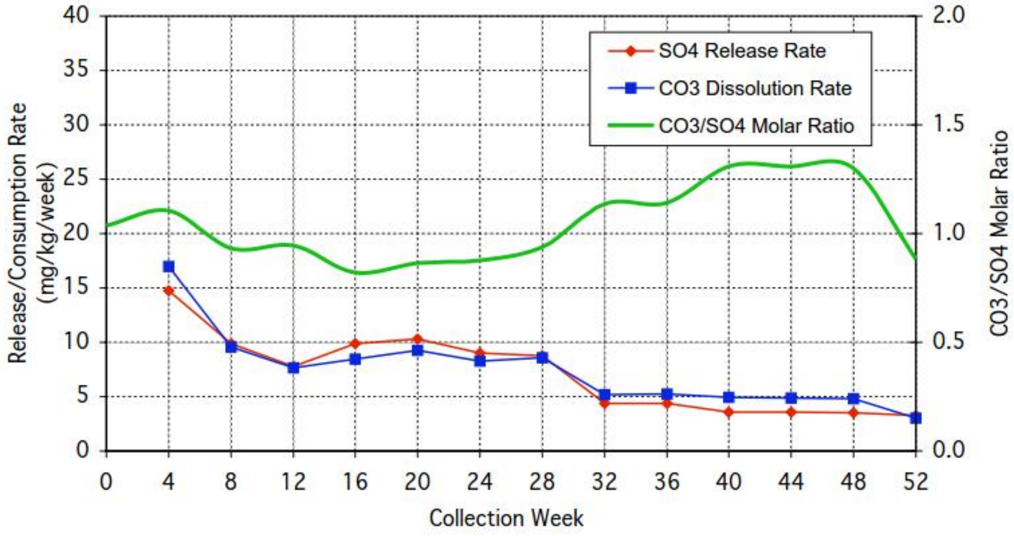

Figure 2.3 Leach column SO_4 release rate, CO_3 dissolution rate and CO_3/SO_4 molar ratio trends (EGi, 2008)

Overall the column leach test results concurred with sulfur speciation test results, and suggested the sample is NAF.

No elevated concentrations of metals or metalloids were present in column leachates, indicating materials represented by this sample were unlikely to generate contaminated seepage.

There was no direct evidence of acid drainage from tailings (though only limited samples were available). The previous geochemical characterisation work discussed above indicated that although Meandu Mine materials tended to have low sulfur contents overall (generally below 0.5%S), there was also an overall lack of inherent buffering in these materials to offset any acid generation that occurred, with carbonaceous (organic C bearing) materials the main potential source of any acid drainage.

GEOCHEMICAL ASSESSMENT (EGI 2016)

Static geochemical characterisation of tailings undertaken by EGi and reported in *Geochemical Assessment of the Meandu Mine, Queensland* (EGi, 2016) was based on the following samples:

- 212 mixed overburden/interburden, rejects and tailings samples three (3) open holes (8018R, 8019R and 8020R) within the North-West Spoil Dump at 66 m to 162 m depth
- 17 tailing samples from the process plant
- 5 historic tailings material samples.

The following standard testing was carried out on the samples:

- pH and electrical conductivity testing on deionised water extracts at a ratio of 1 part solid to 2 parts water ($pH_{1:2}$ and $EC_{1:2}$)
- Leco total sulfur
- acid-neutralising capacity (ANC)
- net acid producing potential (NAPP), calculated from total sulfur and ANC
- single addition NAG testing.

Additional testing was carried out on selected samples to further characterise acid drainage geochemistry including:

- extended boil and calculated NAG testing to account for the effects of high organic carbon contents on standard NAG testing
- sulfur speciation to obtain a guide to the proportion of pyritic sulfur.

All tailings samples had a NAGpH less than 4.5, but the results are influenced by organic acid effects. When plotted on a AMD classification plot showing NAGpH versus NAPP value the tailings samples show a very tight distribution, with all samples plotting in the PAF domain.

To assist in resolving the uncertainty in AMD classification based on the standard NAG test results, extended boil and calculated NAG testing was undertaken on 12 tailings samples. The extended boil NAGpH for 6 of the 12 samples remained less than 4.5, indicating these samples are likely to be acid producing. Results for the remaining samples showed an increase in the NAGpH value of 2 to 3 pH units after the extended boiling step. The increased NAGpH in the extended boil confirmed the organic acids effects in the single addition NAG test.

All samples had positive calculated NAG values but with low capacities of 5 kg H_2SO_4/t or less, indicating these samples are PAF with a low capacity (PAF-LC).

Sulfur speciation analysis was carried out on the 12 tailings samples. Results confirm the presence of pyrite in these samples, with the proportion of acid generating sulfur tending to be around 25% for tailings (note proportion of acid generating sulfur was higher in rejects at around 50%). The remaining sulfur is most likely organic sulfur. The results are reasonably consistent with the calculated NAG testing, indicating most samples are PAF, but with low capacity.

Water extraction tests were carried out on nine (9) tailings samples at a solids: liquor ratio of 1:2. All the tailings samples produced circum-neutral pH and low salinity leachates, with low concentrations of metals/metalloids.

The above results were used to classify samples. All the tailings samples were classified as, PAF-LC or UC (PAF-LC). These results indicated that tailings (along with rejects) are a potential source of acid drainage, though with low capacities. Kinetic leach column testing was recommended to better understand the leaching characteristics of the mine waste material including acid potential, lag times, acid release rates, and leaching characteristics materials.

GEOCHEMICAL ASSESSMENT (RGS)

Sections 3.2.4 to 3.2.6 of the EIR presented the results of geochemical assessment undertaken by RGS to support the environmental investigation. Material classification based on the static geochemical program confirmed that most coal, rejects and tailings were classified as PAF-LC or PAF, due to the low ANC concentrations in the samples. Kinetic leach column test results based on 14 months of leach testing were also presented. The assessment also noted that the 30 years of water quality data from King 2 TSF, North-West A TSF and North-West B TSF showed little evidence that there was or is an acidity production issue associated with tailings.

The 100% tailings sample (KLC 3) had a static PAF-LC classification with 0.14% total sulfur, 0.048% sulfide sulfur, ANC 3.3 kg H_2SO_4/tonne and neutralisation potential ratio (NPR) 0.7. This sample was sourced from a combined composite of tailings collected from the coal handling and preparation plant (CHPP) underflow thickener.

The kinetic leach column test results for this tailings sample indicated that:

— the sample was dominated by material less than 0.075 mm and was not free draining

— the sample initially leached neutral drainage and retains a pH of 6.2 after 14 months of leaching

— the sample had low and consistent acidity and sulfate concentration over the test program of 4 mg/L and 350 mg/L respectively

— material represented by this sample has a lag period of more than 14 months if it were capable of producing acidic drainage under unsaturated atmospheric conditions

— the fine-grained and low permeability nature of the material encourages moisture retention and limits sulfide oxidation.

ONGOING KLC TESTING RESULTS (RGS)

Kinetic leach column testing has been ongoing for 23 months, continuing beyond the 14 months of data originally presented in the EIR. While fine grade rejects, coarse grade rejects and tailings all have similar total sulfur and sulfide sulfur (CRS) content (Table 2.1), suggesting (at face value) a similar potential to produce acidic drainage, the results from kinetic leach column testing over 23 months verify this is not the case.

Table 2.1 Content of total sulfur and sulfide sulfur in mine material samples

MINE MATERIAL	TOTAL SULFUR (%)	SULFIDE SULFUR (CRS) (%)
Tailings	0.14	0.05
Fine-grade rejects	0.15	0.13
Coarse-grade rejects	0.13	0.05

TAILINGS

The 100% tailings sample (KLC#3) retained circum-neutral pH conditions (between pH 5 and 7) after 23 months but showed a gentle decrease in pH value over time (Figure 2.4). The electrical conductivity in the tailings over the 23 months remained consistent at about 1,000 µS/cm (Figure 2.5).

FINE-GRADE REJECTS

The 100% fine-grade rejects sample (KLC#5) retained pH neutral conditions after 23 months (Figure 2.4). The mixed sample of fine-grade rejects and tailings (KLC#6) retained pH neutral conditions after 23 months, although the pH was lower than the fine-grade rejects in sample KLC#5. In summary, the fine-grade rejects contain similar total sulfur and sulfide sulfur concentrations to the coarse-grade rejects but have a much lower potential to produce acidic drainage. This is attributed to the fine particle size distribution of this material that reduces oxygen ingress and sulfide oxidation through reduced permeability.

COARSE-GRADE REJECTS

The 100% coarse grade rejects sample (KLC#12) became acidic after 14 months of exposure to oxidising condition and continued to produce increasing acidity after 23 months (Figure 2.4). The mixed coarse grade rejects and tailings sample (KLC#15) (note: not graphed) maintained circum-neutral pH for the first 12 months verifying that the addition of tailings to the coarse-grade rejects can reduce acid production by filling voids in the rejects and reducing oxygen ingress and permeability. From 12 to 23 months the pH decreased as the available alkalinity in the tailings has been gradually consumed by the acidity being produced by the sulfide mineral in the rejects. At 23 months, the pH is still mildly acidic and significantly higher than the control sample KLC#12.

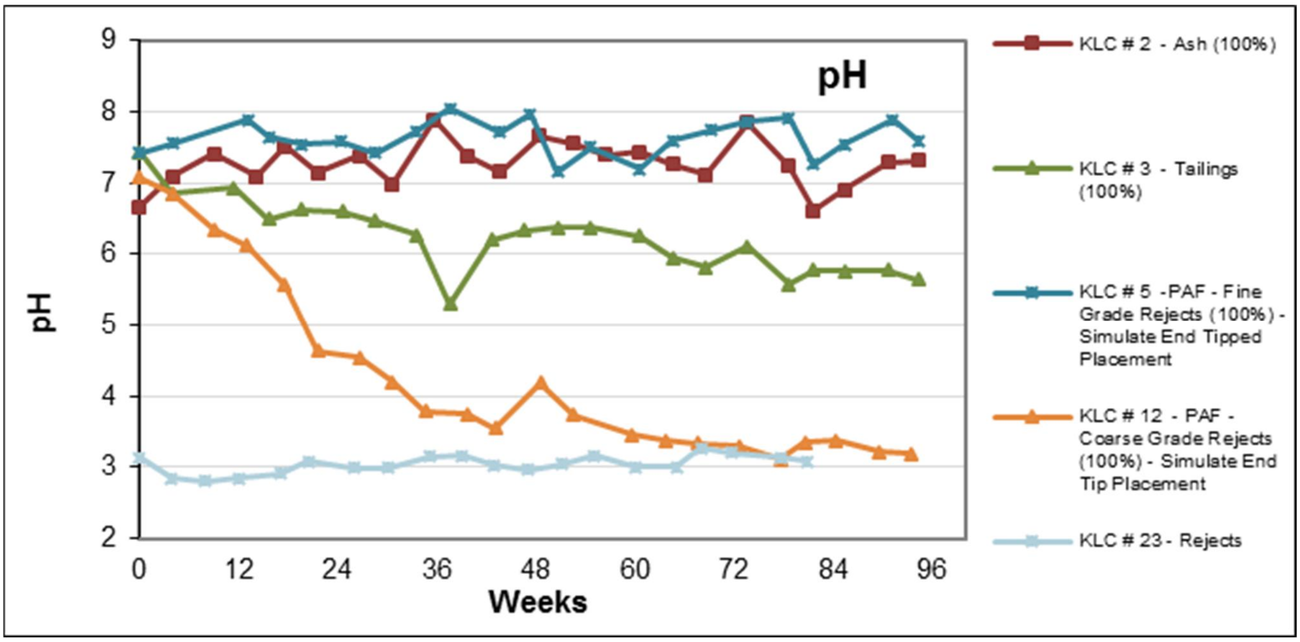

Figure 2.4 pH results for ash, tailings, fine grade and coarse grade rejects and Hitachi Hill rejects

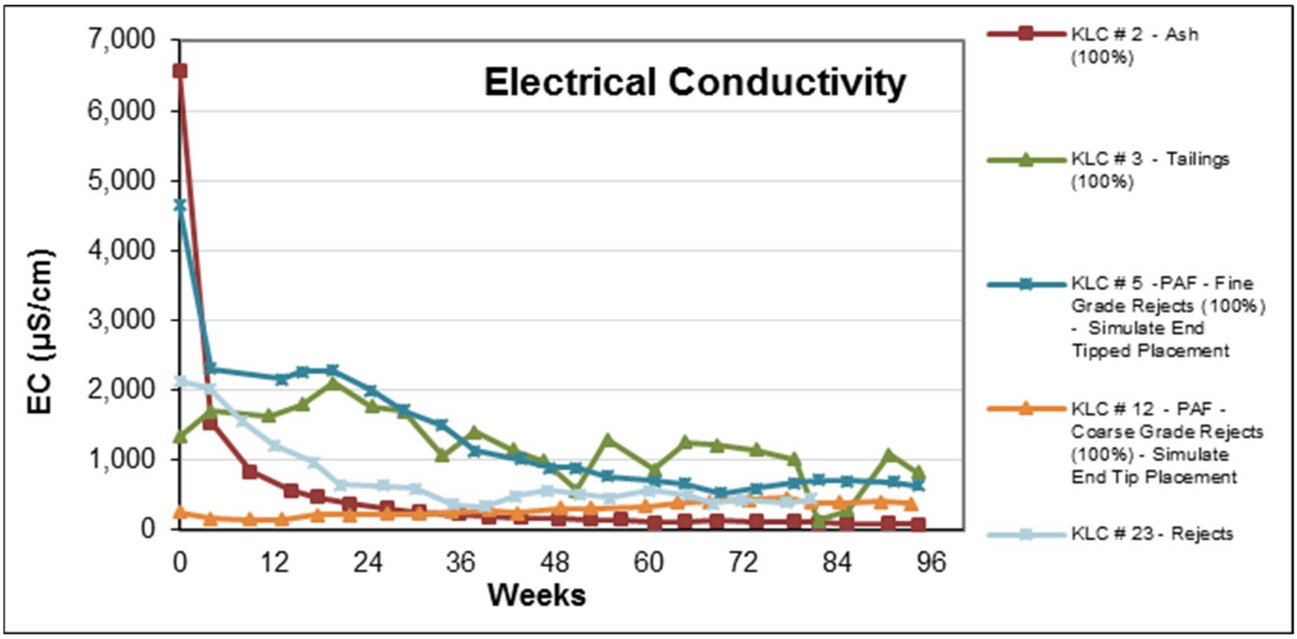

Figure 2.5 Electrical conductivity results for ash, tailings, fine grade and coarse grade rejects and Hitachi Hill rejects

The combination of the kinetic leach testing of tailings from EGi 2008 and RGS 2016-2018 together with the observations by RGS of water quality data from the North-West A and North-West B TSFs and detailed geochemical assessment by RGS supports the fact that tailings are non-acid forming and not the source of AMD in the North-West Backfilled Pit at Meandu Mine.

3 CHARACTERISATION OF THE RECEIVING ENVIRONMENT (SURFACE WATERS)

RFI Notice Requirements 2 to 6 are addressed in this section of the RFI Response report. These RFIs relate to information for surface waters as presented in Section 6: *Characterisation of the Receiving Environment* of the EIR.

3.1 RFI REQUIREMENT 2

RFI REQUIREMENT:

A characterisation of environmental values and water quality objectives for Meandu Creek. It is noted that the only environmental value defined for Meandu Creek upstream of Meandu Creek Dam and Black Creek is industrial use. The direct connectivity of these sections of waterway with Meandu Creek downstream of Meandu Creek Dam should be acknowledged.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Environmental values (EVs) and water quality objectives (WQOs) for Meandu Creek upstream of Meandu Creek Dam and Black Creek were defined in Section 6.3: *Environmental Values and Water Quality Objectives* of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

3.1.1 RESPONSE

Meandu Creek and Black Creek in the vicinity of Meandu Mine comprise a connected waterway system, and as such water is managed to protect the integrity of water quality and aquatic ecosystems in the receiving environment (i.e. downstream of Meandu Creek Dam).

The industrial use EV is considered applicable to Meandu Creek upstream of Meandu Creek Dam and Black Creek. Both these reaches have been significantly modified through the creation of dams and diversions to facilitate operation of the Meandu Mine and Tarong and Tarong North power stations and form part of the overall site water management systems for these facilities.

Water quality objectives (WQOs) for aquatic ecosystems are however not currently appropriate for the reaches of Meandu Creek adjacent to the mine, as these are part of the mine water management system. DES has suggested that WQOs should be determined for Meandu Creek upstream of Meandu Creek Dam (and adjacent to the mine) based on dilution and attenuation predictions. However, any WQOs for Meandu Creek upstream of Meandu Creek Dam derived from dilution and attenuation predictions are likely to be overly high as they will take into account the large dilution and attenuation capacity of Meandu Creek Dam (and may exceed the published WQOs for aquatic ecosystems).

As such, impacts to downstream reaches (that have aquatic ecosystems as an environmental value) will be (and currently are) managed through monitoring and management of contaminant concentrations in release water (including comparison to release limits and monitoring of trends), and water quality in Meandu Creek downstream of Meandu Creek Dam as part of the Meandu Creek REMP.

Item B5 of Table 10.2 of the EIR recommended to update the Meandu Creek REMP. Based on further review by Stanwell, and as an outcome of information presented in this RFI Response, Stanwell will implement as part of the REMP trigger values for dissolved manganese, nickel and zinc at CP3 based on the ANZECC highly disturbed (80% protection) for aquatic ecosystems. The proposed trigger values are conservatively low as an indicator of potential downstream impacts given the amount of dilution and attenuation in Meandu Creek Dam. The location CP3 has been selected for mine release trigger values as it is an established compliance site with the most direct connectivity to Meandu Creek Dam and is most representative of mine impacted water releases. Manganese, nickel and zinc have been chosen as the three most reliable AMD indicators that have a published guideline trigger value. Implementation of B5 along with ongoing monitoring and other controls, including these trigger values will form part of the ongoing proactive management of AMD. This will also provide a level of protection to aquatic ecology to the highly disturbed section of Meandu Creek between CP3 release point and Meandu Creek Dam.

3.1.2 SUPPORTING INFORMATION

Based on the differing nature of and influences on the Meandu Creek system, for the purposes of the EIR assessment Meandu Creek has been separated into the following reaches:

- Meandu Creek upstream of Meandu Mine (ephemeral and upstream of mining operations)
- Meandu Creek upstream of Meandu Creek Dam (direct impact from mining operations)
- Meandu Creek downstream of Meandu Creek Dam (perennial and downstream of mining operations and power station operations).

CONNECTIVITY OF WATERWAY SECTIONS

The characterisation of environmental values applicable for Meandu Creek in the vicinity of Meandu Mine (i.e. upstream of the mine, and upstream and downstream of Meandu Creek Dam) are shown in Figure 3.1 and detailed further below.

Black Creek and the reaches of Meandu Creek upstream of Meandu Creek Dam (adjacent to Meandu Mine) have been significantly modified through the creation of dams (including Meandu Creek Dam) and diversions to facilitate mining operations. In conjunction with Meandu Creek Dam and Black Creek Dam, these reaches form part of the overall site water management systems for Meandu Mine and the Tarong and Tarong North power stations and public access to these sections of waterway is prohibited. Thus, the industrial use EV has been assigned to the following areas:

- Meandu Creek upstream of Meandu Creek Dam and within the Meandu Mine mining lease boundary
- Meandu Creek Dam
- Black Creek and Black Creek Dam.

While surveys of aquatic flora and fauna in the reaches of Meandu Creek adjacent to the mine demonstrated that a resilient aquatic flora and fauna community occurs, due to the modification of these reaches and their use as part of the mine water management system, aquatic ecosystems environmental values are not currently considered appropriate for this reach.

Black Creek and Meandu Creek in the vicinity of the mine comprise a connected waterway system. As Black Creek has been substantially modified from its natural state and is used for industrial purposes, it was de-gazetted as a watercourse under the *Water Act 2000* by the former Department of Natural Resources and Mines (DNRM). Black Creek Dam only overflows during extreme rain events and flows have been diverted around the ash dam via a purpose-built channel to Meandu Creek approximately 3 km downstream of Meandu Creek Dam.

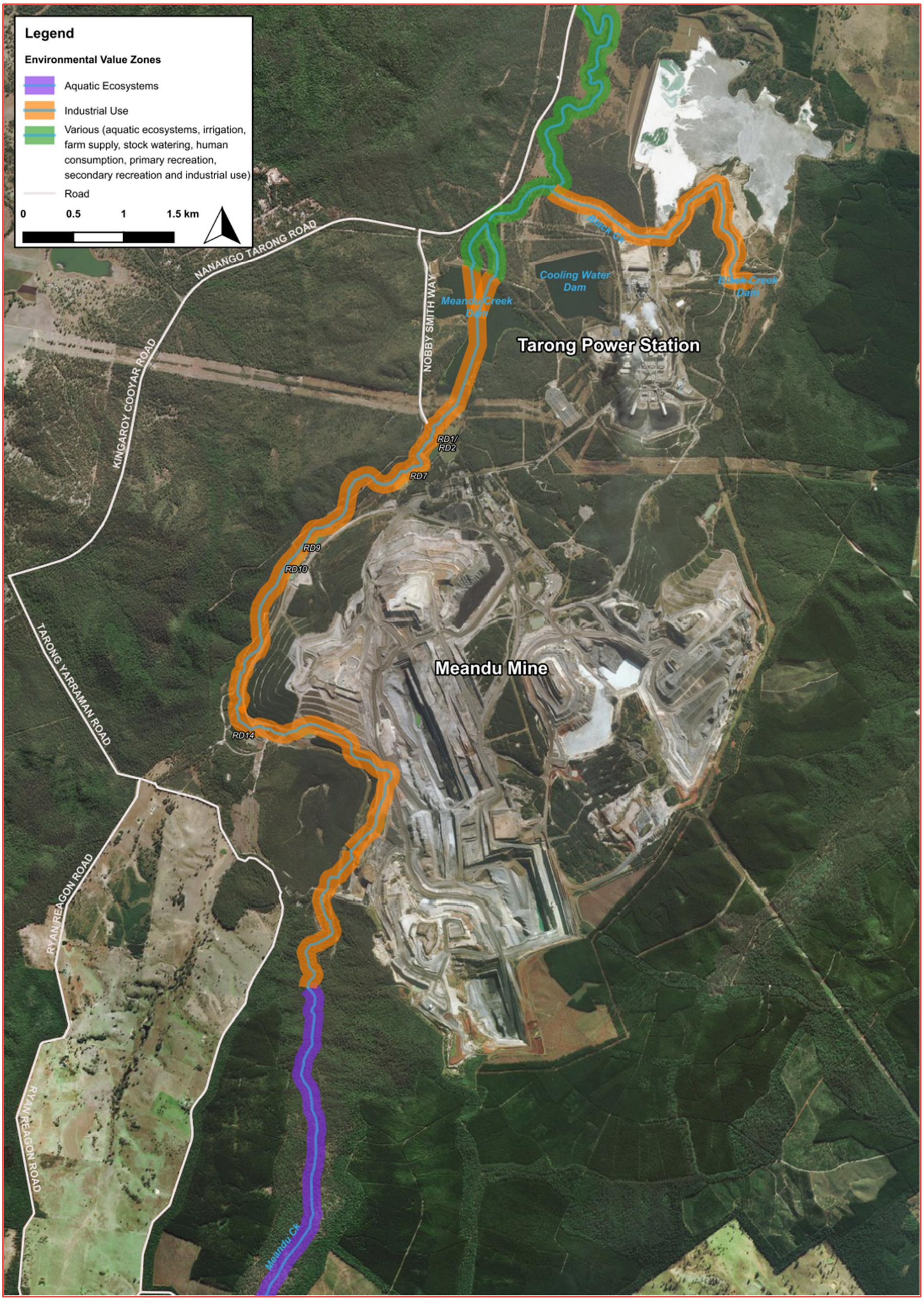

Figure 3.1 Environmental values of Meandu Creek upstream of Meandu Mine; upstream of Meandu Creek Dam and downstream of Meandu Creek Dam

As described in Section 2.5.3 of the EIR, a comprehensive drainage and retention system exists at Meandu Mine covering operational and industrial areas. This system was shown in Figure 2.3 of the EIR and reproduced as Figure 3.2 of this report. This system is maintained and upgraded to preserve the separation of clean and dirty water and to maximise water recycling and minimise the need to discharge from the mine area. The Meandu Mine EA regulates the release of mine-affected waters from Meandu Mine. In addition to information presented in Section 2.5.3 of the EIR, relevant details with respect to connectivity are provided below.

The routine water management approach in the Black Creek catchment of the Meandu Mine is to capture the water that would report to CP2 in a retention dam RD17 and pump this water to retention dam RD2 for use either in the coal wash plant or haul road watering or other site uses. Unused water from RD17 via RD2 is released via CP3. In higher rainfall events, water can be released via CP2 and flow into Black Creek Dam where it is used by the Tarong power stations. Direct connectivity to Meandu Creek from this section will only be in extreme rain events, when both RD17 is overflowing and Black Creek Dam is overflowing. Therefore, there is minimal direct connectivity between the Black Creek Dam catchment at Meandu Mine via CP2 to Meandu Creek.

Meandu Creek runs adjacent to the mine through a series of diversions and flows into Meandu Creek Dam. The main direct connectivity from Meandu Creek upstream of Meandu Creek Dam and Black Creek to Meandu Creek Dam is via the releases from CP3. This location receives water from the two final retention dams RD2 and RD8 that collect water from both the active mining and rehabilitated areas. Water that is not re-used on site via the retention dams is released on a regular basis via CP3 to Meandu Creek Dam via a section of Meandu Creek. Though CP4 is a release point releasing directly into Meandu Creek Dam the catchment is small and this area receives minimal mine impacted water. Stanwell provided flow monitoring data showing that for the period 20 May 2014 to 23 January 2019 water released to Meandu Creek Dam from via compliance points was approximately 93 % via CP3 and 7% via CP4. The connectivity between the sections of Meandu Creek within the mine upstream of CP3 and upstream of the mine to Meandu Creek Dam are limited to higher rainfall events and in any case flow through CP3 to Meandu Creek Dam. Therefore, the location at Meandu Mine that has the most direct connectivity to Meandu Creek Dam is CP3.

Water from Meandu Creek Dam (which has inputs including Meandu Mine releases, Tarong and Tarong power station releases and rainfall) is a release valve at the dam wall. Under normal operating conditions, there is a continual release of water from Meandu Creek Dam. In the absence of rainfall and catchment inflows, these releases are the main source of water for Meandu Creek downstream of Meandu Creek Dam. Water flow and water quality of Meandu Creek downstream of Meandu Creek Dam is directly influenced by water released from the release valve.

Therefore, Meandu Creek upstream of Meandu Creek Dam and Meandu Creek Dam are directly connected to Meandu Creek downstream of Meandu Creek Dam, where the environmental values include aquatic ecosystems. Given this connectivity, water in Meandu Creek upstream of and within Meandu Creek Dam is managed to protect the integrity of water quality and aquatic ecosystems in the receiving environment (i.e. Meandu Creek downstream of Meandu Creek Dam) through compliance monitoring and the Meandu Creek REMP. Although the flow regime and water quality of the receiving environment have been substantially modified due to the construction of the Meandu Creek Dam in 1982 (and subsequent licensed water discharges), ongoing monitoring (as part of the REMP) has demonstrated that the aquatic floral and faunal communities inhabiting downstream reaches have adapted to these altered conditions over time.

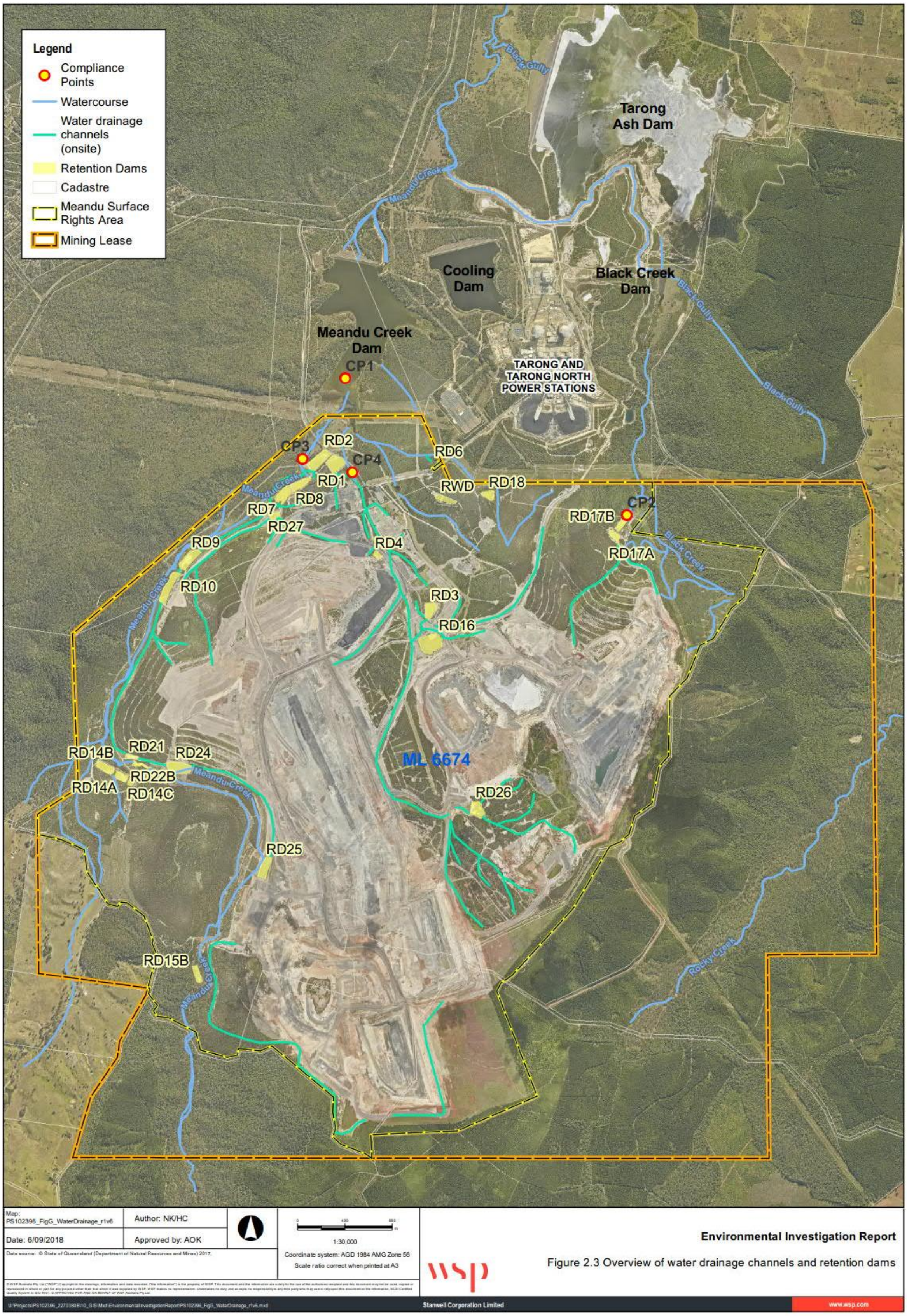

Figure 3.2 Overview of water drainage channels and retention dams

WATER QUALITY OBJECTIVES

The water quality objectives (WQOs) for aquatic ecosystems are not currently appropriate for the reaches of Meandu Creek adjacent to the mine, which are part of the mine water management system and are currently characterised by the industrial use EV only. Water quality in these reaches frequently exceeds the published WQOs for aquatic ecosystems (refer Section 6.3.2 of the EIR) (e.g. electrical conductivity, Figure 1 of Appendix B).

Impacts to downstream reaches (that do have aquatic ecosystems as an EV) need to be (and currently are) managed through monitoring and management of contaminant limits in release water and water quality in Meandu Creek downstream of Meandu Creek Dam as part of the REMP. DES has however suggested that WQOs should be determined for Meandu Creek upstream of Meandu Creek Dam (and adjacent to the mine) based on dilution and attenuation predictions, so that when the water flows to Meandu Creek downstream of Meandu Creek Dam, the required WQOs for aquatic ecosystem protection are achieved. However, the assessment has clearly demonstrated that AMD impacts to water quality are not substantial, and are not influencing aquatic ecosystem values in Meandu Creek downstream of Meandu Creek Dam, likely because of dilution and attenuation in the dam. For example, concentrations of key AMD indicators for Meandu Mine that were relatively high at some sites upstream of Meandu Creek Dam in March 2017, were much lower downstream of Meandu Creek Dam, including:

- cobalt (refer Figures 7 and 8 of Appendix C)
- iron (refer Figures 9 and 10of Appendix C)
- manganese (refer Figures 11 and 12 of Appendix C)
- nickel (refer Figures 15 and 16 of Appendix C)
- zinc (refer Figures 17 and 18 of Appendix C).

Further, concentrations of several parameters, that are generally high at some sites in Meandu Creek upstream of Meandu Creek Dam tend to be much lower in Meandu Creek downstream of Meandu Creek Dam. These include:

- electrical conductivity (Figure 1 of Appendix B)
- sodium (Figure 8 of Appendix B)
- chloride (Figure 10 of Appendix B)
- dissolved manganese (Figure 27 of Appendix B).

This is not surprising given dilution and attenuation capacity of Meandu Creek Dam. Meandu Creek Dam has a large volume of water with a storage capacity of approximately 3,000 ML. It is noted that the dam has operated in the range of 1,900 ML to 3,180 ML in recent years (since July 2014) and historically this has been a typical operating range. . Any WQOs for Meandu Creek upstream of Meandu Creek Dam derived from dilution and attenuation predictions are likely to be overly high as they will take into account the large dilution and attenuation capacity of Meandu Creek Dam (and may exceed the published WQOs for aquatic ecosystems).

The information presented here is consistent with that presented in the EIR, in that the environmental investigation identified no discernible negative impacts to the environmental values of the receiving environment downstream of Meandu Creek Dam as a result of AMD. Measures have also been put in place to manage and reduce the impacts of AMD on water quality. Consistent with Recommendation B5 in Section 10 of the EIR, it is proposed that future impacts to the downstream receiving environment will be monitored and managed through revision of the existing Meandu Creek REMP to address potential AMD impacts. The updated REMP will focus on monitoring trends in water quality results at the release points (particularly at compliance point CP3), in Meandu Creek Dam and in Meandu Creek downstream of Meandu Creek Dam.

Mine water will be adaptively managed based on these results, and changes to mine water management (including management of AMD-related impacts) will be made if there is a trend of increasing concentrations of any contaminants of concern. This is considered a more pro-active approach than the use of WQOs derived from dilution and attenuation predictions in this instance, as comparison to (very high) WQOs alone would likely delay a management response.

As part of the Meandu Creek REMP Stanwell will implement trigger values for dissolved manganese, nickel and zinc at CP3 based on the ANZECC highly disturbed (80% protection) for aquatic ecosystems. The proposed trigger values are conservatively low as an indicator of potential downstream impacts given the amount of dilution and attenuation in Meandu Creek Dam. The location CP3 has been selected for mine release trigger values as it is an established compliance site with the most direct connectivity to Meandu Creek Dam and is most representative of mine impacted water releases. Manganese, nickel and zinc have been chosen as the three most reliable AMD indicators that have a published guideline trigger value. Implementation of B5 along with ongoing monitoring and other controls, including these trigger values will form part of the ongoing proactive management of AMD. This will also provide a level of protection to aquatic ecology to the highly disturbed section of Meandu Creek between CP3 release point and Meandu Creek Dam.

3.2 RFI REQUIREMENT 3

RFI REQUIREMENT:

A characterisation of environmental values and water quality objectives for Meandu Creek upstream of the mine.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Environmental values (EVs) and water quality objectives (WQOs) for Meandu Creek upstream of Meandu Mine were defined in Section 6.3: *Environmental Values and Water Quality Objectives* of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

3.2.1 RESPONSE

No environmental values (EVs) are listed for Meandu Creek upstream of the mine in the Burnett Mary Water Quality Improvement Plan (WQIP). Subsequently, this section of Meandu Creek has been characterised by the aquatic ecosystem EV, based on desktop review and field survey results from March 2017. Note that this section of Meandu Creek is not influenced by water released from the Meandu Mine or Tarong and Tarong North power stations.

There are no other known uses of the surface water from these reaches of Meandu Creek that would characterise this reach with additional environmental values (i.e. irrigation, farm water supply/use; stock watering; human consumers of aquatic foods; primary recreation; secondary recreation or industrial).

Meandu Creek upstream of the mine is currently considered to meet the definition of ‘slightly disturbed’ (i.e. slightly modified physical or chemical indicators but effectively unmodified biological indicators). The default published guidelines for aquatic ecosystem protection in slightly to moderately disturbed upland streams in the Central Coast region (as outlined in the Queensland Water Quality Guidelines[1]) is considered acceptable until additional data to define WQOs is available. The WQOs for slightly to moderately disturbed aquatic ecosystems are outlined in Table 3.2 of Appendix G[2] of the EIR.

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1 EHP (2013) *Queensland Water Quality Guidelines 2009*, Version 3, Minor Updates, Department of Environment and Heritage Protection, Brisbane.

2 ESP (2018) *Environmental Investigation Report: Meandu Mine Surface Waters*, unpublished confidential report prepared for TEC Coal Pty Ltd.

3.2.2 SUPPORTING INFORMATION

The upper reaches of Meandu Creek (upstream of the mine) are a stream order 2, with poorly defined channels that are naturally ephemeral (i.e. they convey runoff after rainfall, but water rarely pools) and dry for most of the year. This section of Meandu Creek (refer Figure 6.5 of the EIR) is upstream of mining operations and is located within the Yarraman State Forest. Surrounding land uses include native forest and hoop pine plantations. No environmental values are listed for this reach of Meandu Creek in the Burnett Mary WQIP. Subsequently, this section of Meandu Creek has been characterised by the aquatic ecosystem environmental value, based on desktop review and field survey results from March 2017. There are no known other uses of this reach.

Although hoop plantations are present throughout the wider area, Meandu Creek upstream of the mine has relatively good coverage of riparian vegetation and as noted from the 2017 field surveys is relatively undisturbed with the most apparent impact being human access to the State Forest (utilised for four-wheel driving and camping). Therefore, the system is currently considered to meet the definition of ‘slightly disturbed’ (i.e. slightly modified physical or chemical indicators but effectively unmodified biological indicators).

The management intent for ‘slightly disturbed’ waters is to progressively improve physical or chemical indicators to achieve the WQOs for ‘high ecological value’ (HEV) waters. However, given that there are currently no WQOs available for this level of protection, the default published guidelines for aquatic ecosystem protection in slightly to moderately disturbed upland streams in the Central Coast region (as outlined in the Queensland Water Quality Guidelines[1]) should be applied until additional data to define WQOs is available. The WQOs for slightly to moderately disturbed aquatic ecosystems are outlined in Table 3.2 of Appendix G of the EIR.

3.3 RFI REQUIREMENT 4

RFI REQUIREMENT:

Location details (including a map) for sampling points W2 and SW16 that were used to derive site specific electrical conductivity Water Quality Objectives (WQOs) in Table 6.2 in Section 6.3.2 of the report.

RELEVANT SECTION EIR (SEPTEMBER 2018):

The location of sampling points W2 and SW16 were presented in Figure 7.4 of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFEI response was provided by ESP.

3.3.1 RESPONSE

The location of sampling points W2 and SW16 are represented in Table 3.1 and Figure 3.3.

Table 3.1 Location of sampling points W2 and SW16

SITE	LOCATION	LATITUDE	LONGITUDE
W2	Meandu Creek approx. 5 km downstream of Meandu Creek Dam	-26.746354°	151.910242°
SW16	Meandu Creek approx. 16 km downstream of Meandu Creek Dam	-26.647803°	151.948303°

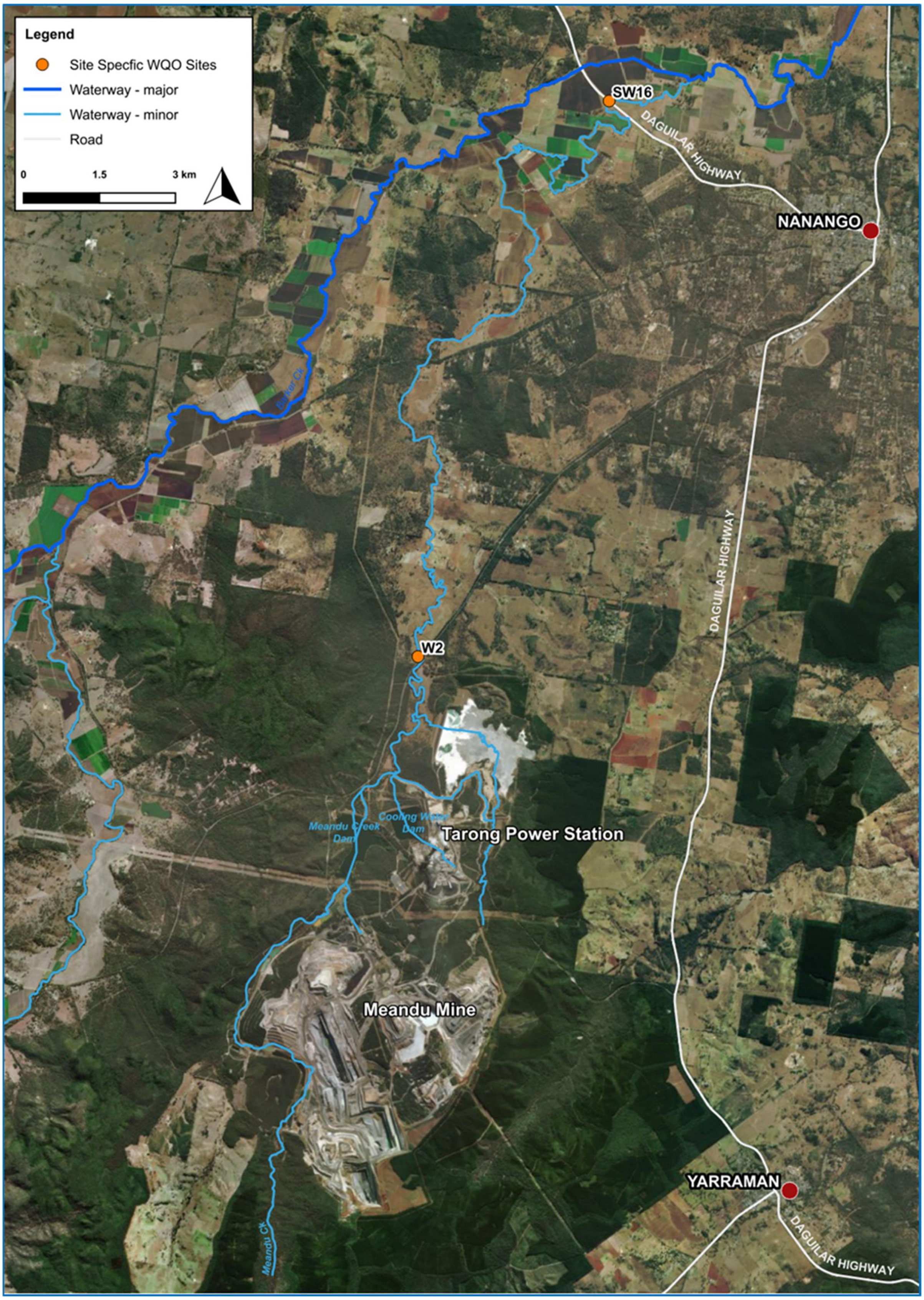

Figure 3.3 Map of sampling points W2 and SW16

3.3.2 SUPPORTING INFORMATION

No additional information is provided for this response.

3.4 RFI REQUIREMENT 5

RFI REQUIREMENT:

A comparison of stock water WQOs for total dissolved solids, fluoride, sulfate and calcium with local background and/or upstream water quality data to determine whether stock water guideline values are appropriate as WQOs for Meandu Creek. It is noted that stock watering guideline values have been utilised to develop water quality objectives for total dissolved solids, fluoride, sulfate and calcium in Table 6.2 in Section 6.3.2 of the report. As an example, sulfate concentrations upstream of the mine are recorded as being less than 50mg/L in Figure 4.8 in Appendix G, indicating a site specific water quality objective is required in place of the stock watering guideline value of 1,000mg/L.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Water Quality Objectives were discussed in Section 6.3: *Environmental Values and Water Quality Objectives* of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

3.4.1 RESPONSE

Stock watering guidelines were applied to the following parameters - total dissolved solids (TDS), fluoride, sulfate and calcium due to the lack of published guidelines for aquatic ecosystems in the Burnett-Mary WQIP / Queensland Water Quality Guidelines / ANZECC & ARMCANZ (2000[3]) guidelines (i.e. they were the most stringent available WQOs to protect the identified environmental values for the receiving environment).

Due to the modified receiving environment, it is not considered appropriate to set site-specific WQOs using data from upstream or reference sites. Water quality, downstream of Meandu Creek Dam reflects the perennial nature of the system due to the consistent releases of water from Meandu Creek Dam, whereas water quality upstream or at reference sites is reflective of the ephemeral nature of these systems. Through analysis of historical monitoring data over time, and results from the field surveys undertaken for the EIR, it has been demonstrated that the water quality in the receiving environment is suitable to protect the identified environmental values, including aquatic ecosystems.

A site-specific WQO for electrical conductivity has been applied for the protection of aquatic ecosystems, and it is considered that a WQO for TDS is not required in addition to a WQO for electrical conductivity. The Dunlop et al. (2016) toxicity-based WQO for sulfate will be adopted as an interim guideline for the receiving environment downstream of Meandu Creek Dam when the Meandu Creek REMP is updated. No other changes to the WQOs presented in Table 6.2 of the EIR are proposed.

3.4.2 SUPPORTING INFORMATION

Stock watering guidelines were applied to the parameters of TDS, fluoride, sulfate and calcium due to the lack of published guidelines for aquatic ecosystems in the Burnett-Mary WQIP / Queensland Water Quality Guidelines / ANZECC & ARMCANZ (2000[4]) guidelines (i.e. they were the most stringent available WQOs to protect the identified environmental values for the receiving environment). There are also no published default guideline values for fluoride,

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3 Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) *Australia and New Zealand guidelines for fresh and marine water quality*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

4 Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) *Australia and New Zealand guidelines for fresh and marine water quality*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

sulfate and calcium in the latest version of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian Government 2018[5]).

The relatively low TDS, fluoride, sulfate and calcium concentrations at sites CKMF and CKME upstream of the mine, and at comparative sites surveyed during the March 2017 survey and historical monitoring for Tarong and Tarong North power stations, are acknowledged. However, setting a site-specific WQO based on concentrations at upstream / comparative sites is not considered to be practical or appropriate for the receiving environment in this instance because:

— Water quality, downstream of Meandu Creek Dam reflects the perennial nature of the system due to the consistent releases of water from Meandu Creek Dam, whereas water quality upstream or at reference sites is reflective of the ephemeral nature of these systems.

— While the low concentrations of these parameters upstream may be indicative of relatively undisturbed conditions in the region, they are likely to be much lower than concentrations that will protect aquatic ecosystem values (i.e. they are overly conservative). For example, monitoring completed to date, including the March 2017 survey, has indicated no discernible adverse impacts to biological communities as a result of water quality (including concentrations of these parameters).

— Concentrations in the receiving environment would consistently exceed site-specific WQOs derived from upstream sites due to a number of influences (including authorised activities at the mine and power stations). As stated above, these exceedances would not be indicative of impacts to the environmental values of the receiving environment.

Using local background and/or upstream water quality data as WQOs for Meandu Creek is considered inappropriate. As such more appropriate guidelines to protect aquatic ecosystem values, including the stock watering guidelines, have been further investigated.

ELECTRICAL CONDUCTIVITY AND TDS

A site-specific WQO for electrical conductivity has been applied for the protection of aquatic ecosystems, and it is considered that a WQO for TDS is not required in addition to a WQO for electrical conductivity (refer Section 6.3.2 of the EIR).

FLUORIDE

Concentrations of fluoride do not appear to be influenced by AMD or operation of the mine due to the relatively low concentrations in Meandu Creek upstream of Meandu Creek Dam and adjacent to the mine (refer Figure 12 of Appendix B). The toxicity of fluoride is largely influenced by hardness, pH, temperature and salinity. In particular, increasing hardness decreases the toxicity of fluoride to aquatic organisms.

No amendment to this WQO is considered necessary due to the lack of existing information available on the toxicity of fluoride in very hard waters such as those in Meandu Creek downstream of Meandu Creek Dam. Monitoring has demonstrated that fluoride concentrations in the receiving environment are below the WQO of 2 mg/L, which is based on the stock watering guideline and is consistent with the DES Model Water Conditions for coal mines in the Fitzroy Basin.

CALCIUM

There are no published Australian or Queensland toxicant guidelines for calcium to protect aquatic ecosystems. Increasing concentrations of calcium contribute to increased water hardness, which is known to have a protective effect against the toxicity of some metals (ANZECC & ARMCANZ 2000[4]). It is not considered necessary to adjust the WQO for calcium.

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[5] Australian Government (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, online, available at: http://www.waterquality.gov.au/anz-guidelines, accessed 7 January 2018.

SULFATE

Sulfate has relatively low toxicity compared with other major ions but is known to be toxic above certain thresholds (Dunlop et al. 2016[6]). A preliminary toxicant guideline for sulfate in the Fitzroy River Basin has been calculated at 545 mg/L for 95% species protection (Dunlop et al. 2016). However, the toxicity of sulfate to aquatic flora and fauna is influenced by hardness and the ionic composition (particularly relative chloride and calcium concentrations) of the water. Waters considered in Dunlop et al. (2016) were characterised by a greater hardness than that in the Meandu Creek receiving environment (550 mg/L, compared to long-term median hardness at sites W2 and SW16 of 362 and 396 mg/L respectively).

Despite the differing hardness, the Dunlop et al. 2016 value of 545 mg/L was based on test species that are relevant to Meandu Creek and provides an indication of the concentrations of sulfate that may be toxic. Results of historical water quality monitoring show that median and 95th percentile sulfate concentrations complied with this guideline at all sites upstream of Meandu Creek Dam (except for the 95th percentile concentrations at sites Meandu Creek-1 and Meandu Creek-3 adjacent to the mine, where aquatic ecosystems is not currently an environmental value) (refer Figure 11 and Table 11 of Appendix B (sites labelled as MC1 and MC3 respectively)). In addition, results from biological indicators sampled during the March 2017 survey suggest that sulfate levels are not having a discernible negative impact to aquatic communities in the receiving environment. The Dunlop et al. (2016) toxicity-based WQO for sulfate will be adopted as an interim guideline for the receiving environment downstream of Meandu Creek Dam when the Meandu Creek REMP is updated.

3.5 RFI REQUIREMENT 6

RFI REQUIREMENT:

Details of relevant water quality data to support the approach taken in Section 6.3.2 of the report.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Section 6.3.2 of the EIR.

SOURCE OF SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

3.5.1 RESPONSE

Site-specific WQOs for electrical conductivity and dissolved oxygen in the receiving environment of Meandu Creek downstream of Meandu Creek Dam were identified in Section 6.3.2 of the EIR. These were based on data from the past 10 years, from two sites in the receiving environment of Meandu Creek downstream of Meandu Creek Dam that have been monitored regularly: data from sites W2 and SW16 were used to calculate the site-specific WQO for electrical conductivity and data from site W2 only was used to set a site-specific WQO for dissolved oxygen (as no dissolved oxygen data were available for site SW16 (site location details are provided in Table 3.1 and Figure 3.2).

Setting a site-specific WQO based on concentrations at upstream / comparative sites is not considered to be practical or appropriate due to the modified receiving environment (i.e. water quality reflects the consistent releases of water from Meandu Creek Dam).

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6 Dunlop, J.E., Mann, R.M., Hobbs, D., Smith, R.E.W., Nanjappa, V., Vardy, S. and Vink, S. (2016) 'Considering background ionic proportions in the development of sulfate guidelines for the Fitzroy River Basin'. *Australasian Bulletin of Ecotoxicology & Environmental Chemistry*. Vol. 3, pp. 1-10.

It has been demonstrated that the water quality in the receiving environment is suitable to protect the identified environmental values, including aquatic ecosystems. Biological communities are acclimated to the conditions, especially higher electrical conductivity. It is therefore considered appropriate to set a site-specific WQO using data from these two receiving environment sites for the purposes of detecting potential impacts to the aquatic ecosystem environmental value, both for the current environmental investigation and for future monitoring. Further details describing this approach and summary statistics for the data used are provided in the supporting information below.

WQOs for all other parameters were compiled based on the published sources outlined in Table 3.2 of Appendix G of the EIR.

3.5.2 SUPPORTING INFORMATION

ELECTRICAL CONDUCTIVITY

Electrical conductivity in the Meandu Creek receiving environment is much higher than that of Meandu Creek upstream of the mine and the regional comparative sites that have been historically monitored. Due to the modified receiving environment (i.e. water quality reflects the consistent releases of water from Meandu Creek Dam), setting a site-specific WQO based on concentrations at upstream / comparative sites is not considered to be practical or appropriate for the receiving environment. If this approach was taken electrical conductivity in the receiving environment would consistently exceed a site-specific WQO based on reference data, due to a number of influences (including ambient environmental conditions and authorised activities at the mine and power stations). The WQO for electrical conductivity in the receiving environment of Meandu Creek downstream of Meandu Creek Dam is 2037, and was calculated using 80^{th} percentile of data from receiving environment sites W2 and SW16 (2007-2017; see summary statistics provided in Table 3.2).

Historical biological monitoring (using macroinvertebrates as an indicator) demonstrates that the electrical conductivity in the receiving environment is suitable to maintain biological communities that are in similar or better condition than would be expected from the region. That is, communities are acclimated to this higher electrical conductivity. It is therefore considered appropriate to set a WQO using data for these sites for the purposes of detecting potential impacts, both for the current environmental investigation and for future monitoring.

Table 3.2 Summary of surface water quality results for electrical conductivity used to aid in the calculation of the site-specific water quality objective, from 2007 to 2017

SITE	COUNT	PAST 10 YEARS (2007 TO 2017)						
		Min.	Max.	Mean	Median	20th %ile	80th %ile	95th %ile
W2	408	407	4100	1811	1803	1204	2086	3727
SW16	47	572	2820	1726	1810	1408	1988	2449
W2 and SW16	455	490	3460	1769	1807	1306	2037	3088

DISSOLVED OXYGEN

The WQO range for the percent saturation of dissolved oxygen in the receiving environment is 70 – 110%, and is based on site-specific data as well as review of the Dissolved Oxygen Fact Sheet from the ANZECC 2000 guidelines.

The guideline range for dissolved oxygen in the current Queensland Water Quality Guidelines central east coast upland streams is 90 – 110 % saturation. However, the ANZECC 2000 Fact Sheet for dissolved oxygen includes the statement that, for the previous ANZECC guideline, it was recommended that *dissolved oxygen concentration should not normally be permitted to fall below 6 mg/L or 80-90% saturation*… and that …*even in highly modified ecosystems, the dissolved oxygen concentration should not be permitted to fall below 60% saturation, determined over at least one diurnal cycle.*

Prior to 1985, Meandu Creek was an ephemeral system, which subsequently became a perennial system following the commencement of discharge from Tarong Power Station. Therefore, for low rainfall periods of the year, the flow in the upper reaches of Meandu Creek is entirely dependent on power station discharges.

A review of dissolved oxygen data at site W2 (Meandu Creek **-** 5 km downstream of the Meandu Creek Dam discharge point) over the past 10 years indicated that the dissolved oxygen is generally within the range of 6 – 10 mg/L, but that the percent saturation generally falls to around 70% in the summer months when the dissolved oxygen carrying capacity of the water is lower due to higher summer water temperatures (refer to summary statistics provided in Table 3.3; note that percent saturation of dissolved oxygen has not been routinely monitored at site SW16, and only data from site W2 was used to inform this WQO). Further, the dissolved oxygen samples from the Barker Creek reference sites tend to be significantly lower, as noted in the 2014 3-yearly report where it was stated[7] that "*low dissolved oxygen persisted at the majority of Meandu Creek sites and at all of the Barkers Creek reference sites. It was actually at the reference sites, that dissolved oxygen was the lowest in the system, with an average concentration of 36.3% (cf. Meandu Creek average 78.1%). In the absence of any obvious point source discharge of water with a high biological or chemical oxygen demand (BOD/COD), low dissolved oxygen is typical of slow moving water and large stagnant pools*".

The WQO for dissolved oxygen of 70 – 110% saturation for the receiving environment is appropriate given the modified nature of Meandu Creek, the observed values and trends at the site over 10 years of monitoring data, the relative background dissolved oxygen of other sampling points in the Meandu Creek/Barker Creek catchment and the fact that, even at 70% saturation, the dissolved oxygen does not tend to fall below 6 mg/L.

Table 3.3 Summary of surface water quality results for the percent saturation of dissolved oxygen used to aid in the calculation of the site-specific water quality objective range, from 2007 to 2017

SITE	COUNT	PAST 10 YEARS (2007 TO 2017)						
		Mean	Min.	Max.	Median	20th %ile	80th %ile	95th %ile
W2	389	80	14	109	95	71	90	96

7 Aquatic Macroinvertebrate Monitoring Program of Meandu Creek – 3-Yearly Monitoring Event Report, Tarong Power Station. Report by Footprints Environmental Consultants, Appendix C of 3-Yearly report (Report No. JBT01-012-022).

4 CHARACTERISATION OF THE RECEIVING ENVIRONMENT (GROUNDWATER)

RFI Notice Requirements 7 and 8 are addressed in this section of the RFI Response report. These RFIs relate to information on ground-waters as presented in Section 6: *Characterisation of the Receiving Environment* of the EIR.

4.1 RFI REQUIREMENT 7

RFI REQUIREMENT:

Assignment of environmental values (EVs) for groundwater, based on identified and potential beneficial uses and protection of the relevant adjoining aquatic ecosystems. It is noted that section 6.3.2.1 of the report states that 'groundwater that occurs within alluvium is managed as surface water; therefore the groundwater EVs for Meandu Creek, as well as for Black Creek, are taken to be the same as the surface water EVs that have been defined above and in Appendix G'. As per point 2 and 3 above, it is not considered appropriate to assign groundwater in the area as having no EVs (for the section aligning with Meandu Creek upstream of the mine), or only industrial usage for the section upstream of Meandu Creek Dam.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Environmental Values for groundwater were presented in Section 6.3.2.1 of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by JBT.

4.1.1 RESPONSE

Based on available data (Department of Natural Resources Mines and Energy (DNRME) groundwater database) there are no registered groundwater bores within the Triassic coal measures (Tarong beds) within the Meandu Creek catchment. The only registered bores that exist within the Meandu Creek Dam catchment are in the upper reaches of the catchment and source groundwater from the Tertiary basalt, which is a distinct groundwater unit that is separate from the Triassic coal measures and Meandu Creek alluvium, adjacent to the Meandu Mine area. Figure 4.1 shows the location of Meandu Creek and the Meandu Creek catchment relative to registered private groundwater bores.

The bores within the basalt unit of the upper reaches of the catchment (i.e. registered bores 121734; 121578; 127810 and 135000 – refer Figure 4.1) are water supply bores likely to be used for stock watering. No alluvium groundwater bores are present along Meandu Creek upstream of the Meandu Mine.

Based on available information it is concluded by JBT that the environmental value for groundwater along Meandu Creek upstream of the Meandu Mine lease would be livestock watering. For Meandu Creek and Black Creek within the mining lease area, the environmental value of groundwater is assessed to be industrial use (consistent with surface water environmental values for the same area) as there are no other uses of groundwater within that section.

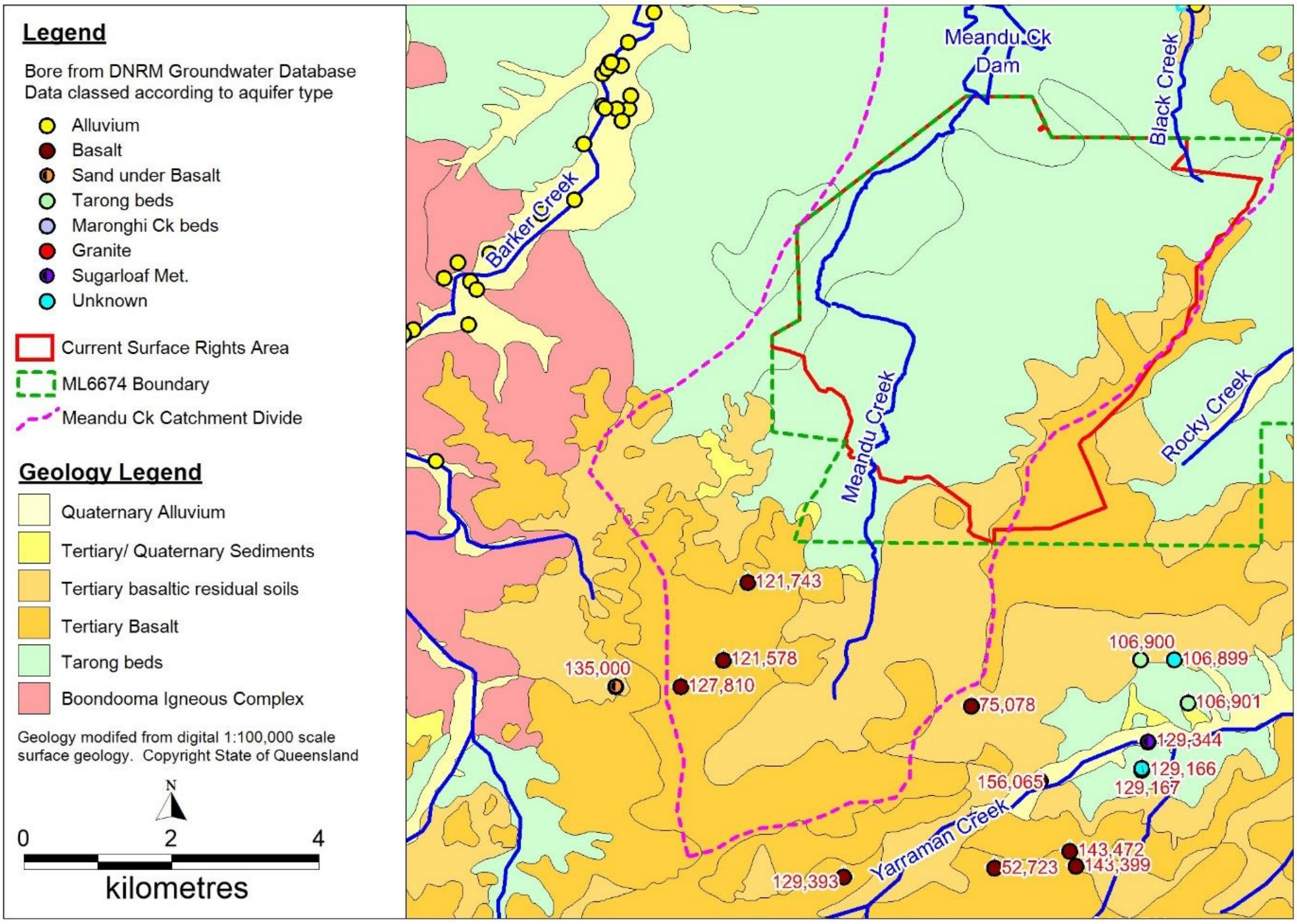

Figure 4.1 Location of registered groundwater bores (excluding site monitoring bores)

4.1.2 SUPPORTING INFORMATION

From Figure 4.1, as well as JBT's knowledge of groundwater occurrence and use in the region, it is observed that:

— There are no registered groundwater bores within the Triassic coal measures (Tarong beds) within the Meandu Creek catchment, for the area shown on Figure 4.1 (which includes the Meandu mining lease area). The only registered private bores that do exist within the Meandu Creek catchment are in the upper reaches of the catchment and source groundwater from the Tertiary basalt, which is a distinct groundwater unit that is separate from the Triassic coal measures and Meandu Creek alluvium that is adjacent to the Meandu Mine area.

— Based on JBT's understanding of groundwater use in the upper catchment of Meandu Creek it is determined that the bores are not utilised for domestic (drinking water) or irrigation use, but likely to be used for occasional stock watering requirements.

— On the basis of the above, it is JBT's conclusion that the environmental value for groundwater along Meandu Creek upstream of the Meandu Mine lease would be livestock watering.

— For Meandu Creek and Black Creek within the mining lease area, the environmental value of groundwater is assessed to be industrial use (consistent with surface water environmental values for the same area) as there are no other uses of groundwater within that section.

4.2 RFI REQUIREMENT 8

RFI REQUIREMENT:

A revised statement regarding the potential future impacts of AMD from the mine in accordance with requirement 4(ii) based on the EVs identified for groundwater.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Section 5.1.1.4 of the EIR

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by JBT.

4.2.1 RESPONSE

As discussed in Section 4.2.2 of the EIR, the conceptual model for the groundwater system at Meandu Mine considers that groundwater flowing towards Meandu Creek (including groundwater seepage from the North-West void where AMD has been identified) is captured by either Meandu Creek alluvium upstream of Meandu Creek Dam or by seepage to the ground surface to be collected via site drains and/or retention dams. In relation to the Meandu Creek alluvium groundwater bores, it has been assessed by JBT that no discernible AMD impacts are observed in groundwater bores that monitor the alluvium, which include GW40 and EA compliance monitoring bore GW39.

As outlined in Section 4.1 above and in Section 6.3.2.1 of the EIR, in terms of groundwater management, it is generally considered that groundwater which occurs within alluvium is managed as surface water. Therefore, the EV for surface waters and groundwater for the section of Meandu Creek adjacent to the mine (i.e. within the Meandu mining lease) is assessed to be the same (i.e. industrial use).

As outlined in Table 8.1 of the EIR future potential impacts on environmental values of surface water in Meandu Creek resulting from AMD at Meandu Mine are considered unlikely given:

- There is currently no evidence that AMD impacted water is have a discernible negative impact on the environmental values of the receiving environment.
- AMD issues at Meandu Mine will be managed through the implementation of changes to the mining and placement of mined materials. This include initial measures including interim lime-dosing and changes to monitoring and operations. Further changes are potentially required to the way mining mine waste, mine water, landform design and rehabilitation are managed at Meandu Mine.
- Water quality will continue to be managed in line with the Meandu Mine and Tarong and Tarong North power stations EAs including compliance monitoring and the Meandu Creek REMP.

The only groundwater quality parameter for which an increasing trend has been assessed to date is sulfate. The currently observed groundwater sulfate concentration at bore GW36 (groundwater bore adjacent to Meandu Creek (within regolith beneath spoil) – refer further to Section 7.1 and response to RFI Requirement 18) displays an increasing sulfate concentration trend that has been assessed to be related to AMD. It is assessed that the observed increase in sulfate concentration does not impact the EV of groundwater in the section of Meandu Creek adjacent to the mine.

For the section of Meandu Creek downstream of Meandu Creek Dam (where the surface water and groundwater environmental values are assessed to include aquatic ecosystem protection), the observed increase in sulfate concentration does not exceed the toxicity-based surface water quality objective that will be adopted in the future for sulfate. The analysis of historical surface water quality monitoring undertaken by ESP has shown that the median and 95^{th} percentile sulfate concentrations have complied with the WQO for aquatic ecosystems at all sites downstream of Meandu Creek Dam (refer to Section 3.4 and response to RFI Requirement 5 as well as Table 11 of Appendix B). The ongoing assessment of groundwater sulfate trends will be one of the primary means of assessing the potential for current and future impacts on groundwater environmental values.

4.2.2 SUPPORTING INFORMATION

No additional information is provided for this response.

5 SURFACE WATER INVESTIGATIONS

RFI Notice Requirements 9 to 14 are addressed in this section of the RFI Response report. These RFIs relate to information presented in Section 7: *Surface Water Investigations* of the EIR.

5.1 RFI REQUIREMENT 9

RFI REQUIREMENT:

Presentation of the results of a comparison of the water quality upstream of the mine, upstream of the Meandu Creek Dam and downstream of Meandu Creek Dam, to assess the impact of the AMD on Meandu Creek, including:

a. Box plots of all data for all parameters for: compliance sites (CP1, CP3, CP4); Meandu Creek sites upstream of Meandu Creek dam (CKMB, CKMD, CKMC, RD7 Road Crossing, Meandu Creek 1, Meandu Creek 2, Meandu Creek 3, Meandu Creek 4, Meandu Creek 5, Meandu Creek 6); Meandu Creek sites upstream of the Mine (CKMF/MCUS1, CKME/MCUS2); Meandu Creek dam (centre of dam); and downstream of the Meandu Creek dam (W3, W2, SW16).

b. Comparison of figures in Section 7.2.3.2 for all metal and metalloid compounds subject to testing during the March 2017 survey, as it is noted that only selected parameters were presented in Figure 7.7.

c. An analysis of the impact of AMD whenever a change in water quality is observed between the sites upstream of the mine, upstream of the Meandu Creek Dam and downstream of Meandu Creek Dam. It is noted that the current analysis does not consider impacts if they occur at levels below the selected WQOs, and where levels at the comparative site SW36 and Black Creek site BC1 are greater.

A revised statement regarding the potential future impacts of AMD from the mine in accordance with requirement 4(ii) based on the EVs identified for groundwater.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Section 7 of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

5.1.1 RESPONSE

PRESENTATION OF WATER QUALITY DATA RESULTS

A) BOXPLOTS

Boxplots and time series plots summarising water quality data are presented in Appendix B. It is noted that:

— A value of half the laboratory limit of reporting (LOR) has been used for values presented as <LOR. For the purposes of preparing box plots, time series plots and summary statistics, outliers have been removed in accordance with the guidance presented in the DES groundwater quality data assessment guidelines[8].

— As confirmed with DES in their written response to Stanwell's questions on the RFI Notice, data for some sites is patchy over time (i.e. sampling sites, times and parameters are not consistent in the historical data), and some sites do not have sufficient data for all parameters (e.g. filtered metals and nutrients).

[8] DSITI (2017) *Using Monitoring Data to Assess Groundwater Quality and Potential Environmental Impacts*, Department of Science, Information Technology and Innovation.

— In order to present the data on the plots, site names ‘Meandu Creek-1’ to ‘Meandu Creek-6’ have been shortened, and are displayed as ‘MC1’ to ‘MC6’.

B) MARCH 2017 SURVEY RESULTS

Concentrations of some metals and metalloid compounds, which were the subject of testing during the March 2017 survey, were equal to or below the laboratory LOR at all sites, and were therefore not graphed for the EIR. This included aluminium (dissolved only), chromium, copper, cadmium (dissolved only), lead, mercury, selenium, and vanadium.

Graphs for remaining metal and metalloids compounds subject to testing during the March 2017 survey are presented in Appendix C. Note at a value of half the LOR has been used for values presented as <LOR.

C) FURTHER ANALYSIS OF MARCH 2017 SURVEY RESULTS

Analysis of results from historical water quality monitoring completed by Stanwell (refer to plots and summary statistics presented in Appendix B) and the March 2017 survey completed by ESP (refer to graphs presented in Appendix C) shows that concentrations of some parameters differed between sites upstream of the mine, sites upstream of Meandu Creek Dam and sites downstream of Meandu Creek Dam. Parameters where concentrations differed included electrical conductivity, the concentrations of total dissolved solids and major ions (including sulfate), the concentration of nitrate and the concentrations of some metals and metalloids (Aluminium, Boron, Cobalt, Copper, Iron, Manganese, Nickel and Zinc).

While this may be indicative of an AMD-related impact, median concentrations of these parameters in Meandu Creek downstream of Meandu Creek Dam (i.e. median calculations from sites W3, W2 and SW16) did not exceed the relevant WQOs, and aquatic plant, macroinvertebrate and fish communities were in very good condition at these sites, indicating that water quality is unlikely to be impacting aquatic communities in the receiving environment.

These parameters are discussed in more detail in the supporting information below. Water quality parameters with concentrations that differed between locations and frequently exceeded the WQO are discussed in detail in Sections 4.2 and 4.3 of the Appendix G of the EIR.

REVISED STATEMENT ABOUT POTENTIAL FUTURE IMPACTS OF AMD FROM THE MINE

The additional analysis as presented in this RFI Response report does not alter the outcomes in response to Notice requirement 4(ii) regarding the potential future impacts of AMD from Meandu Mine as presented in the EIR (refer Table 8.1 of the EIR).

As outlined in the EIR, there is currently no evidence that AMD impacted water is having a discernible negative impact on the environmental values of the receiving environment. Water quality conditions, including hardness and pH, are likely to be reducing the toxicity of metals in the water. Further metals in sediments in Meandu Creek downstream of Meandu Creek Dam are likely to be immobilised by the availability of sulfide complexes and are unlikely to cause acute or chronic toxicity to aquatic flora and fauna. Where water quality conditions remain unchanged (i.e. remain within the historical range and/or comply with WQOs where applicable, and are monitored and managed in accordance with the current EA (EPLM00709113) and/or Meandu Creek REMP, potential AMD impacts on aquatic environmental values are considered unlikely.

The results of historical surface water monitoring completed at Meandu Mine and the Tarong and Tarong North power stations, and from the March 2017 survey, demonstrated that electrical conductivity levels and the concentration of major ions (including sulfate) and some dissolved metals are higher in Meandu Creek adjacent to and downstream of Meandu Mine that at comparative sites within the region. This may be indicative of an AMD-related impact, however, other factors such as the operation of the Tarong and Tarong North power stations and catchment inputs also influence some of these parameters. Regardless of this based on the information available, there is currently no evidence that AMD impacted water is having a discernible negative impact on the environmental values of the receiving environment.

Future potential impacts on environmental values of surface water in Meandu Creek resulting from AMD at Meandu Mine are considered unlikely given:

— There is currently no evidence that AMD impacted water is have a discernible negative impact on the environmental values of the receiving environment.
— AMD issues at Meandu Mine will be managed through the implementation of changes to the mining and placement of mined materials. This include initial measures including interim lime-dosing and changes to monitoring and operations. Further changes are potentially required to the way mining mine waste, mine water, landform design and rehabilitation are managed at Meandu Mine.
— Water quality will continue to be managed in line with the Meandu Mine and Tarong and Tarong North power stations EAs including compliance monitoring and the Meandu Creek REMP.

5.1.2 SUPPORTING INFORMATION

FURTHER ANALYSIS OF MARCH 2017 SURVEY RESULTS

ELECTRICAL CONDUCTIVITY

Overall, electrical conductivity upstream of Meandu Creek Dam was high when compared with the electrical conductivity levels at historical comparative sites upstream of the mine (refer Figure 1 of Appendix B). Historical monitoring also showed a general trend of increasing electrical conductivity levels at Meandu Mine compliance points CP3 (Meandu Creek prior to discharge to Meandu Creek Dam) and CP1 (Meandu Creek Dam) from 2013 to early 2017. Electrical conductivity at sites downstream of Meandu Creek Dam has occasionally exceeded the WQO since historical monitoring began (i.e. since 1984 at site W2, and 1998 at site SW16), however, median electrical conductivity in the receiving environment downstream of Meandu Creek Dam complies with the WQO when all available data is considered (refer Figure 1 of Appendix B), and also when only data for the past five years is considered (refer Table 4.5 in Appendix G of the EIR).

While it is possible that high electrical conductivity levels upstream of Meandu Creek Dam may be a result of AMD, there may also be other contributing factors such as ambient rainfall and catchment inflows, and potentially groundwater seepage, to these reaches of the creek. The groundwater assessment undertaken by JBT identified a high electrical conductivity zone from an airborne geophysics survey along Meandu Creek to the west of the mining area. This zone was interpreted to be related to a combination of factors, including:

— the presence of basaltic clays (from the southern area of the lease) within the Meandu Creek alluvium
— saline seepage from the mining area
— saline seepage from high salinity areas to the west of Meandu Creek (e.g. the drainage channel adjacent to GW78, with the electrical conductivity at GW78 >13,000 µS/cm).

Electrical conductivity is a broad indicator of the amount of dissolved inorganic material in waterways (i.e. total concentration of ions). Effects of electrical conductivity on the aquatic ecosystem are generally based on significant changes to the normal range of waterways (ANZECC & ARMCANZ 2000). Adverse biological effects are most likely to occur when there are changes to electrical conductivity (more so when there is an increase in electrical conductivity).

The electrical conductivity within Meandu Creek downstream of Meandu Creek Dam is maintained within a narrow range during normal mine and power station operating conditions, because the primary source of water to this reach comes from the continuous controlled and monitored discharges from Meandu Creek Dam. While the electrical conductivity levels recorded in Meandu Creek downstream of Meandu Creek Dam are relatively high when compared with the comparative sites surveyed in the region, the electrical conductivity level has not exceeded the WQO (which is based on the long-term 80th percentile value for the sites downstream of the dam) during the past four years. The results of current and historical aquatic biota monitoring confirm that electrical conductivity levels in Meandu Creek downstream of Meandu Creek Dam are not resulting in discernible negative impacts to aquatic biota.

While AMD-related impacts may have contributed to elevated electrical conductivity levels in the surface waters of Meandu Creek upstream of Meandu Creek Dam in the past four years, other factors such as climatic conditions and operation of the Tarong and Tarong North power stations also have a larger influence on the electrical conductivity levels in Meandu Creek Dam. Based on the information available, there is no evidence that electrical conductivity from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

TDS

Overall, the TDS level in Meandu Creek upstream of Meandu Creek Dam was high when compared with the TDS levels at historical comparative sites upstream of the mine (refer Figure 5 of Appendix B). TDS is strongly correlated with electrical conductivity, and followed a similar pattern over time (i.e. increased at sites on Meandu Creek upstream of Meandu Creek Dam in recent years, as noted above for electrical conductivity). Like electrical conductivity, while it is possible that high TDS levels upstream of Meandu Creek Dam may be a result of AMD, there may be other contributing factors such ambient rainfall and catchment inflows, and potentially groundwater seepage, to these reaches of the creek.

MAJOR IONS

Concentrations of most major anions and cations have varied substantially over time and between sites on Meandu Creek upstream of Meandu Creek Dam. Concentrations of all anions and cations (including chloride, fluoride, magnesium, potassium and sodium; sulfate is discussed separately below) at each site generally showed similar patterns over time (refer Figures 3 to 7 of Appendix D). Concentrations of ions on Meandu Creek adjacent to Meandu Mine and at the compliance sites during historical monitoring were higher than those recorded upstream of the mine (refer Figures 6 to 12 of Appendix B). There was a general trend of increasing ion concentrations at site CKMB (Meandu Creek adjacent to the mine) through the 1990s and 2000s, when this site was consistently monitored. Concentrations of ions in Meandu Creek adjacent to the mine measured more recently (since 2015) have generally been within the range recorded during historical monitoring. Similar to electrical conductivity, ions can be strongly influenced by many factors such as ambient rainfall and catchment inflows, groundwater seepage, and operation of the mine and power station. Therefore, it is possible that concentrations in water at these sites have been impacted by a combination of factors, including AMD.

SULFATE

Concentrations of sulfate in Meandu Creek (both upstream and downstream of Meandu Creek Dam) were higher than concentrations recorded at sites upstream of the mine and comparative sites in the region (refer Figure 11 of Appendix B). There has also been a general trend of increasing sulfate concentrations at Meandu Mine compliance points CP3 and CP4 in the past 10 years, which may be an AMD-related impact (refer Figure 11 of Appendix B). The trend of increasing sulfate concentrations was not observed at site CP1 in Meandu Creek Dam, where sulfate concentrations are also influenced by operation of the Tarong and Tarong North power stations. Concentrations of sulfate upstream of and within Meandu Creek Dam have historically been below the WQO (based on the stock watering guideline) (refer Table 11 of Appendix B), as well as the more stringent guideline of 545 mg/L outlined in Section 3.4 (response to RFI Requirement 5).

Similar to the historical results, concentrations of sulfate in March 2017 (Figure 5.1) were higher in Meandu Creek (upstream and downstream of Meandu Creek Dam) than at the comparative sites, but were below the preliminary toxicant guideline for sulfate in the Fitzroy River Basin (545 mg/L for 95% species protection, as discussed in Section 3.4 (response to RFI Requirement 5), and the WQO for protection of the stock watering EV (1000 mg/L). Note that the concentration of sulfate in Meandu Creek downstream of Meandu Creek Dam was also below the Fitzroy Basin Model Mining Condition of 250 mg/L, which is derived from the Australian drinking water guidelines.

Sulfate is a potential indicator of AMD as well as ash seepage and other general impacts from mining operations, so it is possible that a combination of factors including AMD are contributing to this pattern. As such, while AMD-related impacts have resulted in elevated sulfate concentrations in the surface waters released from Meandu Mine, there is no evidence of this impact extending to Meandu Creek Dam or Meandu Creek downstream of Meandu Creek Dam. Based on the information available, there is no evidence that the concentration of sulfate in mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

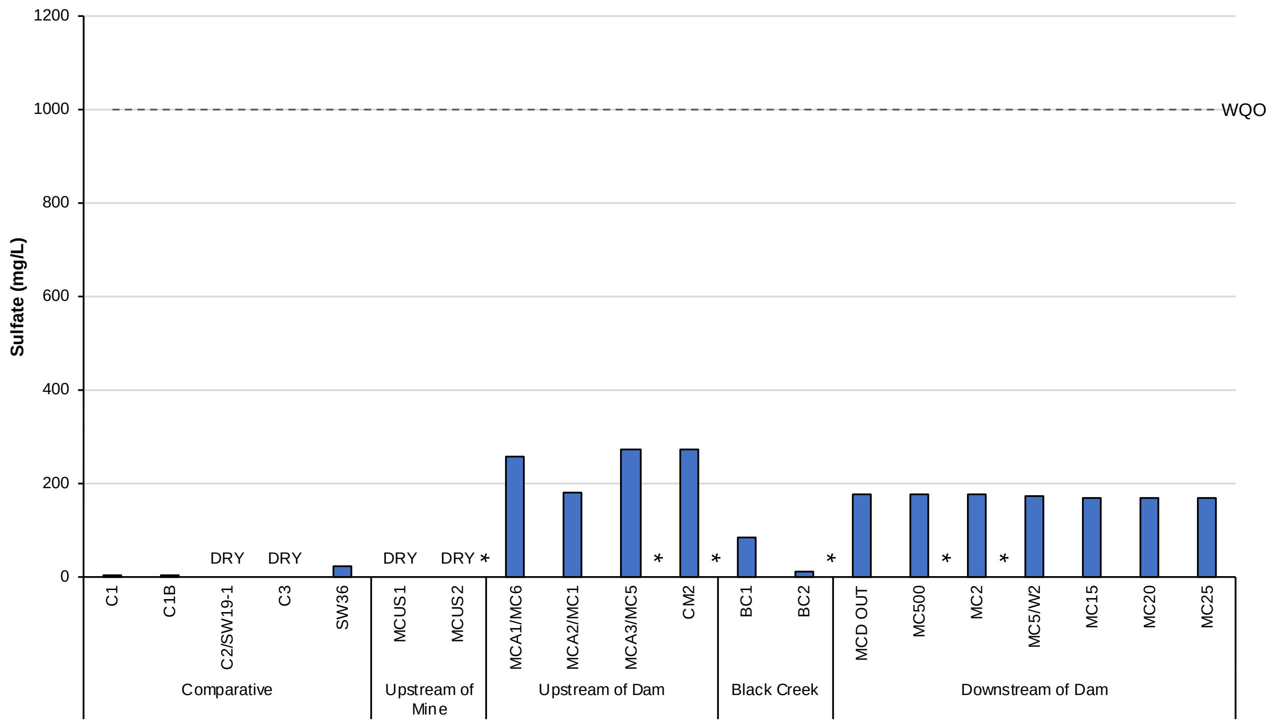

Figure 5.1 Sulfate in water (March 2017 survey)

NITRATE

Long-term median concentrations of nitrate have historically been higher at the Meandu Mine compliance point CP3 than at sites in Meandu Creek adjacent to and upstream of the mine (refer Figure 15 of Appendix B). However, long-term median concentrations were highest at site W2 (Meandu Creek - 2 km downstream of Meandu Creek Dam), suggesting external factors were influencing the concentration of nitrate. Concentrations of oxidised nitrogen (nitrate and nitrite) in Meandu Creek downstream of Meandu Creek Dam during the March 2017 survey varied between sites, also indicating that there were likely to be other (catchment) inputs of oxidised nitrogen (nitrate and nitrite) to Meandu Creek. While nitrate can be indicative of AMD impacted water, other sources, such as the liberation of elemental geological nitrogen at Meandu Mine, the operation of the Tarong and Tarong North power stations and catchment inputs also influence concentrations of nitrate.

ALUMINIUM

During historical monitoring, total aluminium has been relatively high at compliance site CP4 and at some sites on Meandu Creek adjacent to the mine, relative to sites downstream of Meandu Creek Dam (refer Figure 33 of Appendix B). However, the concentration of total aluminium upstream of the mine for the one data point available from historical monitoring was the highest recorded value during historical monitoring. The results of the March 2017 survey indicated that concentrations of total aluminium are also relatively high at the comparative sites, suggesting that total aluminium concentrations are likely to be naturally high in the study area (refer Figure 3 of Appendix C). Aluminium is not considered a key indicator of AMD as it can be indicative of other impacts associated with general mining activities, cooling water blowdown as well as naturally high concentrations in the region. Therefore, high concentrations at these sites may be due to a combination of factors.

Concentrations of dissolved aluminium during historical monitoring were greatest downstream of Meandu Creek Dam (there are no dissolved aluminium data available for reaches upstream of the mine; refer Figure 18 of Appendix B), but median and 80th percentile concentrations were below the WQO. This suggests that factors other than AMD are influencing the concentration of dissolved aluminium in the receiving environment downstream of the dam. Concentrations of dissolved aluminium were below the laboratory LOR at all sites in March 2017. Overall, these results suggest that aluminium is not having a discernible negative impact on the environmental values of the receiving environment, which is confirmed by the results of the biological monitoring.

BORON

Median concentrations of total and dissolved boron were similar upstream and downstream of Meandu Creek Dam during historical monitoring (refer Figures 20 and 35 of Appendix B); while no boron data are available for reaches upstream of the mine, it is considered likely that concentrations exceed the natural background concentrations. This was the case in the March 2017 survey, where concentrations of dissolved and total boron were generally lower at comparative sites than at sites upstream and downstream of Meandu Creek Dam (refer Figures 6 and 7 of Appendix C).

Concentrations of dissolved boron are consistently below the WQO at all sites both upstream and downstream of Meandu Creek Dam (apart from a few results from downstream of the dam in the late 1980s). Based on the information available, there is no evidence that the concentration of boron from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

COBALT

Concentrations of dissolved cobalt during historical monitoring were much higher at Meandu Mine compliance sites CP3 and CP4 than all other sites, including site CP1 on Meandu Creek Dam (refer Figure 23 of Appendix B and Figure 11 of Appendix D). While not directly applicable, concentrations of dissolved cobalt at these sites were generally below the WQO. Concentrations of cobalt in Meandu Creek Dam and Meandu Creek downstream of the dam were well-below the WQO during historical monitoring. In the March 2017 survey, cobalt was only detected (i.e. at concentrations above the laboratory LOR) at sites on Meandu Creek upstream of Meandu Creek Dam (adjacent to the mine), but the concentrations were well below the WQO (refer Figures 9 and 10 of Appendix C).

Cobalt is considered a key indicator of AMD, and it is likely that AMD is contributing to the higher concentrations at sites upstream of Meandu Creek Dam. However, while AMD-related impacts may be resulting in elevated cobalt concentrations in the surface waters released from Meandu Mine, there is no evidence of this impact extending to Meandu Creek Dam or Meandu Creek downstream of Meandu Creek Dam (refer Figure 23 in Appendix B). Concentrations are well-below the WQO for the protection of aquatic ecosystems and are often below the laboratory LOR in the receiving environment. Based on the information available, there is no evidence that the concentration of cobalt from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

COPPER

During historical monitoring, median concentrations of copper were highest at the release point at Meandu Creek Dam at site W3, and decreased slightly with distance downstream from sites W2 to SW16. While dissolved copper was detected at sites on Meandu Creek upstream of Meandu Creek Dam adjacent to the mine (including compliance sites CP3 and CP4), concentrations here were below those recorded in Meandu Creek Dam and the receiving environment. No historical data for concentrations of copper upstream of the mine are available, and concentrations of total and dissolved copper were below the laboratory LOR in the March 2017 survey.

Concentrations of copper have historically been high (compared to background concentrations in the waterways of the region) in the blowdown water from the Tarong and Tarong North power stations, due to the use of CCA-treated timber in the cooling towers. This can affect (increase) the concentration of copper in Meandu Creek Dam, though concentrations have decreased over recent years (2014–2017) relative to historical concentrations (refer Figure 24 of Appendix B and Figure 12 of Appendix D). No discernible impacts were detected in the March 2017 survey. Any historical elevations concentration in copper upstream of the dam are considered negligible in comparison to the historical influence of power station operations, and as such copper is not considered to be a key indicator of AMD. Concentrations of dissolved copper in recent years have also generally been below the WQO at all historical monitoring sites, indicating that they are unlikely to have an influence on aquatic communities. Results of biological sampling for aquatic plants, macroinvertebrates and fish in March 2017 also support this conclusion, with communities in good condition in the receiving environment.

IRON

In March 2017, the concentration of total iron was higher upstream of the dam (adjacent to the mine) than it was at sites downstream of the dam and comparative sites (refer Figure 12 of Appendix C). However, the concentrations of dissolved iron were below the LOR at all sites except at site MCA2/MC1 on Meandu Creek upstream of Meandu Creek Dam (adjacent to the mine), where it exceeded the WQO (refer Figure 11 of Appendix C). Historical monitoring has indicated that concentrations of total iron are within the range recorded at sites upstream of the mine (refer Figure 40 of Appendix B); no dissolved iron data are available for historical monitoring sites upstream of the mine.

Therefore, while the results indicate that it is possible that concentrations of iron, particularly total iron, may be influenced by AMD, historical monitoring demonstrates that concentrations of iron in Meandu Creek adjacent to the mine are generally consistent with concentrations in other reaches of the creek. As such, iron is not considered to be a reliable indicator of AMD impact on water quality in Meandu Creek. Median concentrations of dissolved iron in the receiving environment during historical monitoring and concentrations in the March 2017 survey were below the WQO and therefore were highly unlikely to have impacted aquatic communities; results of biological sampling in March 2017 supported this conclusion, with aquatic floral and faunal communities in good condition.

MANGANESE

Historical monitoring results showed that concentrations of dissolved manganese on Meandu Creek upstream of Meandu Creek Dam are variable, but were often highest (and while not directly applicable, above the WQO for ecosystem protection) at compliance point CP3 (refer Figure 27 of Appendix B and Figure 14 of Appendix D). However, concentrations of dissolved manganese at site CP1 on Meandu Creek Dam were much lower than those recorded at CP3, and were below the WQO. Whilst manganese has not been routinely monitored in Meandu Creek downstream of Meandu Creek Dam, available data indicates that concentrations of manganese in Meandu Creek downstream of Meandu Creek Dam are within the range recorded at comparative sites, and concentrations of dissolved manganese are below the WQO for the protection of aquatic ecosystems. This is consistent with the results for the March 2017 survey, which are described in detail in Section 4.3.4.3 of Appendix G of the EIR.

As such, while AMD-related impacts may be resulting in elevated manganese concentrations in the surface waters released from Meandu Mine, there is no evidence of this impact extending to Meandu Creek Dam or Meandu Creek downstream of Meandu Creek Dam. Based on the information available, there is no evidence that the concentration of manganese from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

NICKEL

Concentrations of dissolved nickel were much higher at Meandu Mine compliance site CP3 than at all other sites, including site CP1 on Meandu Creek Dam (refer Figure 29 of Appendix B and Figure 16 of Appendix D). While not directly applicable, the median concentration of dissolved nickel at site CP3 was below the hardness-modified WQO for nickel. There are no historical monitoring data for concentrations of nickel upstream of the mine. In March 2017, concentrations of nickel in Meandu Creek Dam and Meandu Creek downstream of the dam were higher than those recorded at the comparative sites in the region (refer Figure 17 of Appendix C), but well-below the hardness-modified WQO.

Nickel can be present in the environment through natural and anthropogenic sources. It is possible that AMD-related impacts may be resulting in elevated nickel concentrations in the surface waters released from Meandu Mine at CP3. However, there are also likely to be catchment sources of nickel to Meandu Creek (e.g. concentrations of nickel in the sediment of Meandu Creek upstream of Meandu Mine were relatively high). Based on the information available, there is no evidence that the concentration of nickel from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

ZINC

Concentrations of dissolved zinc were much higher at Meandu Mine compliance site CP3 than at all other sites, including site CP1 on Meandu Creek Dam (refer Figure 32 of Appendix B and Figure 17 of Appendix D). While not directly applicable, concentrations of dissolved zinc at site CP3 have generally been below the hardness-modified trigger value for zinc. Long-term median concentrations of dissolved zinc in Meandu Creek Dam and Meandu Creek downstream of the dam are low (close to the laboratory LOR) and below the WQO (refer Figure 32 and Table 32 of Appendix B).

It is possible that AMD-related impacts may be resulting in elevated zinc concentrations in the surface waters released from Meandu Mine. However, there is no evidence of this impact extending downstream to Meandu Creek Dam or the receiving environment. Based on the information available, there is no evidence that the concentration of zinc from mine impacted water is having a discernible negative impact on the environmental values of the receiving environment.

5.2 RFI REQUIREMENT 10

RFI REQUIREMENT:

Revision of the labelling of monitoring sites on maps to ensure consistency between Figures (the main report and Appendix G; e.g. CKMF/MCUS1 and CKME/MCUS2).

RELEVANT SECTION EIR (SEPTEMBER 2018):

Figures 7.1 and 7.4 of the EIR and Figure 2.1 and 2.2 of Appendix G: Surface water quality investigation report of the EIR.

SOURCE OF SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

5.2.1 RESPONSE

Revised maps displaying consistent labels (specifically labels for sites CKMF/MCUS1 and CKME/MCUS2) between figures in the main EIR report and Appendix G are presented in Figure 5.2 and Figure 5.3.

Figure 5.2 Approximate location of historical water quality monitoring sites

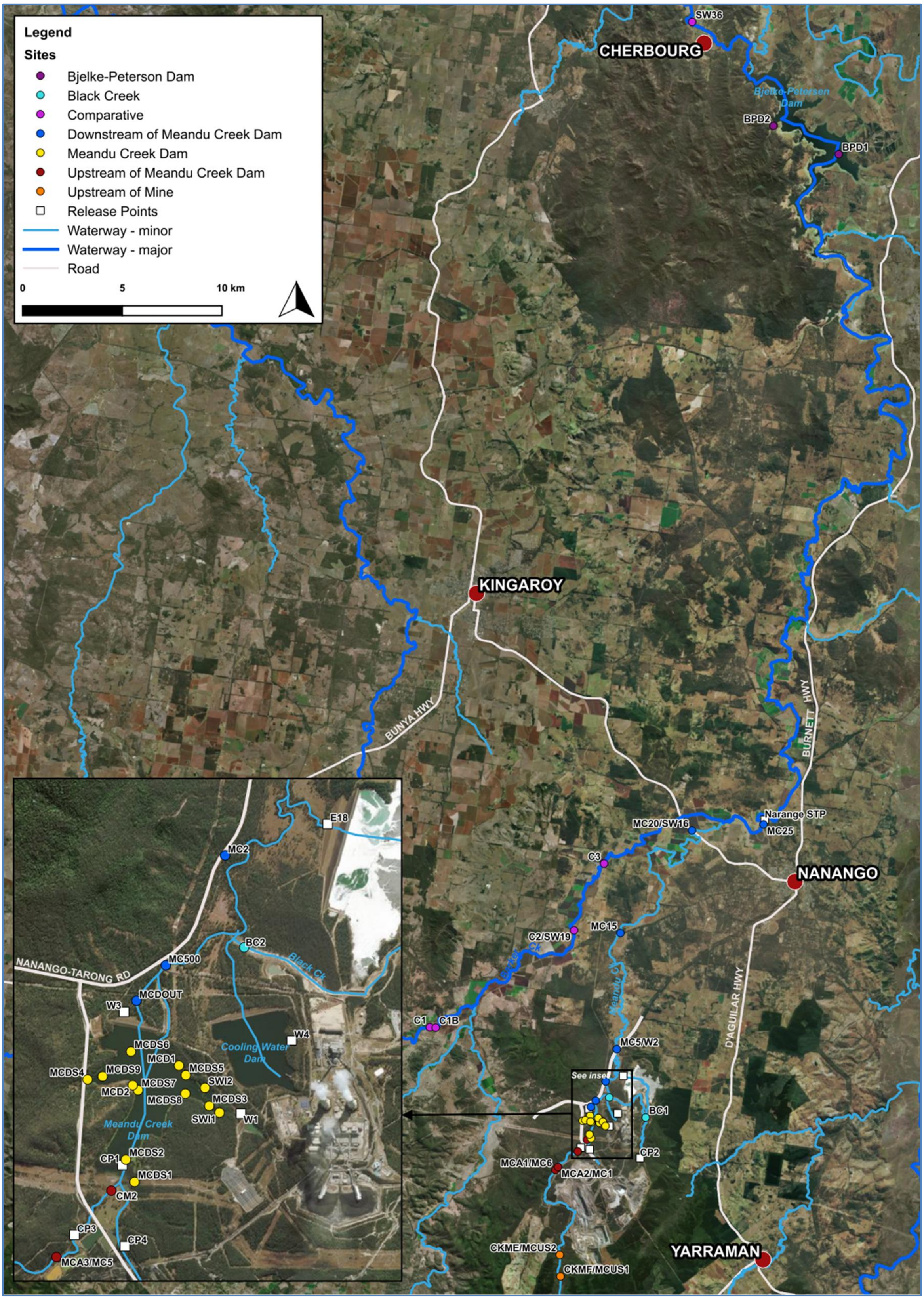

Figure 5.3 Waterway sites sampled during the March 2017 field survey

5.2.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

5.3 RFI REQUIREMENT 11

RFI REQUIREMENT:

Revision of the water quality data presented on Figures in Section 7 and Appendix G of the report to ensure the data is clearly legible and at a scale that can be read (e.g. Figure 7.2 and Figure 7.8).

RELEVANT SECTION EIR (SEPTEMBER 2018):

Section 7 and Appendix G of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

5.3.1 RESPONSE

Figures summarising water quality data in Section 7 and Appendix G of the EIR have been increased in size so that axes are clearly legible and at a scale that can be read. These are presented in Appendix D.

5.3.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

5.4 RFI REQUIREMENT 12

RFI REQUIREMENT:

Raw surface water and groundwater quality data that has been utilised in the report in an Excel format for further analysis by the department.

RELEVANT SECTION EIR (SEPTEMBER 2018):

Section 7 and Appendix G of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP and JBT.

5.4.1 RESPONSE

Raw surface water data has been provided in Excel format in Appendix E. The dataset includes all outliers that were removed for the purposes of preparing the graphs and summary statistics presented in Appendix B. Raw groundwater quality data is also provided in Appendix E.

5.4.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

5.5 RFI REQUIREMENT 13

RFI REQUIREMENT:

Additional information in relation to the historical macroinvertebrate surveys in Section 7.2.7.1 of the report. The data that is provided is pooled for all sites, and insufficient data has been provided to support the statement that 'Richness at sites on Meandu Creek downstream of Meandu Creek Dam is generally within or greater than the range at the comparative sites'.

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 13 relates to Section 7.2.7.1: *Historical survey results* of the EIR, which presents the results for historical surveys of macroinvertebrate within Meandu Creek Dam, Meandu Creek downstream of Meandu Creek Dam and comparative sites on Barkers Creek.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

5.5.1 RESPONSE

Historical surveys of macroinvertebrate communities have been completed in the vicinity of Meandu Mine for Stanwell periodically from 1998 to 2014. Additional information from these historical surveys is presented below, with a focus on most recent surveys from 2012 (EMPS 2013[9]), and 2014 (Footprints 2014[10]) (i.e. the two most recent surveys prior to the March 2017 survey).

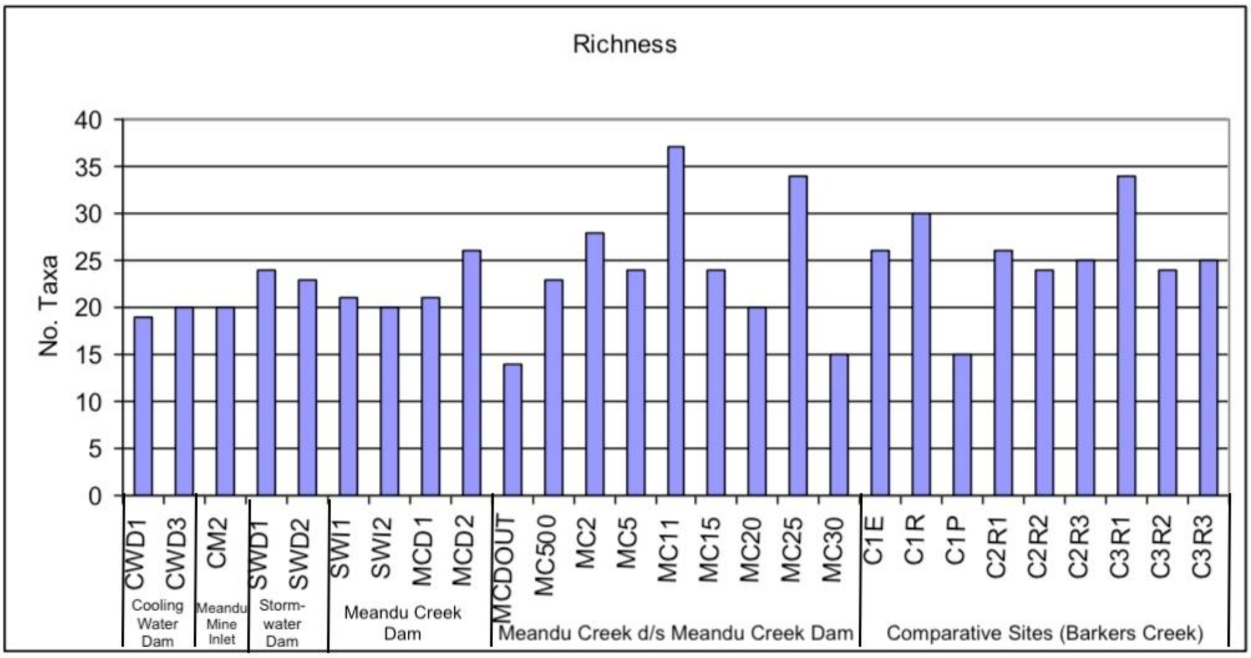

Figure 5.4 Number of taxa present in each sample in the 2014 survey (adapted from Footprints 2014)

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9 EMPS (2013) *Aquatic Ecological Effects of Tarong Power Generation Operations on Meandu Creek, Review 1998-2012*, report prepared by Environmental Management and Planning Services for Tarong Energy.

10 Footprints (2014) *Aquatic Macroinvertebrate Monitoring Program if Meandu Creek: 3 Yearly Monitoring Event Report, Tarong Power Station,* report prepared by Footprint Environmental Consultants for Stanwell Corporation Limited.

In the 2014 survey (the survey immediately prior to the March 2017 survey), taxonomic richness in Meandu Creek downstream of Meandu Creek Dam ranged from 14 at site MCDOUT (Meandu Creek at the Meandu Creek Dam outlet) to 36 at site MC11 (11 km downstream of the Meandu Creek Dam outlet), with most samples having 20–30 taxa (Footprints 2014). The number of taxa recorded in samples at the comparative sites ranged from 15 to 34, with most samples having 20–25 taxa (refer Figure 5.4). That is, the number of taxa found at the receiving environment sites was generally within the range recorded at the comparative sites.

In 2012 (the survey prior to the 2014 survey), taxonomic richness in Meandu Creek downstream of Meandu Creek Dam ranged from 10 at site MC500 (500 m downstream of the Meandu Creek Dam outlet) to 16 at site MC25 (25 km downstream of the Meandu Creek Dam outlet). Only one comparative site was sampled in 2012 (site C1), with 10 taxa recorded (Figure 5.5). That is, all sites in Meandu Creek downstream of Meandu Creek Dam had equal or greater taxonomic richness compared to the comparative site sampled.

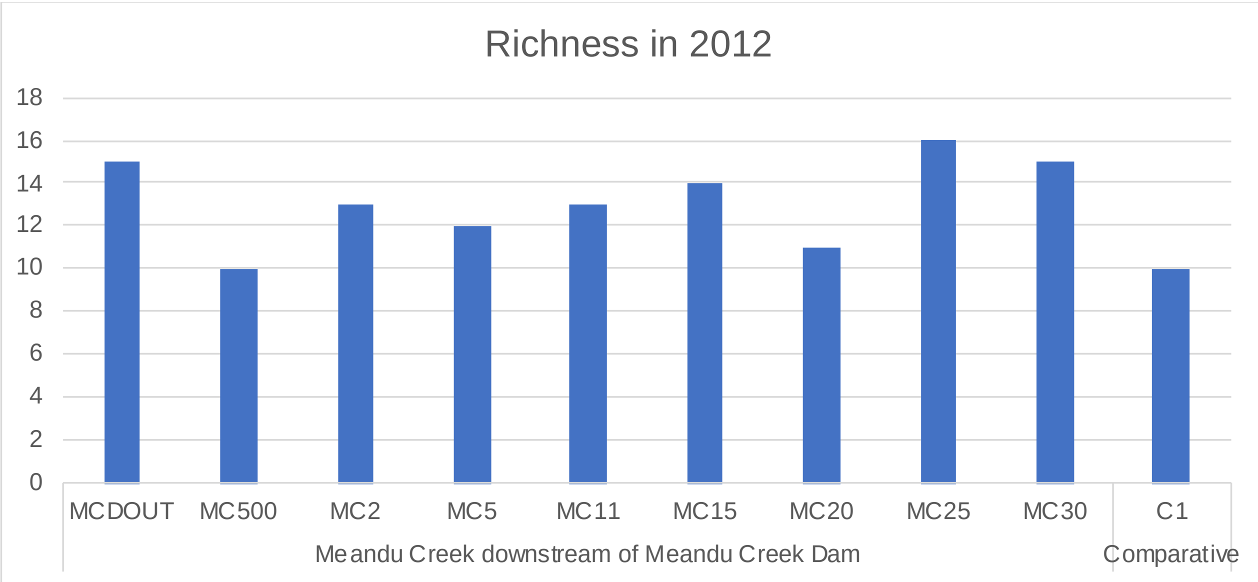


Figure 5.5 Number of taxa present in each sample in the 2012 survey (created from data provided in Footprints 2014)

A review of historical sampling results from 1998 to 2012 found a similar pattern, with between 3 and 29 taxa found in each sample collected in Meandu Creek downstream of Meandu Creek Dam and between 6 and 25 taxa found in each sample collected from comparative sites, with the results varying depending on site and survey (EMPS 2013). Except for one sample at site MC2 in June 2011, the taxonomic richness of all other samples collected from sites on Meandu Creek downstream of Meandu Creek Dam was within or above the range recorded at comparative sites (refer Table 5.1).

Table 5.1 Minimum and maximum number of taxa recorded per sample in surveys completed from October 1998 to June 2012 (created from data provided in EMPS 2013)

SITE	NUMBER OF TAXA PER SAMPLE FROM 1998 TO 2012*	
	Minimum	**Maximum**
MCDOUT	6	19
MC500	9	20
MC2	3	25
MC5	8	24
MC11	8	21
MC15	7	24
MC20	5	22
MC25	13	25
MC30	10	29
MC40	8	26
Comparative Sites	6	25

* Values read from graphs presented in EMPS (2013)

5.5.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

5.6 RFI REQUIREMENT 14

RFI REQUIREMENT:

Information to clarify whether the calculated macroinvertebrate indices in Section 7.2.7.2 are only for the most recent survey (2017).

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 14 relates to Section 7.2.7.2 *Indices* of the EIR, which presents the results for standard macroinvertebrate indices.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

5.6.1 RESPONSE

The macroinvertebrate indicates presented in Section 7.2.7.2 of the EIR are calculated from the 2017 data only. Results from historical surveys are summarised separately in Section 7.2.7.1 of the EIR with further details provided in the response to RFI Requirement 13 as requested.

5.6.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

6 IMPACTS TO THE RECEIVING ENVIRONMENT

RFI Notice Requirements 15 to 17 are addressed in this section of the RFI Response report. These RFI relate to information presented in Section 8: *Impacts to the Receiving Environment* of the EIR.

6.1 RFI REQUIREMENT 15

RFI REQUIREMENT:

Revised assessment of potential impacts to the receiving environment, particularly giving consideration to the points raised in items 2, 3, 5, 6, 7 and 8. The department suggests that AMD from Meandu Mine also appears to have potential impacts in terms of elevated concentrations of aluminium, arsenic, copper, and iron in the waters discharged to Meandu Creek and Meandu Creek Dam.

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 15 relates to Section 8 of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

6.1.1 RESPONSE

Analysis of historical monitoring data over time, and results from the March 2017 field survey, shows increased concentrations of some parameters at sites upstream and downstream of Meandu Creek Dam, compared to sites upstream of Meandu Creek mine (including electrical conductivity, total dissolved solids, major ions (including sulfate), nitrate and some metals and metalloids (aluminium, boron, cobalt, copper, iron, manganese, nickel and zinc).While this may be indicative of an AMD-related impact the concentrations of some parameters are also influenced by other factors including ambient rainfall and runoff, potentially groundwater and general operation of the mine and Tarong and Tarong North power stations. These parameters are discussed in detail in Section 5.1 (response to RFI Requirement 9c) and this discussion is not repeated here.

ALUMINIUM

As discussed in Section 5.1 (response to RFI Requirement 9), the limited available data for upstream and comparative sites indicates that total aluminium concentrations are likely to be naturally high in the study area (refer Figure 18 and 33 and Tables 18 and 33 of Appendix B). Aluminium is not considered a key indicator of AMD as it can be indicative of natural sources and other impacts associated with general mining activities. Therefore, the high concentrations of aluminium identified adjacent to and downstream of the mine may be due to a combination of factors. In the March 2017 survey, concentrations of total aluminium at sites immediately downstream of Meandu Creek Dam were within the range of concentrations at comparative sites, and aquatic communities at these sites were in good condition, indicating no discernible impact to the receiving environment.

ARSENIC

Concentrations of total and dissolved arsenic adjacent to the mine have historically been lower than those recorded in Meandu Creek Dam and the receiving environment downstream of the dam, and consistent with the concentrations at sites upstream of the mine (apart from isolated high concentrations recorded around 1985) (refer Figures 19 and 34 of Appendix B). In March 2017, concentrations of arsenic were below the laboratory LOR at sites on Meandu Creek upstream of Meandu Creek Dam and higher at sites downstream of the dam, decreasing with distance downstream to site MC20 (refer Figures 4 and 5 of Appendix D). The results are likely to reflect influences from the use of CCA-treated timber at the Tarong and Tarong North power stations. Arsenic is therefore not an indicator of AMD at Meandu Mine. Concentrations of arsenic in the receiving environment downstream of Meandu Creek Dam were below the WQO and therefore are highly unlikely to impact aquatic communities; results of biological sampling in March 2017 supported this conclusion, with aquatic floral and faunal communities in good condition.

COPPER

Results of historical monitoring of copper are discussed in Section 5.1 (response to RFI Requirement 9c), and indicate that historical elevated concentrations of copper were likely associated with blowdown water from the Tarong and Tarong North power stations (due to the historical use of CCA-treated timber in the cooling towers), and that concentrations are decreasing over time (refer Figure 24 and Table 24 of Appendix B, which shows that overall, median concentrations of copper are higher at sites downstream of Meandu Creek Dam than at sites upstream). Copper is therefore not considered to be a key indicator of AMD. Results of water quality and biological sampling for aquatic plants, macroinvertebrates and fish in March 2017 also support this conclusion, with concentrations of copper below the laboratory LOR (and therefore below the WQO and highly unlikely to be causing environmental harm), and communities in good condition in the receiving environment.

IRON

Results of historical monitoring of iron are discussed in Section 5.1 (response to RFI Requirement 9), and indicate that while it appears that AMD may have potentially impacted concentrations of iron in Meandu Creek upstream of Meandu Creek Dam (adjacent to the mine), in the March 2017 survey, concentrations of total iron during historical monitoring were within the range recorded at the sites upstream of the mine. Furthermore, concentrations of iron historically were higher at sites downstream of Meandu Creek Dam than at sites upstream, indicating other factors affect the concentration of iron in the receiving environment. Iron is therefore not considered to be a reliable indicator of AMD impact on water quality in Meandu Creek. Regardless of the source of iron, median concentrations of dissolved iron have historically been below the WQO and considered unlikely to have impacted aquatic communities; results of biological sampling in March 2017 support this conclusion, with aquatic floral and faunal communities in good condition downstream of Meandu Creek Dam.

REVISED ASSESSMENT OF IMPACTS TO THE RECEIVING ENVIRONMENT

Concentrations of aluminium, arsenic copper, and iron in the receiving environment downstream of Meandu Creek Dam were generally below the WQOs and therefore are highly unlikely to impact aquatic communities; results of biological sampling support this conclusion, with aquatic floral and faunal communities in good condition in the receiving environment.

The additional analysis as presented in this RFI Response report does not alter the outcomes regarding the potential impacts of AMD from Meandu Mine on the receiving environment as presented in the EIR (refer Table 8.1 of the EIR as well as Section 5.1 of this report (response to RFI Requirement 9c)).

6.1.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

6.2 RFI REQUIREMENT 16

RFI REQUIREMENT:

Comparison of the concentration of sulfate upstream of the Meandu Creek Dam against the sulfate concentration upstream of the mine with consideration of the stock watering guideline (1,000mg/L) (refer to point 5 above).

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 16 relates to Section 11.3.1.2 of Appendix G of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

6.2.1 RESPONSE

Median concentrations of sulfate historically monitored upstream of Meandu Creek Dam (adjacent to the mine) were between 6 and 329 mg/L, and higher than concentrations upstream of the mine. As shown in Figure 11 of Appendix B concentrations of sulfate are higher at sites adjacent to the mine - MC1, MC3, MC4, MC5 and MC6, CKMB, CP3 and CP4 than at upstream sites CKMF and CKMC (refer also to Section 3.4 response to RFI Requirement 5). Concentration of sulfate are also higher than at other comparative sites in the region sampled in March 2017 (as acknowledged in the EIR, see Section 11.3.1.2 of Appendix G of the EIR). Median concentrations at all sites during all historical monitoring events were below the stock watering guideline of 1,000 mg/L, and below the preliminary indicative guideline (to protect 95% of species from toxic effects) for the receiving environment of 545 mg/L noting that these WQOs act as a guideline only and do not strictly apply to water quality in Meandu Creek upstream of Meandu Creek Dam within the mining lease (refer to Section 3.4 response to RFI Requirement 5).

6.2.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

6.3 RFI REQUIREMENT 17

RFI REQUIREMENT:

The conclusion in Section 8.1.1.7 of the report that no impact is occurring should be reassessed on the basis that Tables 4.3, 4.4 and 4.5 in Appendix G indicate there are elevated zinc concentrations at the first site downstream of the release point compared to the further downstream monitoring point.

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 17 relates to Section 8.1.17 of the EIR

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was provided by ESP.

6.3.1 RESPONSE

Analysis of historical water quality data from compliance sites in Meandu Creek upstream of Meandu Creek Dam (i.e. sites CP3 and CP4) indicates that concentrations of zinc were relatively high at those sites when compared to all other monitoring sites (refer Figure 32 of Appendix B). This suggests that AMD from Meandu Mine may have contributed to elevated concentrations of zinc in the surface waters received from the mine upstream of Meandu Creek Dam.

Concentrations of zinc at Meandu Creek Release point (W3) (median 6 µg/L) may be influenced by elevated concentration of dissolved zinc at Meandu Mine release point into Meandu Creek Dam (CP3) (median 55 µg/L), however, concentrations of zinc at site CP1 (in the upper reaches of Meandu Creek Dam) were below the LOR, suggesting that there is substantial dilution and attenuation in Meandu Creek Dam.

Regardless of exact contribution of Meandu Mine water releases on the zinc downstream of Meandu Creek Dam, concentrations in the receiving environment were low and below the hardness-modified trigger values (refer to boxplots in Figure 32 and summary statistics in Table 32 of Appendix B). Therefore, the concentrations of zinc are highly unlikely to impact aquatic communities; results of biological sampling in March 2017 supported this conclusion, with aquatic floral and faunal communities in good condition.

Based on this analysis, there is no basis on which to reassess the conclusions presented in Section 8.1.1.7 of the EIR.

6.3.2 SUPPORTING INFORMATION

As well as being measured at compliance sites upstream of Meandu Creek Dam, historical and ongoing monitoring of the concentration of zinc is undertaken by Stanwell at the Meandu Creek Dam release point (i.e. site W3), and at two sites downstream of Meandu Creek Dam: site W2 (5 km downstream of Meandu Creek Dam), and site SW16 (20 km downstream of Meandu Creek Dam). Summary statistics of results from this historical monitoring show that concentrations of zinc were high at site CP3 upstream of Meandu Creek Dam, below the LOR at site CP1 (in the upper reaches of Meandu Creek Dam), suggesting substantial dilution and attenuation in Meandu Creek Dam. Zinc concentrations then increased slightly at the release point at site W3 (though were still lower at site W3 than at site CP3 upstream).. Concentrations then declined with distance downstream from site W2 to site SW16 (refer to summary statistics in Table 32 of Appendix B). Regardless of this, concentrations were still well below the hardness-modified trigger values for zinc at all three sites (W3, W2 and SW16). Results also suggested that the concentrations of zinc may be declining over time, with all summary statistics (i.e. minimum, maximum, median concentrations and 20th, 80th and 95th percentiles) for sites W2 and SW16 calculated over the past four years being lower when compared with those calculated from the entire monitoring period (noting that there are fewer data points for site SW16 than for the other two monitoring sites) (Table 6.1 and Table 6.2).

This suggests that AMD from Meandu Mine, may have contributed to a slight elevation in concentrations of zinc in the surface waters in the receiving environment downstream of Meandu Creek Dam, but that the dam is contributing to the dilution and attenuation of zinc concentrations. Regardless of this, concentrations were very close to the LOR and well below the hardness-modified WQOs for zinc. This indicates that although AMD may be influencing the concentration of zinc in water:

— the magnitude of this impact is minor

— operation of the power stations is also likely influencing concentrations of zinc in the receiving environment

— these concentrations are unlikely to be having a discernible impact on the aquatic ecological value of Meandu Creek downstream of Meandu Creek Dam (given that they are still very low in the surface water downstream).

In the March 2017 field survey, there was no evidence to suggest that AMD was influencing concentrations of zinc in the receiving environment downstream of Meandu Creek Dam, with concentrations of dissolved (i.e. bioavailable) and total zinc remaining below the LOR and below the WQO at all sites downstream of Meandu Creek Dam. The concentration of zinc was higher at site CM2 (inlet to Meandu Creek Dam from Meandu Mine, i.e. upstream of Meandu Creek Dam) than at all other sites, but apart from this site there was also no difference in concentrations of zinc between sites upstream and downstream of Meandu Creek Dam.

Table 6.1 Summary of surface water quality results for the concentration of dissolved zinc (µg/L) from 1983 to June 2017

SITE	ALL AVAILABLE DATA (1983–2017)						
	Count	Min.	Max.	Median	20th %ile	80th %ile	95%ile
W3	119	<LOR	64	7	<LOR	13	25
W2	165	<LOR	50	5	<LOR	11	24
SW16	6	<LOR	2	<LOR	<LOR	<LOR	<LOR

Table 6.2 Summary of surface water quality results for the concentration of dissolved zinc (µg/L) from June 2013 to June 2017

SITE	PAST 4 YEARS (JUNE 2013–JUNE 2017)						
	Count	Min.	Max.	Median	20th %ile	80th %ile	95%ile
W3	48	<LOR	64	5	<LOR	9	30
W2	49	<LOR	35	<LOR	<LOR	6	11.6
SW16	3	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR

7 APPENDIX F: CONTAMINANT HYDROGEOLOGICAL ASSESSMENT

RFI Notice Requirement 18 is addressed in this section of the RFI Response report.

7.1 RFI REQUIREMENT 18

RFI REQUIREMENT:

Delineation of impacts to groundwater, in particular, for elevated electrical conductivity.

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 18 relates to 5.1.1.4 of the EIR

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was prepared by JBT.

7.1.1 RESPONSE

As presented in Section 5.1.1.4 of the EIR, JBT concluded that the primary indicators of AMD seepage include pH, sulfate, and metals/ metalloids including cobalt, iron, manganese, nickel and zinc. It was assessed that the most reliable AMD indicator of potential impacts to groundwater is sulfate.

Based on available data it is concluded that the background concentration of sulfate within groundwater (Triassic coal measures adjacent to Meandu Creek) is generally less than 244 mg/L, though AMD impacts, based on an increasing trend in sulfate concentrations, are observable in bores GW25, GW34, GW35, GW36, GW75 and GW76 (refer Figure 7.1 for bore locations and Figure 7.2 for interpreted area of AMD impacts to groundwater).

Based on assessment of electrical conductivity data for both the Triassic coal measures and the Meandu Creek alluvium, it is concluded that there is no definitive evidence of impact on the electrical conductivity of groundwater from AMD within or reporting to Meandu Creek. Electrical conductivity can vary over a wide range for groundwater units at the Meandu Mine site, with the occurrence of high electrical conductivity values in groundwater unimpacted by mining and areas of confirmed AMD seepage (e.g. Bullgang Drain and Ramp 7-1) showing relatively low electrical conductivity values.

However, sulfate is assessed to be a more reliable indicator of groundwater impacts from AMD and will continue to be one of the primary parameters used to assess for AMD impacts as part of ongoing monitoring.

The area of interpreted AMD impacts to groundwater is shown on Figure 7.2 and includes the location of the bores listed above, as well as surface water sites where seepage from the North-West Backfilled Pit has been observed, including Bullgang Corner and Ramp 7-1. There is no evidence to date of AMD-related impacts in sulfate data at downstream bores that monitor the Meandu Creek alluvium (GW39 and GW40).

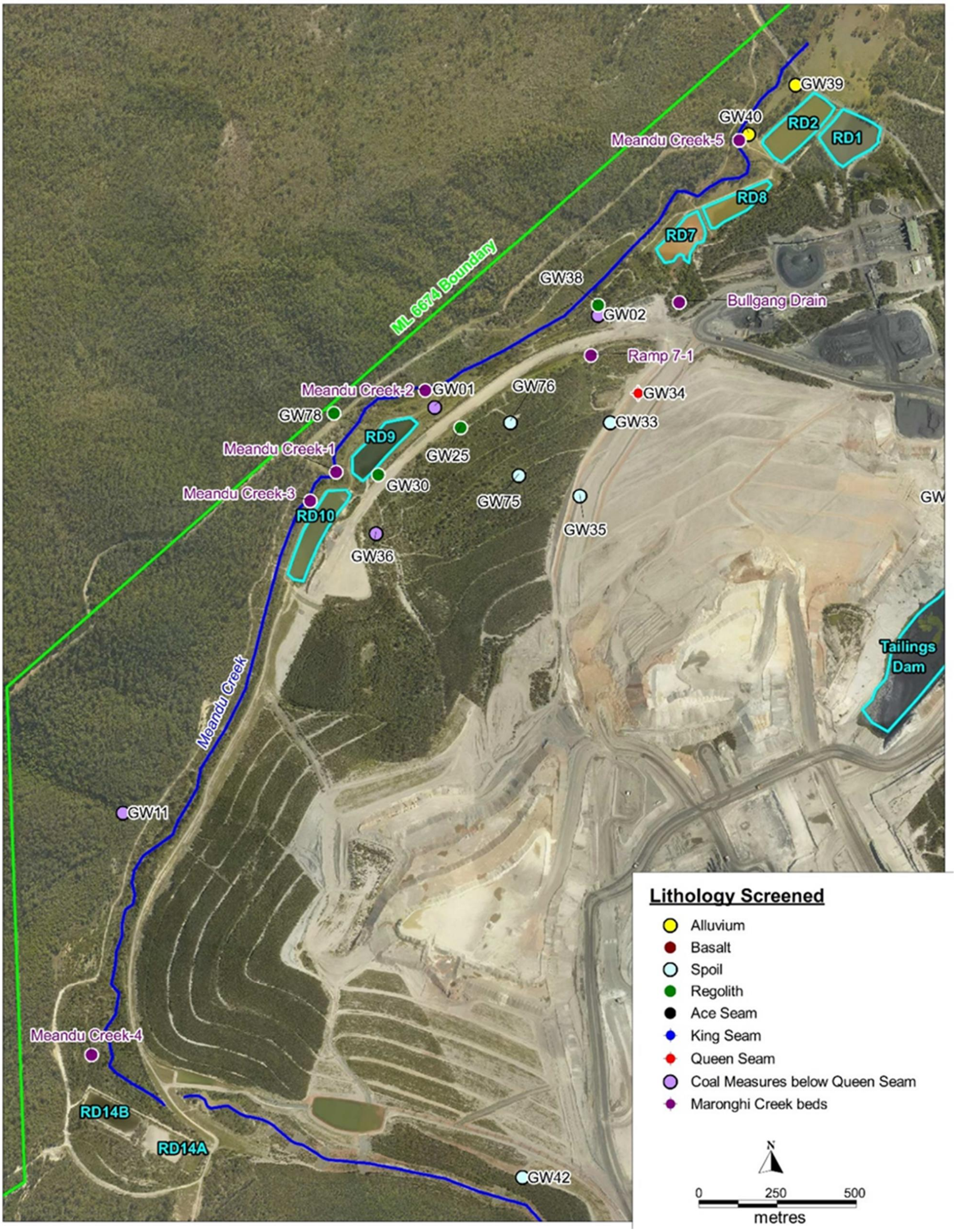


Figure 7.1 Location of bores and retention dams adjacent to Meandu Creek

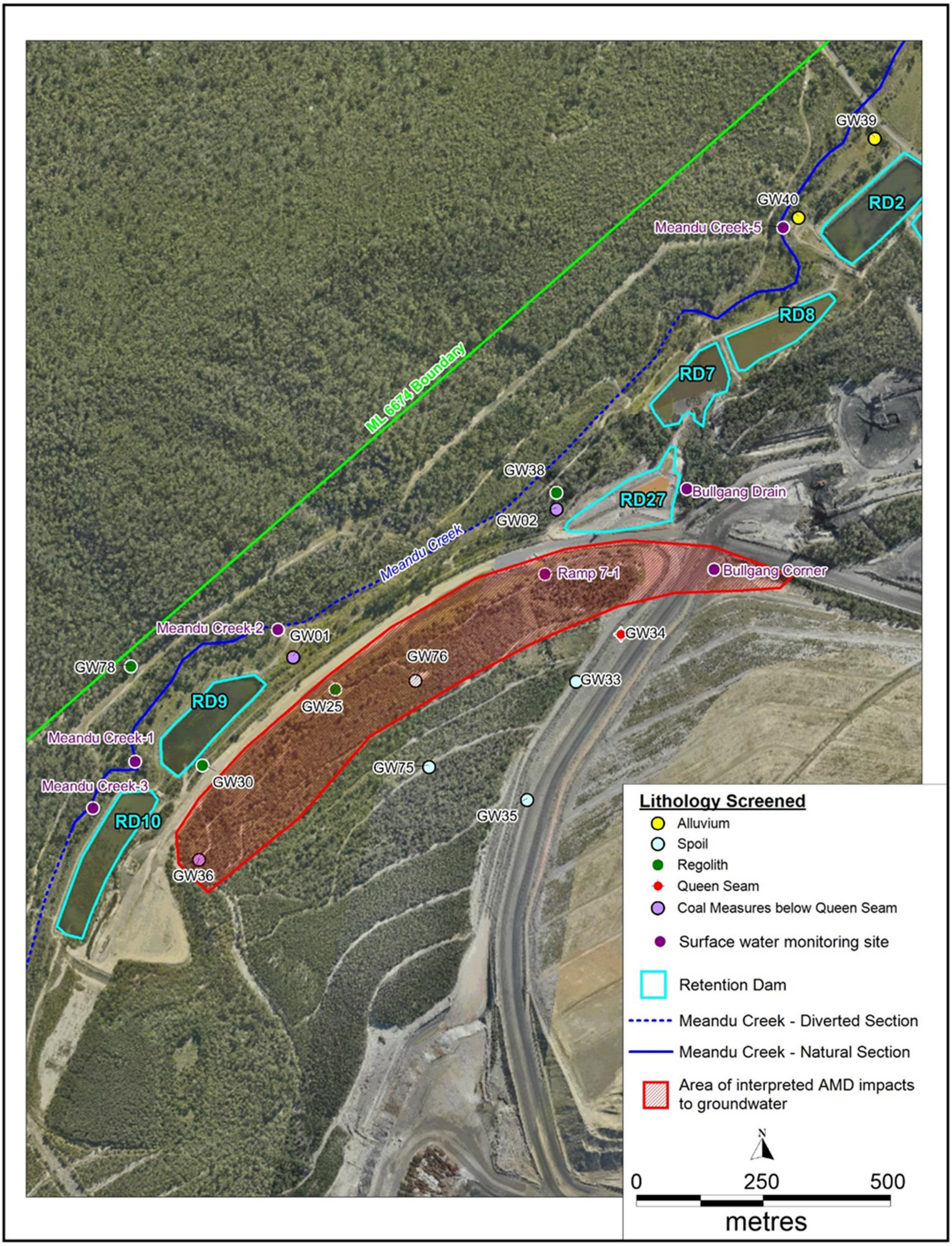


Figure 7.2 Area of interpreted AMD impacts to groundwater

7.1.2 SUPPORTING INFORMATION

SULFATE DATA

The following observations are made with respect to groundwater sulfate data:

— Groundwater sulfate data is discussed in Section 5.4.5.4 and presented in Figures 22, 23, 35 of Appendix F of the EIR).

— The Meandu Mine Environmental Authority (EA) contains groundwater trigger values for sulfate for the Triassic coal measures. These values are assessed using bores that are adjacent to Meandu Creek (bores GW01 and GW11). These bores monitor groundwater quality within coal measures at locations where groundwater discharge from the coal measures towards Meandu Creek has been assessed to be occurring).

— Sulfate has been assessed to be the most reliable indicator of impacts from mining to the groundwater system (refer Section 5.4.5.4 of Appendix F of the EIR). The summary water quality data presented in Table 5.3 of Appendix F of the EIR indicates that the median sulfate value for the Triassic coal measures (background water quality) is 66 mg/L, compared to samples from spoil monitoring bores (median of 505 mg/L) and areas of known AMD impacts (e.g. Bullgang Drain, median sulfate concentration of 1,224 mg/L; Ramp 7-1, median sulfate concentration 1,000 mg/L).

— Within groundwater bores that are within or adjacent to Meandu Creek, the sulfate concentration is generally below 244 mg/L (the EA sulfate trigger level for the coal measures is 244 mg/L, while there is no sulfate trigger level for sulfate for the Meandu Creek alluvium). However, it has been observed that the sulfate concentration is either elevated relative to the background concentration, or is exhibiting an increasing concentration trend, in a number of bores adjacent to Meandu Creek including GW25, GW34, GW35, GW36, GW75 and GW76 (refer Figure 7.1 for bore locations and Figure 7.3 for sulfate concentration data). For example, at bore GW36 (a bore that monitors regolith/ coal seams below Queen Seam adjacent to Meandu Creek) sulfate concentration has increased from < 50 mg/L in 2011 to > 450 mg/L in May 2017. The bores listed above have been assessed as being impacted by AMD seepage from the North-West Backfilled Pit (refer also Table 5-6 of Appendix F of the EIR). The area of interpreted AMD impacts to groundwater is shown on Figure 7.2 and includes the location of the bores listed above, as well as surface water sites where seepage from the North-West Backfilled Pit has been observed, including Bullgang Corner and Ramp 7-1.

— It is noted that bore GW75 records a sulfate concentration generally ~1,000 mg/L (refer Figure 7.3) but is not included in the area of interpreted AMD seepage (refer Figure 7.2). This is because GW75 screens spoil within the footprint of the North-West Backfilled Pit and is therefore indicative of sulfate concentration at that location within the North-West backfilled void, rather than being indicative of the water quality of seepage from the North-West Backfilled Pit.

— There is no evidence to date of AMD-related impacts in sulfate data at downstream bores that monitor the Meandu Creek alluvium (GW39 and GW40).

ELECTRICAL CONDUCTIVITY) DATA

The following observations are made with respect to groundwater electrical conductivity data:

— Groundwater electrical conductivity data is discussed in Section 5.5.5.3, Section 7.2 and presented on Figures 20, 21, 34 and 36 of Appendix F of the EIR.

— The Meandu Mine EA contains groundwater quality trigger levels that are assessed for groundwater from the coal measures as well as the Meandu Creek alluvium. The trigger levels have been based on background groundwater quality.

— As noted in Section 5.5.5.3 of Appendix F of the EIR, areas of confirmed AMD seepage are relatively low in electrical conductivity when compared to groundwater data (e.g. Bullgang Drain and Ramp 7-1 both record a median value of ~3,000 µS/cm, with the electrical conductivity of groundwater samples at sites adjacent to Meandu Creek or within the Meandu Creek alluvium (refer Figure 7.4) generally in excess of 3,000 µS/cm.

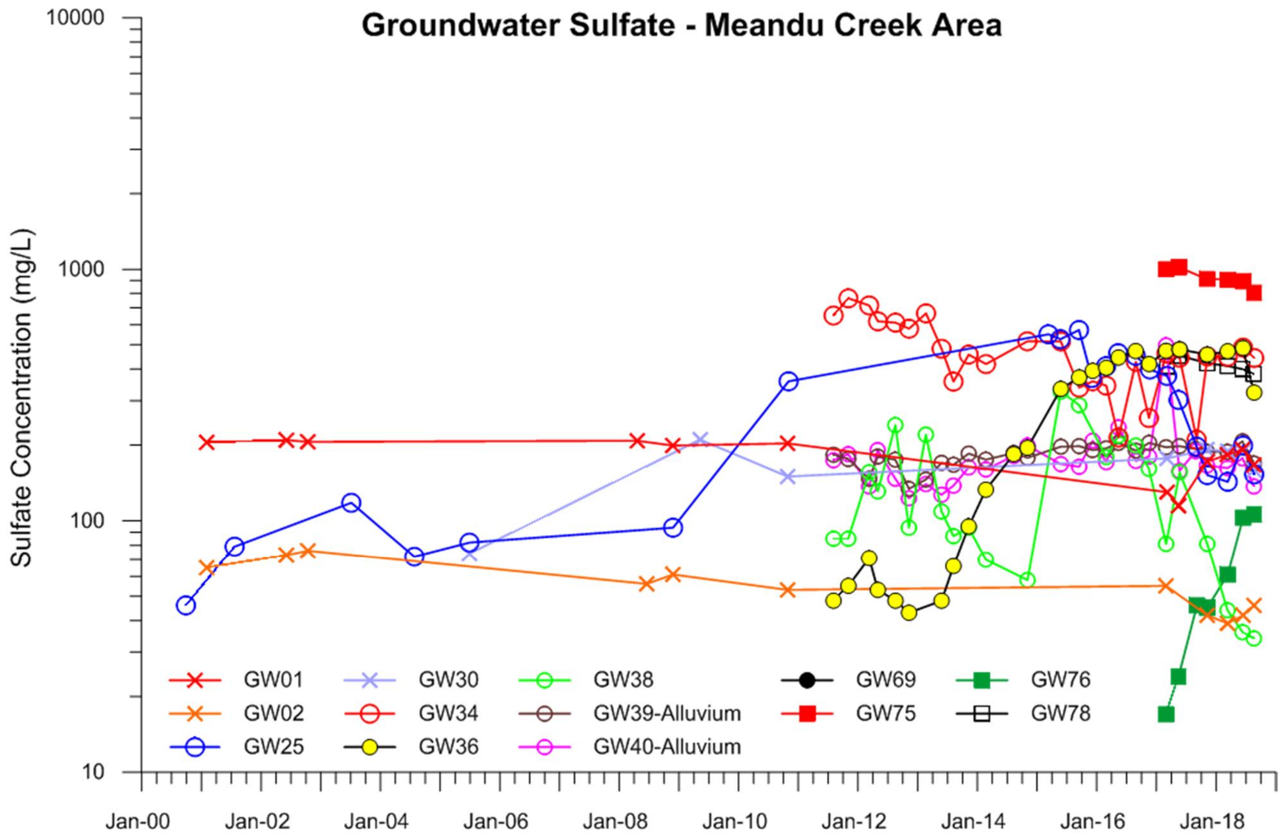


Figure 7.3 Sulfate concentration in groundwater bores adjacent to Meandu Creek

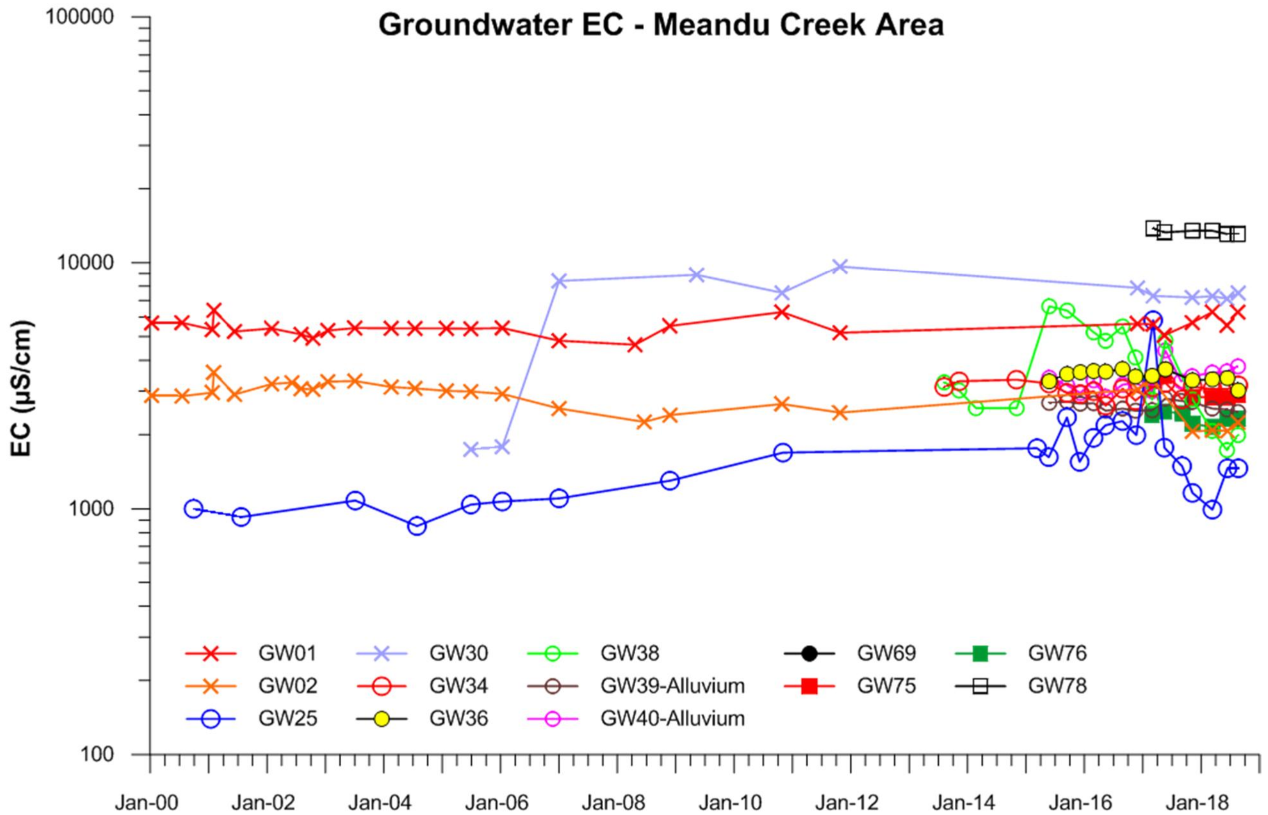


Figure 7.4 Electrical conductivity (EC) in groundwater bores adjacent to Meandu Creek

- At one groundwater monitoring site (GW30, the electrical conductivity has increased from <2,000 µS/cm to ~8,000 µS/cm (Figure 7.4), however it is noted that electrical conductivity increased suddenly between 2006 and 2007 and has remained relatively stable since. At other sites where AMD impacts have been interpreted based on an increasing trend in sulfate concentration data, the electrical conductivity has remained relatively stable. For example, for site GW36 the electrical conductivity has remained relatively constant (3,000 to 3,500 µS/cm) despite a significant increase in sulfate concentration at this site from <50 mg/L to > 450 mg/L (as discussed above).
- Electrical conductivity is therefore regarded as being a relatively poor indicator of groundwater impacts from AMD.
- As also noted in Section 5.5.5.3 of Appendix F of the EIR, the greatest potential for impacts to Meandu Creek (with respect to electrical conductivity) is from the high salinity plume (> 10,000 µS/cm) that extends along a natural drainage line towards RD1/ RD2 (retention dams that are adjacent to Meandu Creek), though there is no evidence to date of impacts on bores GW39 and GW40 (Meandu Creek alluvium downstream of RD1/RD2). There is also no discernible impact on water quality of RD1 and RD2 to date from the high electrical conductivity groundwater within the plume. A potential reason for this apparent lack of water quality impact on RD1 and RD2 is the relatively low rate of seepage within the plume. Based on a preliminary assessment JBT calculated the groundwater inflow rate to RD1/RD2 to be between 0.3 and 1.3 L/second (0.025 to 0.1 ML/day) (refer Appendix F of the EIR). This flow rate would be relatively insignificant when compared to surface water inflows to both dams over the course of a year. From the preliminary assessment presented in the EIR it was concluded that even if the saline plume has extended to RD1/RD2, the potential rate of inflow to the dams is calculated to be low and based on available water quality data, it is evident that the plume has not made a discernible impact on the electrical conductivity of RD1/RD2. It was also concluded that due to the relatively low seepage rates and the presence of retention dams to intercept groundwater flow, the risk to the environmental values of Meandu Creek is also low.
- Based on assessment of electrical conductivity data for both the Triassic coal measures and the Meandu Creek alluvium, it is concluded that there is currently no definitive evidence of impact on the electrical conductivity of groundwater within or reporting to Meandu Creek. However, as noted above, sulfate is assessed to be a more reliable indicator of groundwater impacts from AMD and will continue to be one of the primary parameters used to monitor for AMD impacts.

8 APPENDIX G: MINE AND ENVIRONMENTAL INVESTIGATION – SURFACE WATER

RFI Notice Requirements 19 and 20 are addressed in this section of the RFI Response report. These RFIs relate to information provided in Table 4.1, Table 4.2 and Figure 2.2 of Appendix G of the EIR.

8.1 RFI REQUIREMENT 19

RFI REQUIREMENT:

Presentation of the summary data for each of the sites individually as detailed in Table 4.1 and Table 4.2. The summary data for all compliance sites and all sites on Meandu Creek upstream of Meandu Creek Dam have been combined (Table 4.1 and Table 4.2).

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 19 relates to Tables 4.1 and 4.2 of Appendix G of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was prepared by EPS.

8.1.1 RESPONSE

Summary statistics of water quality data from individual sites have been calculated and are presented in Appendix B.

8.1.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

8.2 RFI REQUIREMENT 20

RFI REQUIREMENT:

Revision of Figure 2.2 to ensure that sites Meandu Creek 1 to 6 are presented as sampled sites including the details of the location of all water quality sampling sites provided on a map.

RELEVANT SECTION EIR (SEPTEMBER 2018):

RFI Requirement 20 relates to Figure 2.2 of Appendix G of the EIR.

SOURCE OF INFORMATION FOR THIS RFI RESPONSE:

The information for this RFI response was prepared by ESP

8.2.1 RESPONSE

The approximate locations of all historical water quality monitoring sites, including sites Meandu Creek 1 to 6 are shown on Figure 5.2.

8.2.2 SUPPORTING INFORMATION

No additional supporting information is provided for this response.

APPENDIX A

NOTICE REQUESTING FURTHER INFORMATION

Notice

Environmental Protection Act 1994
Environmental Evaluation

Notice requesting further information

This notice requesting further information in response to receiving an environmental report about an environmental investigation is issued by the administering authority pursuant to section 326F(2) of the Environmental Protection Act 1994.

TEC Coal Pty Ltd
Level 13, 42 Albert Street
BRISBANE QLD 4000

Your reference: TEC Coal Pty Ltd - Environmental Investigation Report Meandu - 14 September 2018

Our Reference: CA34208 STAT1118

Take notice: that under the *Environmental Protection Act 1994* (the Act), a notice requesting further information on an environmental report is issued to TEC Coal Pty Ltd (you) by the administering authority. The administering authority is the Chief Executive of the Department of Environment and Science (the department).

This notice requesting further information is issued in respect of the activities by TEC Coal Pty Ltd at Meandu Coal Mine on land described as mining lease ML6674 situated at around four kilometres west of YARRAMAN, Queensland.

The further information is requested in relation to the environmental investigation report (STAT1118) submitted to the department on 14 September 2018.

A. Grounds

The notice requesting further information is issued on the following grounds:

1. A notice to conduct or commission an environmental investigation was given to you by the department on 21 December 2016.
2. An environmental report titled 'TEC Coal Pty Ltd Environmental Investigation Report Meandu - 14 September 2018, WSP Australia Ref: PS102396-ENV-REP-001 Rev B' was submitted to the department by you on 14 September 2018.
3. The department is satisfied that further information is needed to decide whether to approve the environmental report.

B. Facts and Circumstances

The facts and circumstances forming the basis for these grounds are:

1. You submitted a report on to the department on 14 September 2018 titled TEC Coal Pty Ltd Environmental Investigation Report Meandu - 14 September 2018, WSP Australia Ref: PS102396-ENV-REP-001 Rev B (the report).

2. This report was submitted to fulfil the requirements of the notice to conduct or commission an environmental evaluation that was issued to you by the department on 21 December 2016.
3. A notice extending the period for the department to consider the report was issued to you by the department on 28 September 2018.
4. The department has conducted a review of the report, including an assessment by a technical specialist in the fields of water quality and hydrogeology.
5. The department has identified that further information is required to characterise the environmental values and water quality objectives for surface waters and groundwater around Meandu Mine. This relates to requirement 2 of the notice to conduct or commission an environmental evaluation.
6. The department has identified that further information is required in relation to the geochemical assessment of tailings material that has been deposited in the North West Backfill Pit. This relates to requirement 3(i) of the notice to conduct or commission an environmental evaluation.
7. The department has identified that further information is required to assess whether Acid Metalliferous Drainage (AMD) has impacted on or has the potential to impact on groundwater and/or surface waters including Meandu Creek. Additional data is needed to assess impacts, and it appears from the data that has been provided, there are impacts observed downstream of Meandu Creek Dam that have not been fully described in the report. This relates to requirement 4(ii) of the notice to conduct or commission an environmental evaluation.
8. The department has identified that further information is required regarding the effectiveness of the proposed long term measures to manage AMD and related contaminant discharges, particularly in relation to long term management of seepage from the North West Backfill Pit. This relates to requirement 4(iii) of the notice to conduct or commission an environmental evaluation.

C. Requirements

The further information you are required to provide is as follows:

Section 5 – AMD source and extent:

1. Additional information for the testing of the sample of tailings from the North West A Tailings Storage Facility (TSF) collected by Environmental Geochemistry International (EGI) in 2007 and subject to kinetic leach column testing. This information should support the claim made in section 5.1.1.2 that this material is not contributing to AMD.

Section 6 – Characterisation of the receiving environment (surface waters):

2. A characterisation of environmental values and water quality objectives for Meandu Creek. It is noted that the only environmental value defined for Meandu Creek upstream of Meandu Creek Dam and Black Creek is industrial use. The direct connectivity of these sections of waterway with Meandu Creek downstream of Meandu Creek Dam should be acknowledged.
3. A characterisation of environmental values and water quality objectives for Meandu Creek upstream of the mine.
4. Location details (including a map) for sampling points W2 and SW16 that were used to derive site specific electrical conductivity Water Quality Objectives (WQOs) in Table 6.2 in Section 6.3.2 of the report.
5. A comparison of stock water WQOs for total dissolved solids, fluoride, sulfate and calcium with local background and/or upstream water quality data to determine whether stock water guideline values are

appropriate as WQOs for Meandu Creek. It is noted that stock watering guideline values have been utilised to develop water quality objectives for total dissolved solids, fluoride, sulfate and calcium in Table 6.2 in Section 6.3.2 of the report. As an example, sulfate concentrations upstream of the mine are recorded as being less than 50mg/L in Figure 4.8 in Appendix G, indicating a site specific water quality objective is required in place of the stock watering guideline value of 1,000mg/L.

6. Details of relevant water quality data to support the approach taken in Section 6.3.2 of the report.

Section 6 – Characterisation of the receiving environment (groundwater):

7. Assignment of environmental values (EVs) for groundwater, based on identified and potential beneficial uses and protection of the relevant adjoining aquatic ecosystems. It is noted that section 6.3.2.1 of the report states that *'groundwater that occurs within alluvium is managed as surface water; therefore the groundwater EVs for Meandu Creek, as well as for Black Creek, are taken to be the same as the surface water EVs that have been defined above and in Appendix G'*. As per point 2 and 3 above, it is not considered appropriate to assign groundwater in the area as having no EVs (for the section aligning with Meandu Creek upstream of the mine), or only industrial usage for the section upstream of Meandu Creek Dam.

8. A revised statement regarding the potential future impacts of AMD from the mine in accordance with requirement 4(ii) based on the EVs identified for groundwater.

Section 7 – Surface water investigations:

9. Presentation of the results of a comparison of the water quality upstream of the mine, upstream of the Meandu Creek Dam and downstream of Meandu Creek Dam, to assess the impact of the AMD on Meandu Creek, including:
    a. Box plots of all data for all parameters for: compliance sites (CP1, CP3, CP4); Meandu Creek sites upstream of Meandu Creek dam (CKMB, CKMD, CKMC, RD7 Road Crossing, Meandu Creek 1, Meandu Creek 2, Meandu Creek 3, Meandu Creek 4, Meandu Creek 5, Meandu Creek 6); Meandu Creek sites upstream of the Mine (CKMF/MCUS1, CKME/MCUS2); Meandu Creek dam (centre of dam); and downstream of the Meandu Creek dam (W3, W2, SW16).
    b. Comparison of figures in Section 7.2.3.2 for all metal and metalloid compounds subject to testing during the March 2017 survey, as it is noted that only selected parameters were presented in Figure 7.7.
    c. An analysis of the impact of AMD whenever a change in water quality is observed between the sites upstream of the mine, upstream of the Meandu Creek Dam and downstream of Meandu Creek Dam. It is noted that the current analysis does not consider impacts if they occur at levels below the selected WQOs, and where levels at the comparative site SW36 and Black Creek site BC1 are greater.

10. Revision of the labelling of monitoring sites on maps to ensure consistency between Figures (the main report and Appendix G; e.g. CKMF/MCUS1 and CKME/MCUS2).

11. Revision of the water quality data presented on Figures in Section 7 and Appendix G of the report to ensure the data is clearly legible and at a scale that can be read (e.g. Figure 7.2 and Figure 7.8).

12. Raw surface water and groundwater quality data that has been utilised in the report in an Excel format for further analysis by the department.

13. Additional information in relation to the historical macroinvertebrate surveys in Section 7.2.7.1 of the report. The data that is provided is pooled for all sites, and insufficient data has been provided to support

the statement that *'Richness at sites on Meandu Creek downstream of Meandu Creek Dam is generally within or greater than the range at the comparative sites'*.

14. Information to clarify whether the calculated macroinvertebrate indices in Section 7.2.7.2 are only for the most recent survey (2017).

Section 8 – Impacts to the receiving environment:

15. Revised assessment of potential impacts to the receiving environment, particularly giving consideration to the points raised in items 2, 3, 5, 6, 7 and 8. The department suggests that AMD from Meandu Mine also appears to have potential impacts in terms of elevated concentrations of aluminium, arsenic, copper, and iron in the waters discharged to Meandu Creek and Meandu Creek Dam.
16. Comparison of the concentration of sulfate upstream of the Meandu Creek Dam against the sulfate concentration upstream of the mine with consideration of the stock watering guideline (1,000mg/L) (refer to point 5 above).
17. The conclusion in Section 8.1.1.7 of the report that no impact is occurring should be reassessed on the basis that Tables 4.3, 4.4 and 4.5 in Appendix G indicate there are elevated zinc concentrations at the first site downstream of the release point compared to the further downstream monitoring point.

Appendix F – Contaminant Hydrogeological Assessment:

18. Delineation of impacts to groundwater, in particular, for elevated electrical conductivity.

Appendix G – Mine and environmental investigation – Surface Water:

19. Presentation of the summary data for each of the sites individually as detailed in Table 4.1 and Table 4.2. The summary data for all compliance sites and all sites on Meandu Creek upstream of Meandu Creek Dam have been combined (Table 4.1 and Table 4.2).
20. Revision of Figure 2.2 to ensure that sites Meandu Creek 1 to 6 are presented as sampled sites including the details of the location of all water quality sampling sites provided on a map.

END OF INFORMATION REQUESTED

The further information is requested to be submitted to the department on or before **31 January 2019**.

C. Reviews and appeals

There are no review or appeal rights under the *Environmental Protection Act 1994* for a request for further information made under section 326F(2).

A person whose interests are or would be adversely affected by a decision of the department may be able to request a statement of reasons for a decision or a statutory order review under the *Judicial Review Act 1991*.

Under the *Judicial Review Act 1991,* a person whose interests are, or would be adversely affected by a decision of the department is able to:

- Request a statement of reasons from the department explaining the decision.
- Apply to the Supreme Court for a statutory order of review of the decision if the person is not satisfied with the statement of reasons.

You may have other legal rights or obligations and should seek your own legal advice.

If you fail to provide the further information, the department will make a decision about the environmental report on the information already submitted.

Should you have any queries in relation to this notice, please contact Dan Cohen of the department on telephone number (07) 4302 8516.

Signature	Date
	9 November 2018

Tony Baker
Manager (Compliance)
Delegate of the Chief Executive
Environmental Protection Act 1994
Department of Environment and Science

Enquiries:

Dan Cohen, Principal Environmental Officer
Coal and Central Queensland Compliance
Ph: (07) 4302 8516
Email: widebay.esr@des.qld.gov.au

APPENDIX B

BOXPLOTS, TIME SERIES PLOTS AND SUMMARY STATISTICS FOR WATER QUALITY PARAMETERS

Figure 1: Boxplot and Time Series Plot of data: EC (uS/cm)

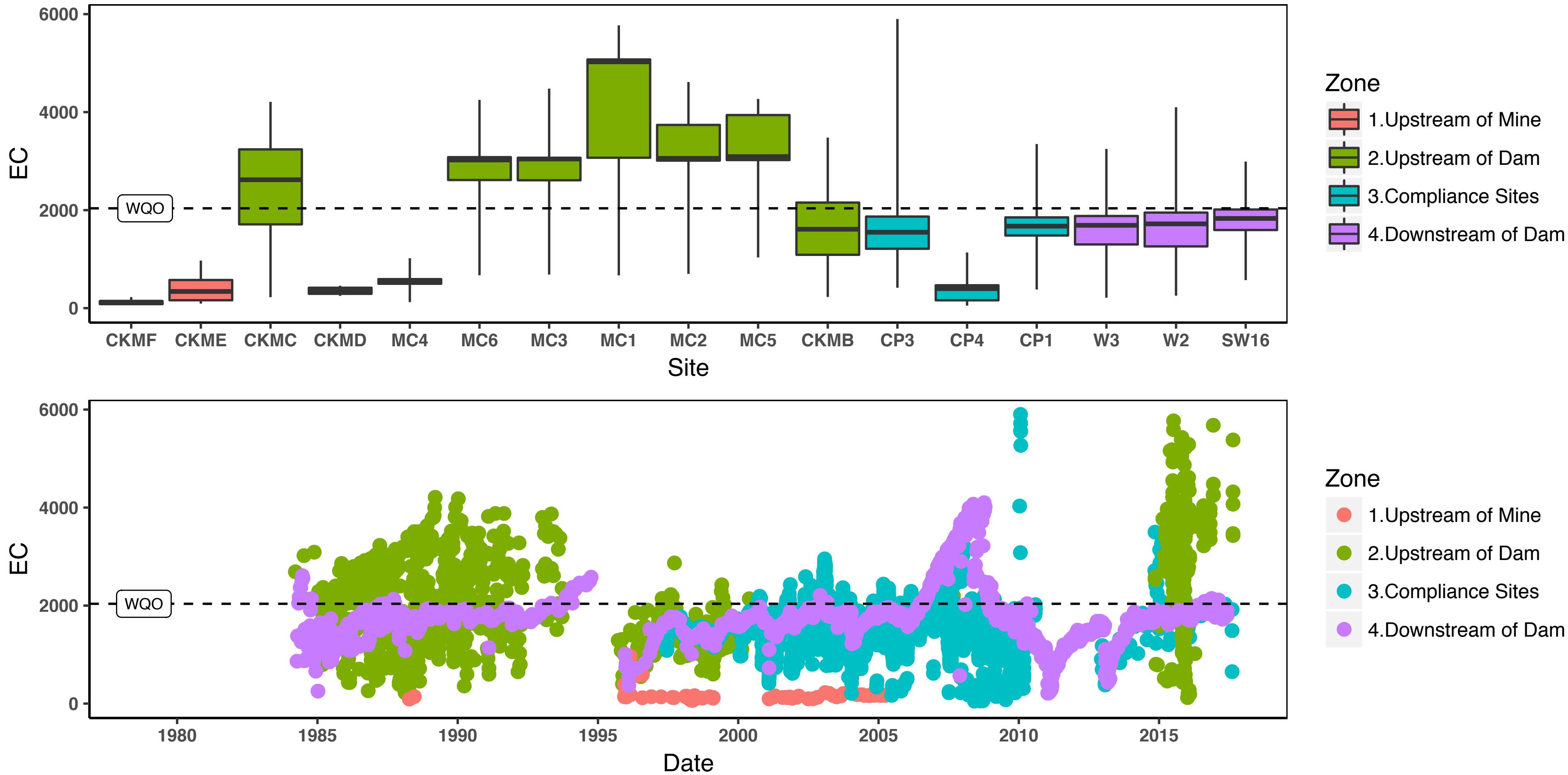


Table 1: Summary of data: EC (uS/cm)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	143	10	251	2	43	84	88	89	98	93	559	3755	274	4518	991	876	95
Min	68.7	93.0	224.0	251.0	123.0	671.0	685.0	669.0	699.0	1034.0	229.0	416.0	51.4	381.0	213.0	254.0	572.0
Max	225	970	4210	458	1020	4250	4480	5770	4615	4270	3480	5901	1136	3349	3250	4100	2990
Median	123.1	340.0	2620.0	354.5	528.0	3024.0	3043.5	5026.0	3057.0	3093.0	1610.0	1549.0	397.9	1673.0	1690.0	1720.0	1830.0
20th %ile	82.4	161.0	1710.0	292.4	498.0	2614.8	2609.4	3069.2	3010.6	3022.4	1088.8	1212.0	160.2	1482.0	1300.0	1260.0	1594.0
80th %ile	144.7	574.0	3240.0	416.6	591.8	3080.8	3068.0	5074.6	3738.6	3940.4	2154.0	1869.0	466.3	1852.0	1880.0	1950.0	2013.2
95th %ile	179.7	799.0	3765.0	447.6	695.9	3555.4	3536.5	5386.0	4260.5	4010.4	2732.0	2182.0	623.2	2479.0	2590.0	3352.5	2674.0

Figure 2: Boxplot and Time Series Plot of data: pH (pH_unit)

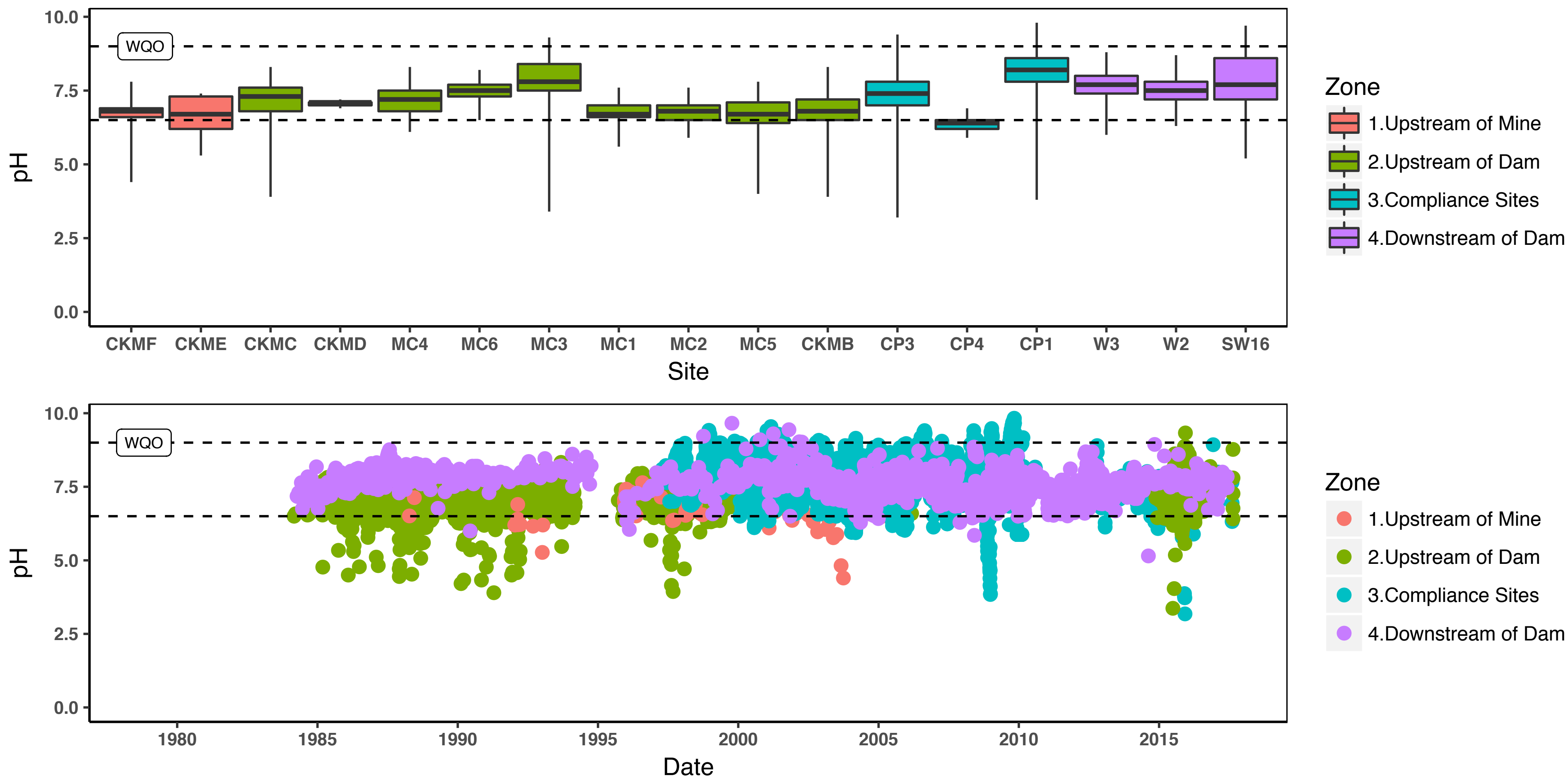


Table 2: Summary of data: pH (pH_unit)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	144	18	326	3	43	84	88	89	97	91	635	3753	12	4496	994	975	95
Min	4.4	5.3	3.9	6.9	6.1	6.5	3.4	5.6	5.9	4.0	3.9	3.2	5.9	3.8	6.0	6.3	5.2
Max	7.8	7.4	8.3	7.2	8.3	8.2	9.3	7.6	7.6	7.8	8.3	9.4	6.9	9.8	8.8	8.7	9.7
Median	6.8	6.7	7.3	7.1	7.2	7.5	7.8	6.7	6.8	6.7	6.8	7.4	6.4	8.2	7.7	7.5	7.7
20th %ile	6.6	6.2	6.8	7.0	6.8	7.3	7.5	6.6	6.5	6.4	6.5	7.0	6.2	7.8	7.4	7.2	7.2
80th %ile	6.9	7.3	7.6	7.1	7.5	7.7	8.4	7.0	7.0	7.1	7.2	7.8	6.5	8.6	8.0	7.8	8.6
95th %ile	7.2	7.4	7.8	7.1	8.0	7.9	8.7	7.3	7.3	7.3	7.7	8.4	6.9	9.0	8.2	8.0	9.1

Figure 3: Boxplot and Time Series Plot of data: DO (%_sat)

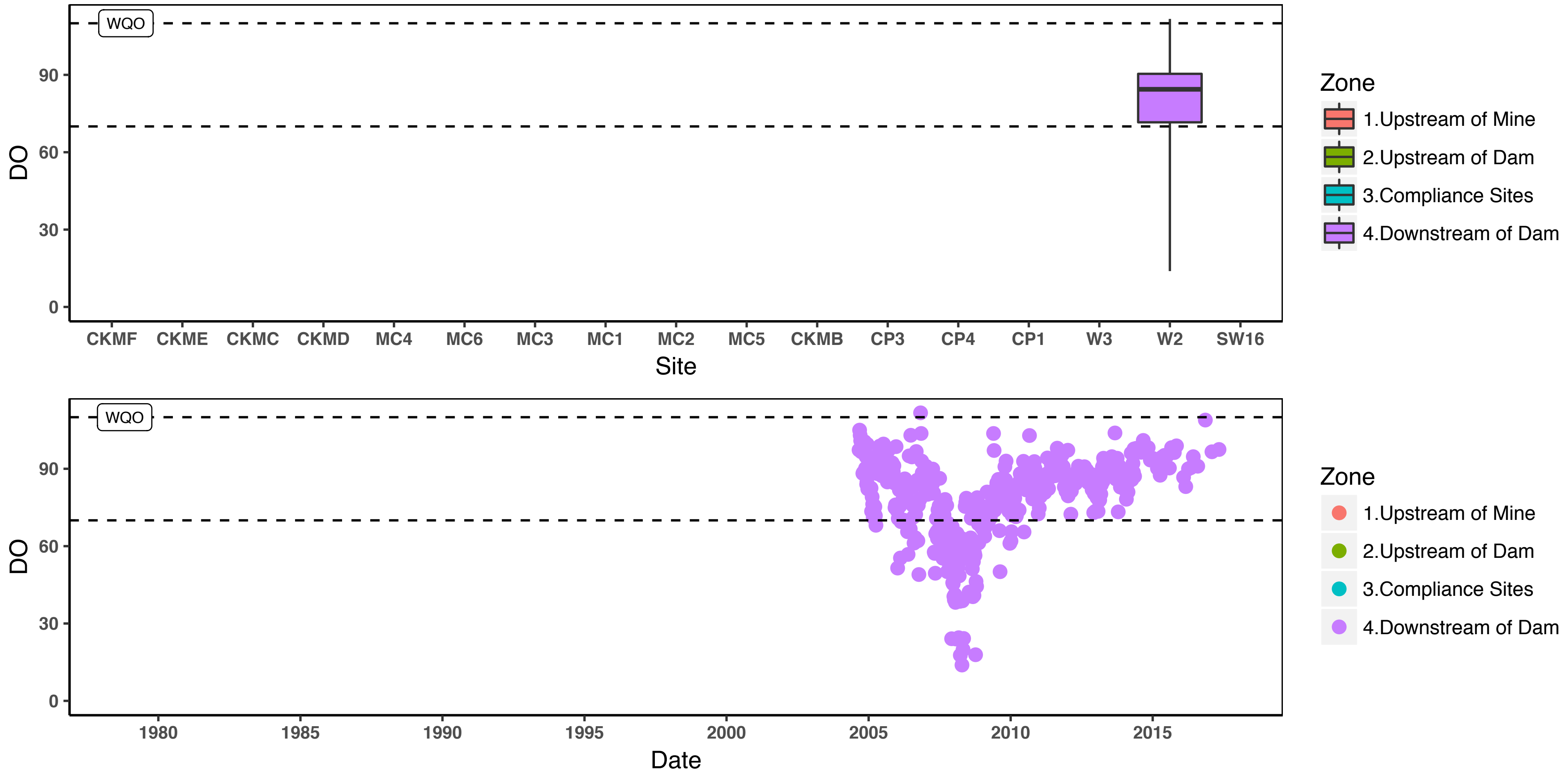


Table 3: Summary of data: DO (%_sat)

Site	W2
N	529
Min	13.9
Max	111.7
Median	84.4
20th %ile	71.6
80th %ile	90.4
95th %ile	98

Figure 4: Boxplot and Time Series Plot of data: Turbidity (NTU)

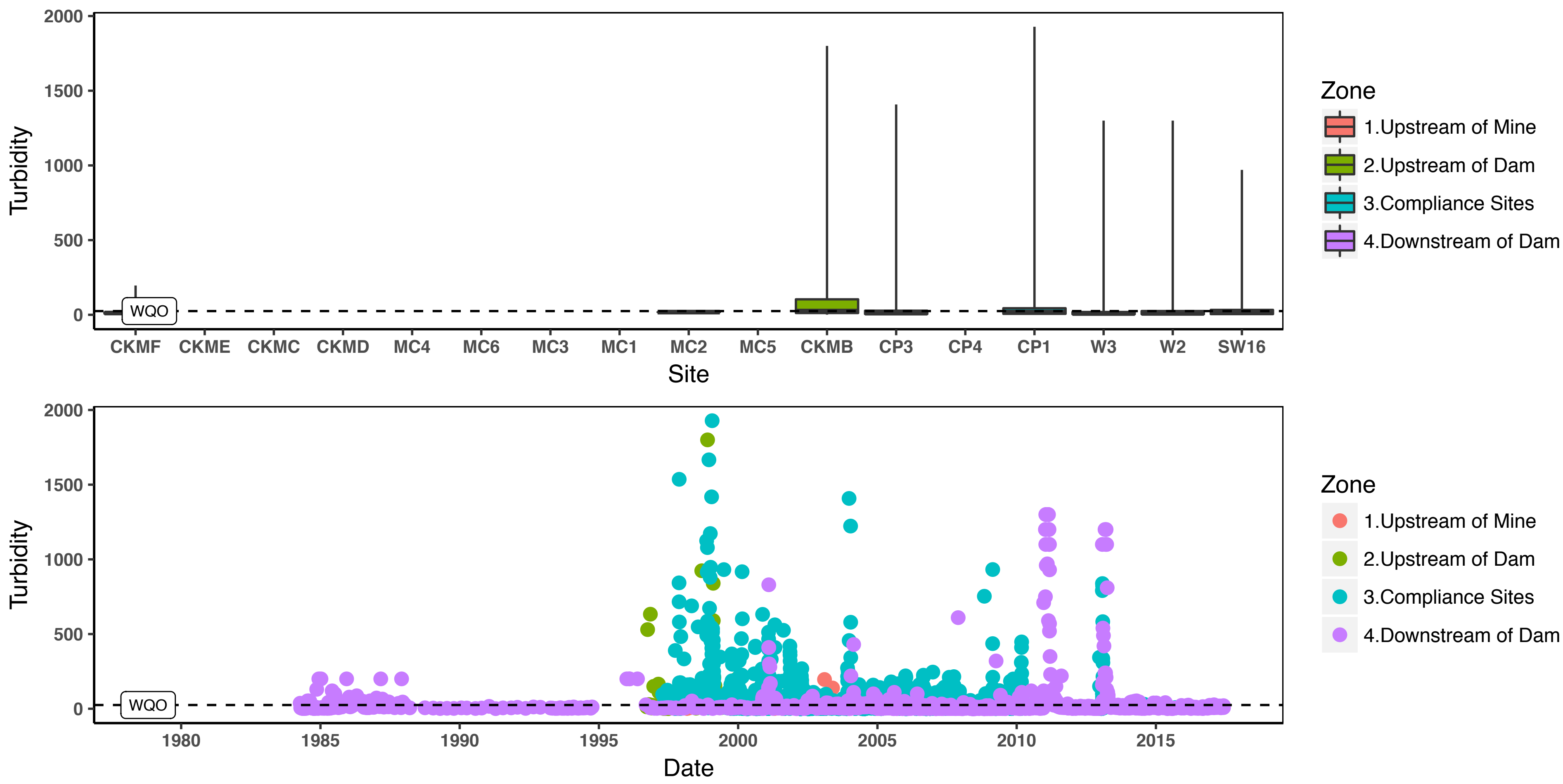


Table 4: Summary of data: Turbidity (NTU)

Site	CKMF	MC2	CKMB	CP3	CP1	W3	W2	SW16
N	105	1	85	3356	4546	759	884	76
Min	2.0	18.0	1.0	0.1	0.2	0.0	0.0	0.0
Max	196.0	18.0	1800.0	1408.0	1928.3	1300.0	1300.0	970.0
Median	12.0	18.0	25.0	11.1	18.3	8.6	9.4	14.5
20th %ile	7.8	18.0	11.8	5.2	6.5	4.0	4.1	4.6
80th %ile	15.6	18.0	103.6	27.6	44.0	18.9	25.4	33.0
95th %ile	31.1	18.0	578.0	88.8	117.5	71.7	77.8	137.5

Figure 5: Boxplot and Time Series Plot of data: TDS (mg/L)

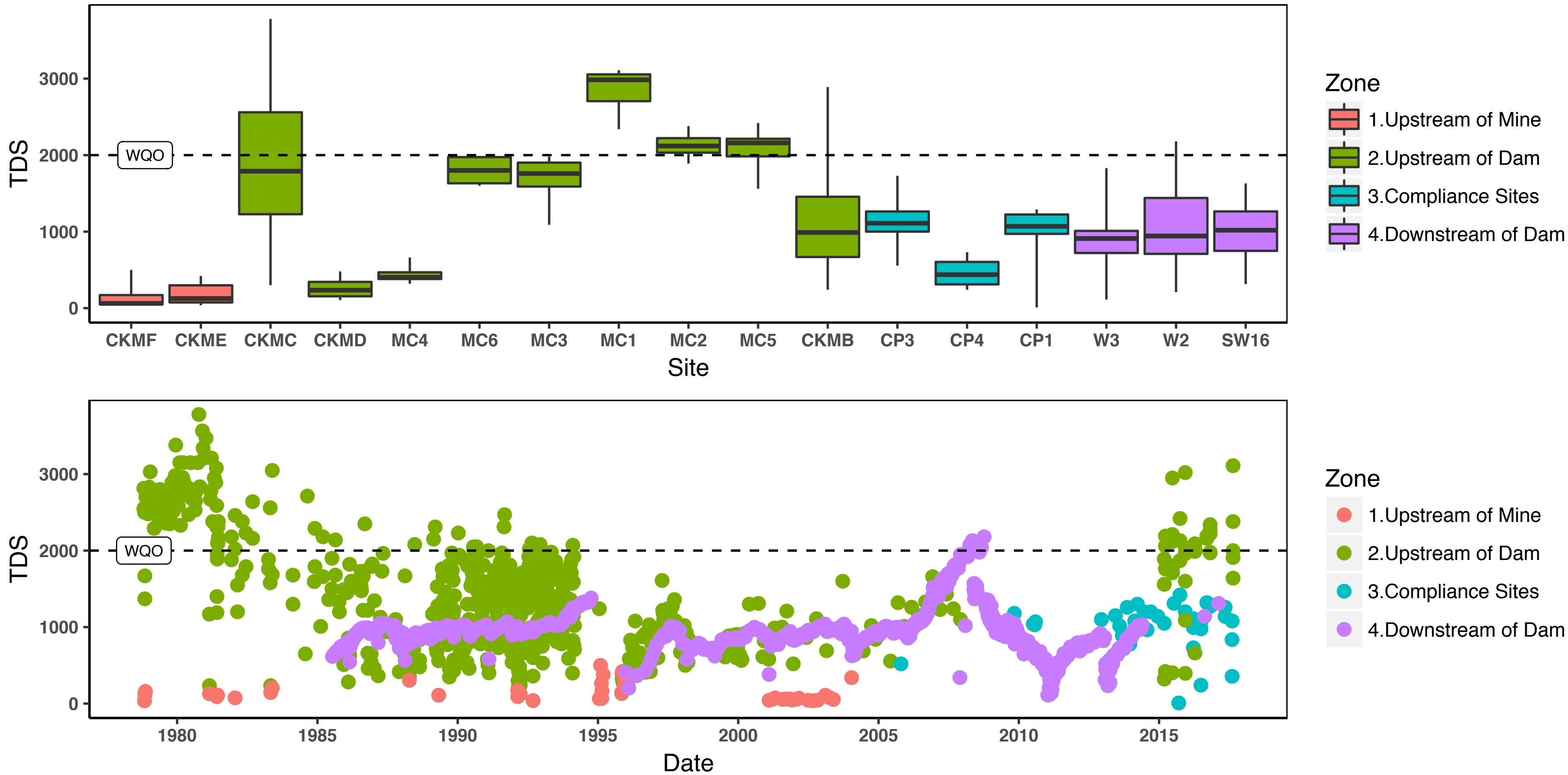


Table 5: Summary of data: TDS (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	23	29	315	8	5	5	7	4	9	9	408	29	4	7	847	107	52
Min	37.4	37.0	300.0	105.0	320.0	1600.0	1090.0	2340.0	1890.0	1560.0	240.0	557.0	241.0	9.0	113.0	209.0	314.0
Max	500	420	3780	480	662	1990	1980	3110	2380	2420	2890	1730	730	1290	1830	2180	1630
Median	61.7	126.0	1790.0	235.0	403.0	1800.0	1760.0	2985.0	2120.0	2160.0	989.0	1110.0	438.5	1070.0	910.0	943.0	1018.5
20th %ile	49.9	74.6	1228.0	155.0	380.8	1632.0	1590.0	2706.0	2032.0	1984.0	668.8	1000.4	310.6	970.8	721.2	709.4	748.8
80th %ile	170.8	298.4	2560.0	343.4	468.4	1974.0	1902.0	3056.0	2222.0	2214.0	1456.0	1263.4	604.0	1224.0	1010.0	1440.0	1264.0
95th %ile	332.4	396.8	2951.5	436.2	613.6	1986.0	1959.0	3096.5	2336.0	2340.0	2589.5	1380.0	698.5	1281.0	1477.0	1944.0	1512.5

Figure 6: Boxplot and Time Series Plot of data: Calcium (mg/L)

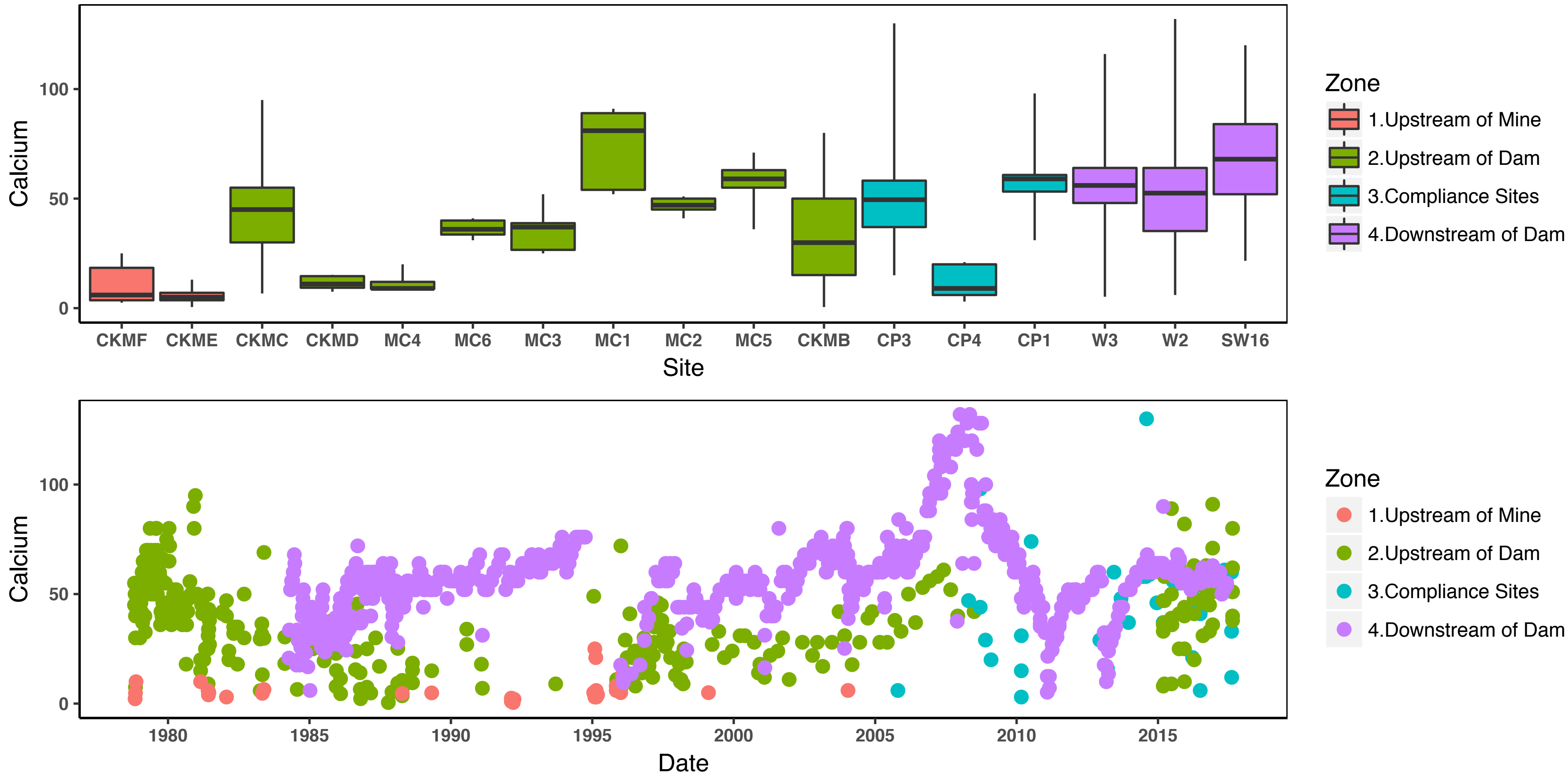


Table 6: Summary of data: Calcium (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	118	7	5	7	7	6	11	11	166	30	6	7	527	410	57
Min	2.5	0.5	6.7	7.5	8.0	31.0	25.0	52.0	41.0	36.0	0.5	15.0	3.0	31.0	5.2	6.0	21.6
Max	25.0	13.0	95.0	15.2	20.0	41.0	52.0	91.0	51.0	71.0	80.0	130.0	21.0	98.0	116.0	132.0	120.0
Median	6.0	5.0	45.0	11.0	9.0	36.0	37.0	81.0	47.0	59.0	29.9	49.5	9.0	59.0	56.0	52.5	68.0
20th %ile	3.6	3.6	30.0	9.3	8.8	33.6	26.6	54.0	45.0	55.0	15.1	37.0	6.0	53.2	48.0	35.2	52.0
80th %ile	18.4	7.0	55.0	14.6	12.0	40.0	38.8	89.0	50.0	63.0	50.0	58.2	20.0	60.8	64.0	64.0	84.0
95th %ile	23.8	10.0	65.6	15.1	18.0	40.7	48.1	90.5	51.0	67.0	70.0	72.6	20.8	86.9	76.0	94.2	100.8

Figure 7: Boxplot and Time Series Plot of data: Magnesium (mg/L)

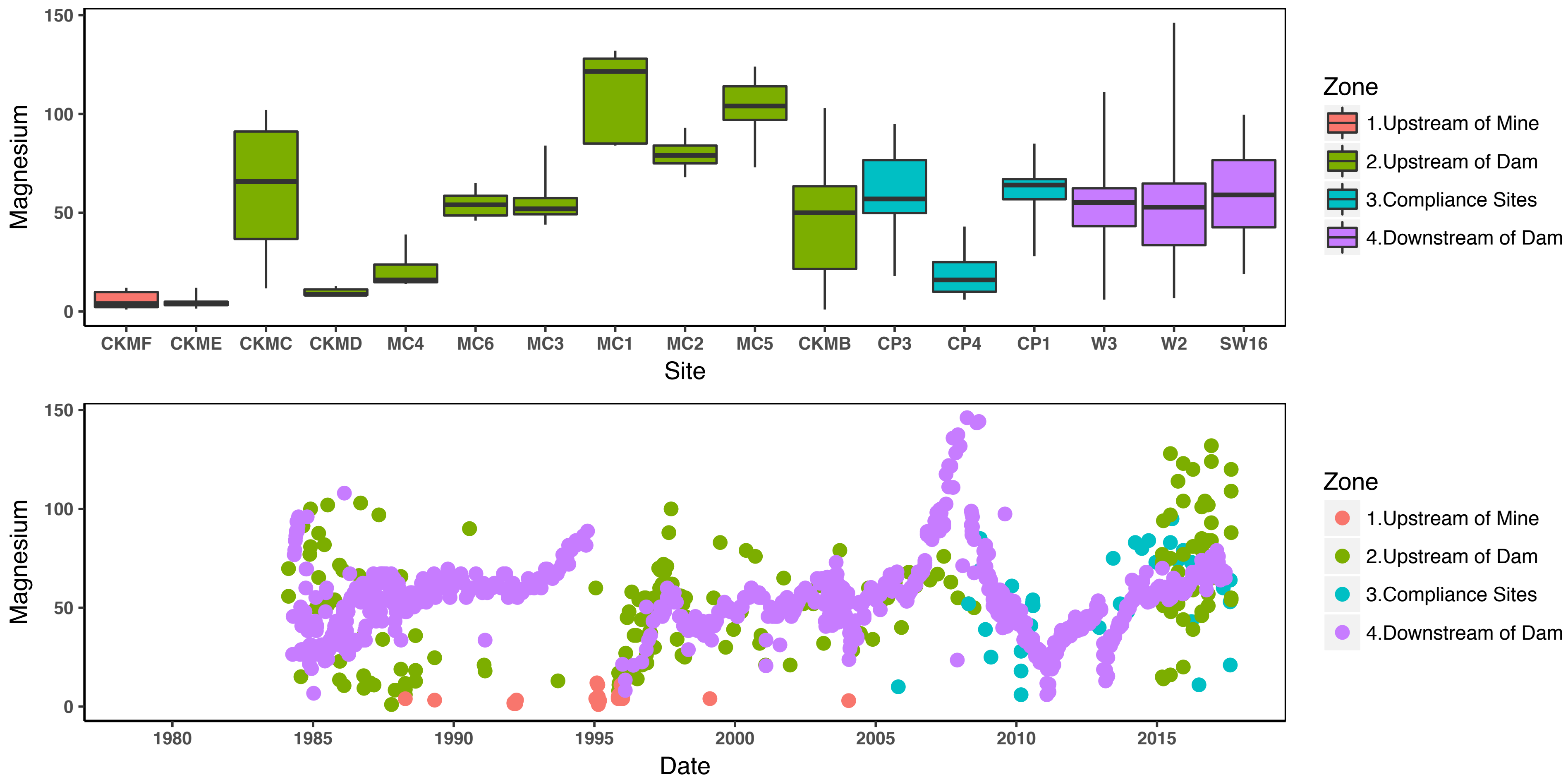


Table 7: Summary of data: Magnesium (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	19	17	3	5	7	9	6	11	11	124	29	6	7	530	406	57
Min	1.0	1.5	11.7	8.0	14.0	46.0	44.0	84.0	68.0	73.0	1.0	18.0	6.0	28.0	6.0	6.7	19.0
Max	12.0	12.0	102.0	12.8	39.0	65.0	84.0	132.0	93.0	124.0	103.0	95.0	43.0	85.0	111.1	146.2	99.6
Median	4.0	4.0	65.8	8.7	16.0	54.0	52.0	121.5	79.0	104.0	50.0	57.0	16.0	64.0	55.2	52.8	59.0
20th %ile	2.2	3.2	36.7	8.3	14.8	48.6	49.2	85.0	75.0	97.0	21.6	49.8	10.0	56.8	43.2	33.6	42.6
80th %ile	9.8	5.0	91.1	11.2	23.8	58.6	57.4	128.0	84.0	114.0	63.4	76.6	25.0	67.0	62.4	64.8	76.6
95th %ile	11.7	11.1	100.4	12.4	35.2	63.2	73.6	131.0	90.5	122.0	80.6	83.6	38.5	79.6	72.5	91.2	95.7

Figure 8: Boxplot and Time Series Plot of data: Sodium (mg/L)

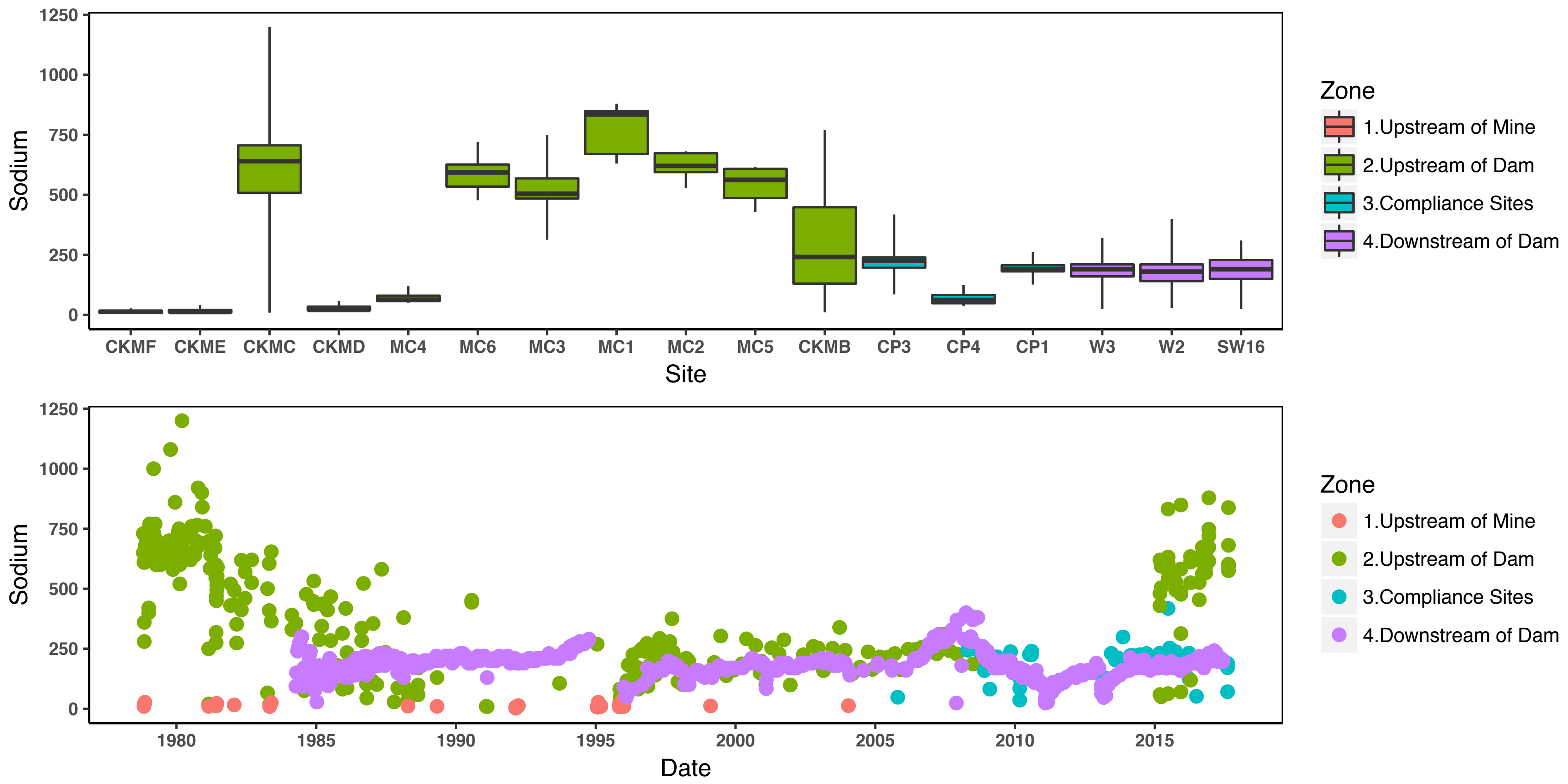


Table 8: Summary of data: Sodium (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	118	7	5	7	7	6	11	11	166	34	6	7	464	381	57
Min	7.4	2.5	9.0	12.0	50.0	477.0	313.0	630.0	529.0	429.0	10.0	85.0	36.0	126.0	24.0	28.0	24.0
Max	27.0	40.0	1200.0	58.2	119.0	720.0	748.0	879.0	681.0	615.0	770.0	418.0	125.0	261.0	320.0	400.0	310.0
Median	13.0	12.0	640.0	20.0	63.0	593.0	504.0	835.0	620.0	562.0	241.0	224.5	61.5	189.0	190.0	180.0	190.0
20th %ile	8.0	10.0	508.0	18.6	57.2	534.2	484.6	670.0	594.0	486.0	130.0	196.2	48.0	181.0	160.0	140.0	150.0
80th %ile	17.0	20.8	706.0	33.9	79.8	625.8	568.2	849.0	673.0	608.0	448.0	238.8	82.0	206.4	210.0	210.0	228.0
95th %ile	24.3	30.6	843.0	51.4	109.2	694.2	696.1	871.5	677.0	614.5	680.0	269.1	114.2	245.7	258.5	290.0	292.0

Figure 9: Boxplot and Time Series Plot of data: Potassium (mg/L)

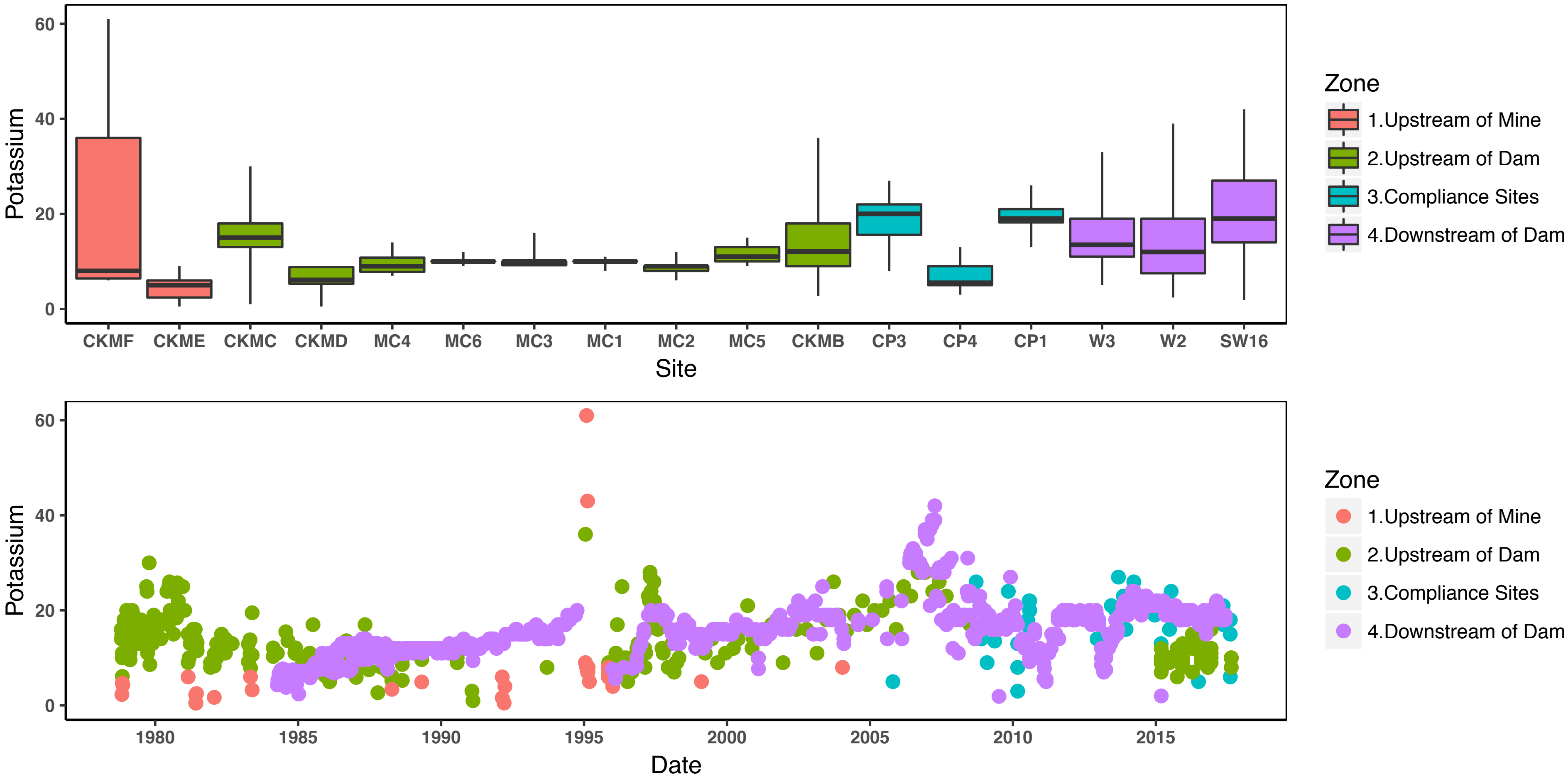


Table 9: Summary of data: Potassium (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	117	7	5	7	7	6	11	11	166	34	6	7	458	382	57
Min	6.0	0.5	1.0	0.5	7.0	9.0	9.0	8.0	6.0	9.0	2.7	8.0	3.0	13.0	5.0	2.4	1.9
Max	61	9	30	9	14	12	16	11	12	15	36	27	13	26	33	39	42
Median	8.0	5.0	15.0	6.1	9.0	10.0	10.0	10.0	9.0	11.0	12.1	20.0	5.5	19.0	13.5	12.0	19.0
20th %ile	6.4	2.4	13.0	5.3	7.8	10.0	9.2	10.0	8.0	10.0	9.0	15.6	5.0	18.2	11.0	7.5	14.0
80th %ile	36.0	6.0	18.0	8.8	10.8	10.0	10.0	10.0	9.0	13.0	18.0	22.0	9.0	21.0	19.0	19.0	27.0
95th %ile	55.6	7.6	25.0	9.0	13.2	11.4	14.2	10.8	10.5	14.0	25.0	24.7	12.0	24.5	22.0	23.0	36.2

Figure 10: Boxplot and Time Series Plot of data: Chloride (mg/L)

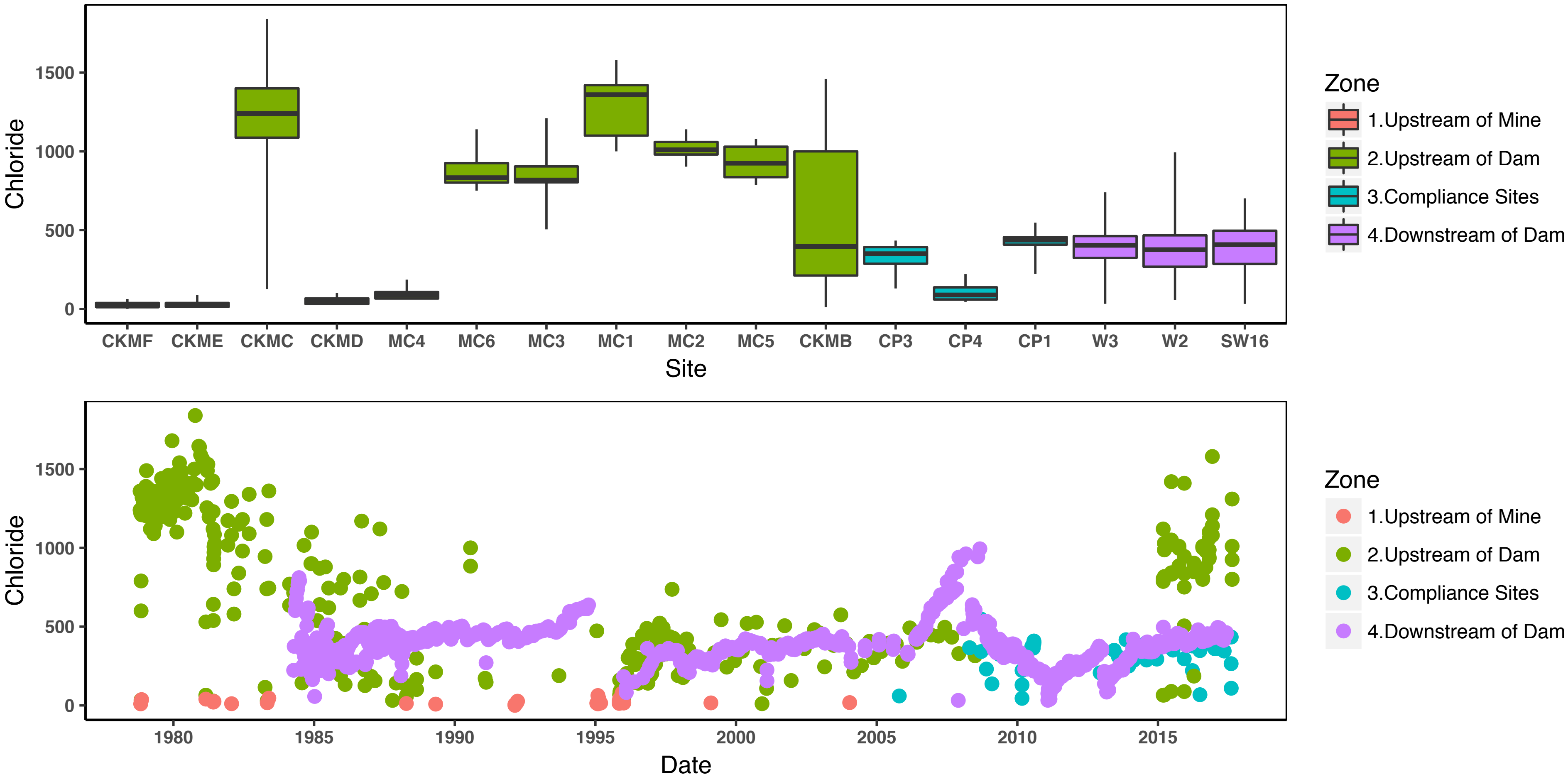


Table 10: Summary of data: Chloride (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	118	7	5	7	9	6	11	11	166	38	6	11	465	381	57
Min	0.5	6.0	126.0	28.0	65.0	751.0	505.0	1000.0	903.0	787.0	11.0	130.0	45.0	222.0	32.6	57.0	32.1
Max	63	89	1840	101	186	1140	1210	1580	1140	1080	1460	434	221	548	740	994	702
Median	18.0	22.0	1240.0	54.4	88.0	833.0	818.0	1360.0	1010.0	925.0	396.0	350.5	88.5	437.0	404.0	376.0	408.0
20th %ile	13.0	13.3	1087.0	31.0	65.8	801.8	803.4	1100.0	980.0	836.0	212.0	286.9	60.0	408.0	324.0	268.0	285.8
80th %ile	38.0	38.2	1400.0	67.4	108.4	925.4	904.4	1420.0	1060.0	1030.0	1000.0	392.0	137.0	456.0	462.2	467.0	496.6
95th %ile	57.0	64.6	1543.7	91.1	166.6	1080.0	1098.8	1540.0	1130.0	1065.0	1360.0	410.2	200.0	503.5	572.2	661.0	628.2

Figure 11: Boxplot and Time Series Plot of data: Sulfate (mg/L)

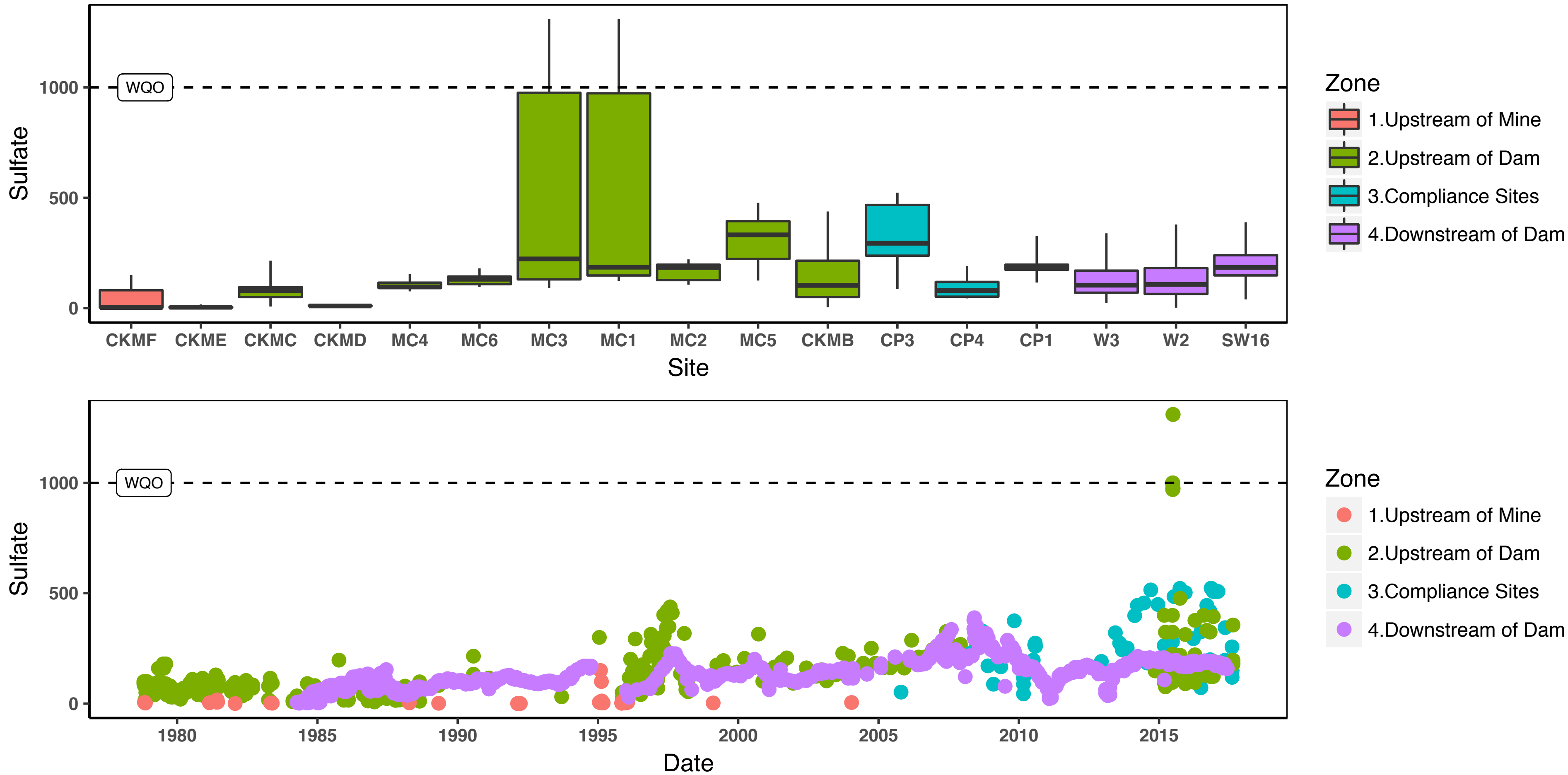


Table 11: Summary of data: Sulfate (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	116	7	5	7	17	22	11	11	167	39	6	11	462	384	57
Min	0.5	0.5	7.5	7.0	76.0	96.0	90.0	123.0	106.0	125.0	4.0	88.0	44.0	116.0	22.6	2.0	39.7
Max	150	17	215	14	154	180	1310	1310	221	477	438	523	191	328	339	379	389
Median	3.0	4.0	80.0	10.0	96.0	131.0	223.0	185.5	184.0	332.0	103.0	294.0	80.0	184.0	104.0	107.5	185.0
20th %ile	2.2	1.9	50.0	9.0	91.2	108.4	130.2	148.0	127.0	223.0	50.0	237.8	52.0	174.0	70.0	64.3	148.2
80th %ile	81.0	6.0	95.0	12.1	115.6	143.4	975.6	973.2	197.0	394.0	215.0	467.6	119.0	197.0	170.0	181.4	239.6
95th %ile	135.0	11.6	115.2	13.5	144.4	169.5	1062.0	999.8	220.0	438.5	317.1	515.7	173.0	263.5	226.0	234.0	289.0

Figure 12: Boxplot and Time Series Plot of data: Fluoride (mg/L)

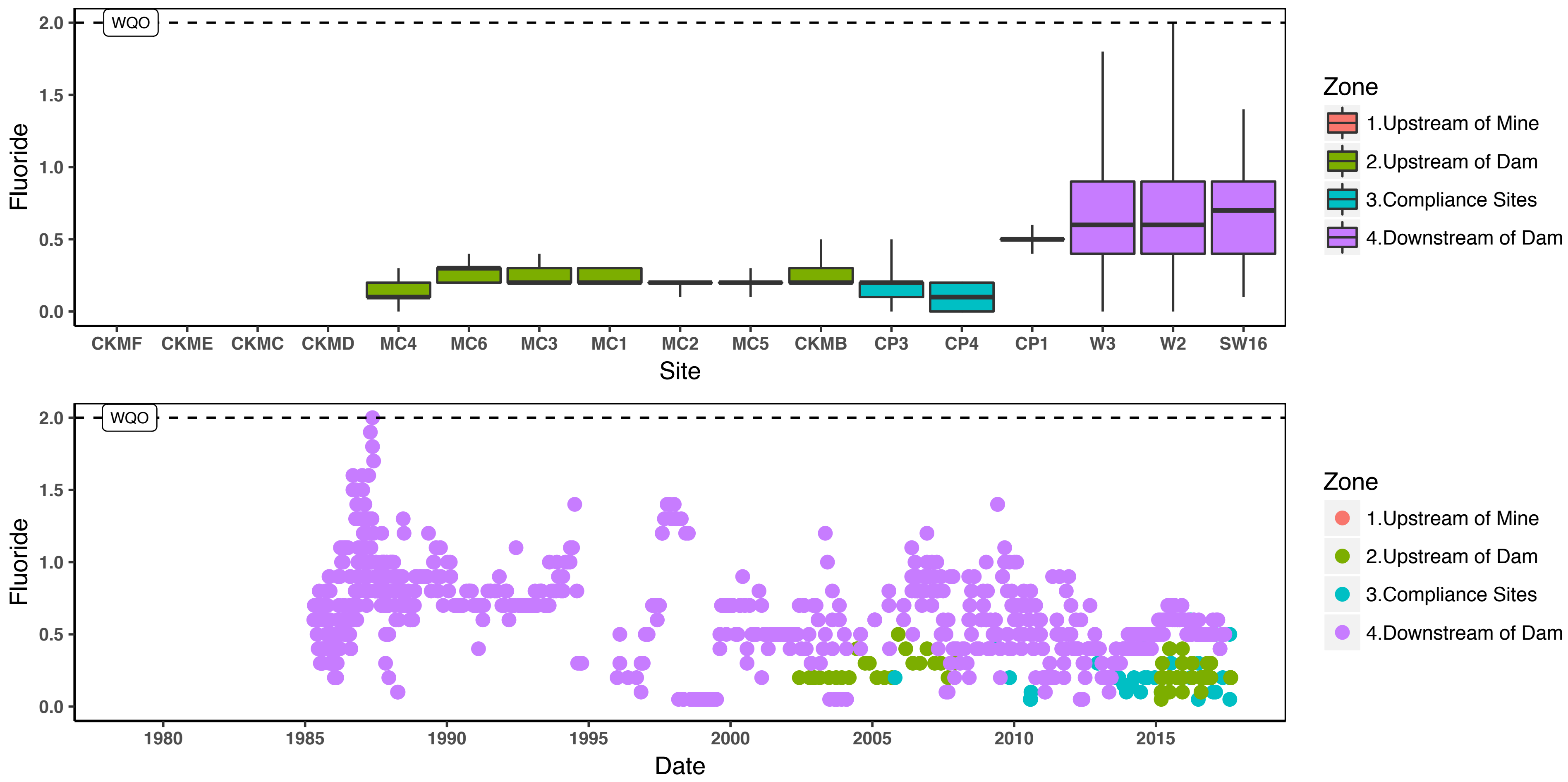


Table 12: Summary of data: Fluoride (mg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	31	4	9	455	331	53
Min	0.0	0.2	0.2	0.2	0.1	0.1	0.2	0.0	0.0	0.4	0.0	0.0	0.1
Max	0.3	0.4	0.4	0.3	0.2	0.3	0.5	0.5	0.2	0.6	1.8	2.0	1.4
Median	0.1	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.5	0.6	0.6	0.7
20th %ile	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.5	0.4	0.4	0.4
80th %ile	0.2	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.5	0.9	0.9	0.9
95th %ile	0.3	0.4	0.4	0.3	0.2	0.2	0.4	0.3	0.2	0.6	1.1	1.3	1.0

Figure 13: Boxplot and Time Series Plot of data: Hardness (mg/L)

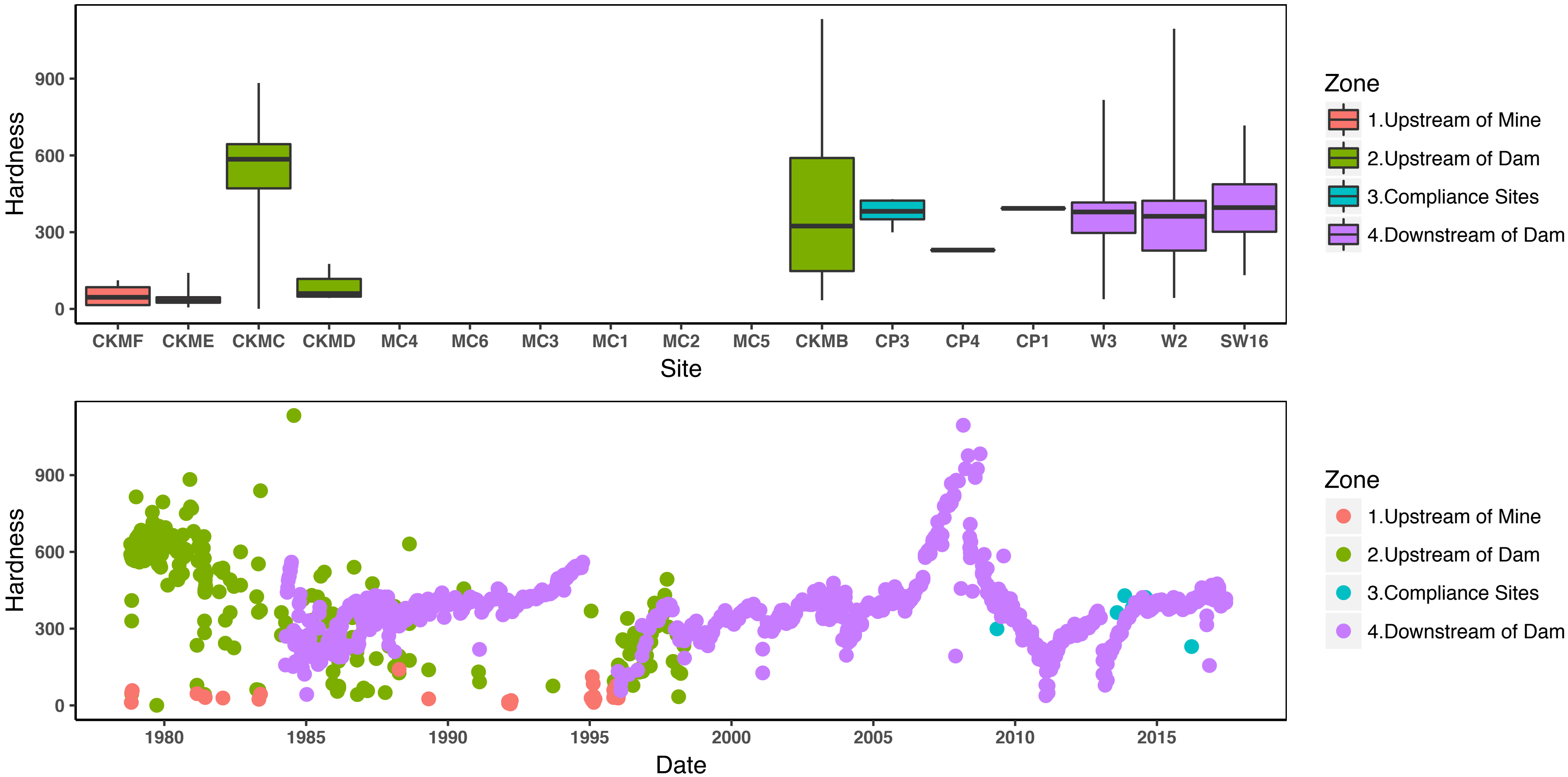


Table 13: Summary of data: Hardness (mg/L)

Site	CKMF	CKME	CKMC	CKMD	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	6	28	117	7	131	5	1	1	531	409	59
Min	12.0	6.0	0.5	43.0	34.0	299.3	230.0	393.0	38.0	43.0	132.0
Max	112	141	883	176	1133	429	230	393	817	1095	717
Median	45.5	32.0	585.0	60.0	324.0	381.5	230.0	393.0	379.0	362.0	396.0
20th %ile	15.0	24.4	471.2	48.0	148.0	350.3	230.0	393.0	297.0	228.0	301.6
80th %ile	85.0	45.6	644.0	117.4	590.0	423.4	230.0	393.0	416.0	422.8	487.2
95th %ile	105.2	80.6	698.0	161.3	695.0	427.6	230.0	393.0	497.0	591.6	635.3

Figure 14: Boxplot and Time Series Plot of data: Ammonia (mg/L)

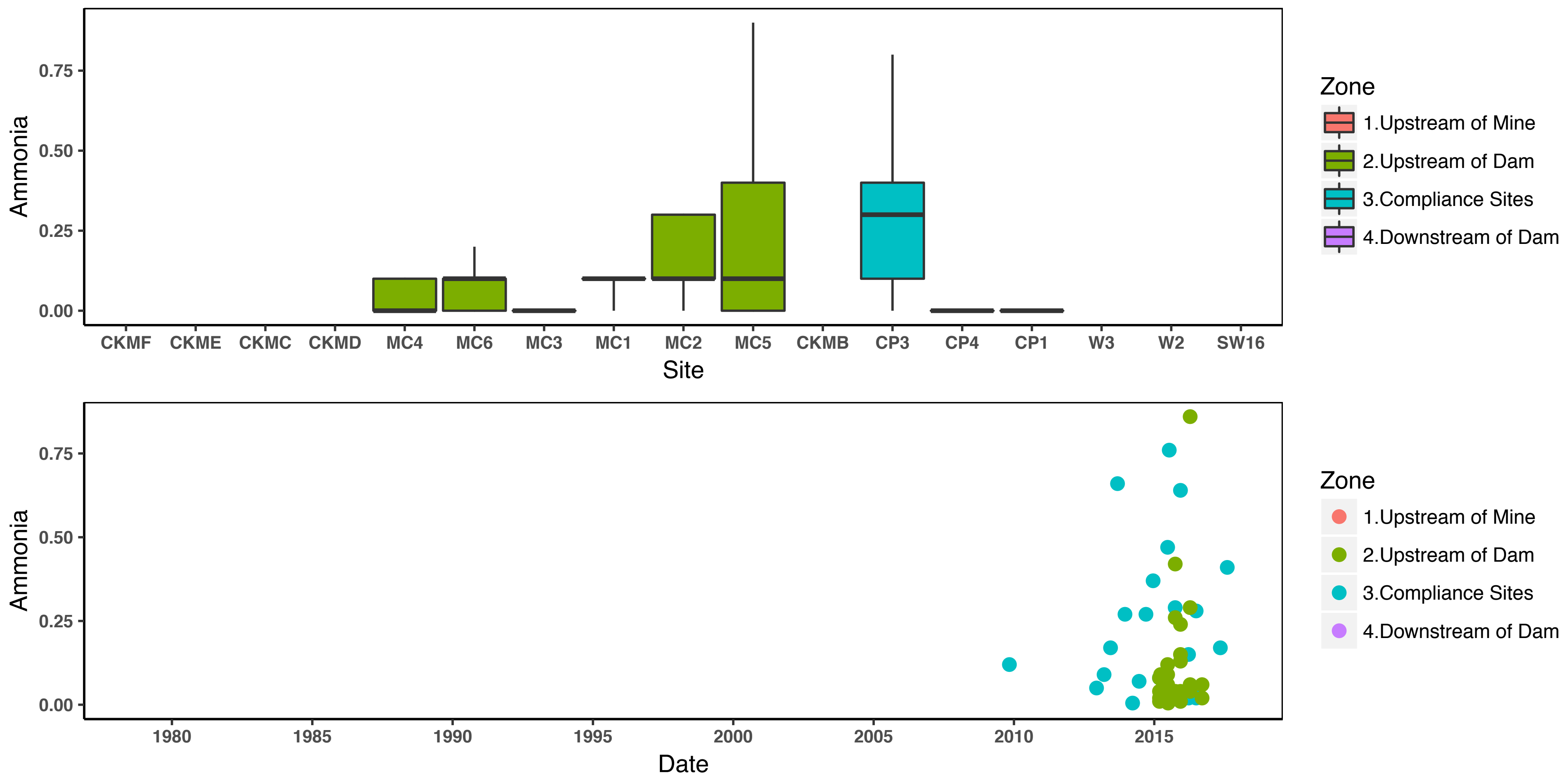


Table 14: Summary of data: Ammonia (mg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1
N	5	3	5	2	7	7	19	2	2
Min	0	0	0	0	0	0	0	0	0
Max	0.1	0.2	0.0	0.1	0.3	0.9	0.8	0.0	0.0
Median	0.0	0.1	0.0	0.1	0.1	0.1	0.3	0.0	0.0
20th %ile	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0
80th %ile	0.1	0.1	0.0	0.1	0.3	0.4	0.4	0.0	0.0
95th %ile	0.1	0.1	0.0	0.1	0.3	0.7	0.7	0.0	0.0

Figure 15: Boxplot and Time Series Plot of data: Nitrate (mg/L)

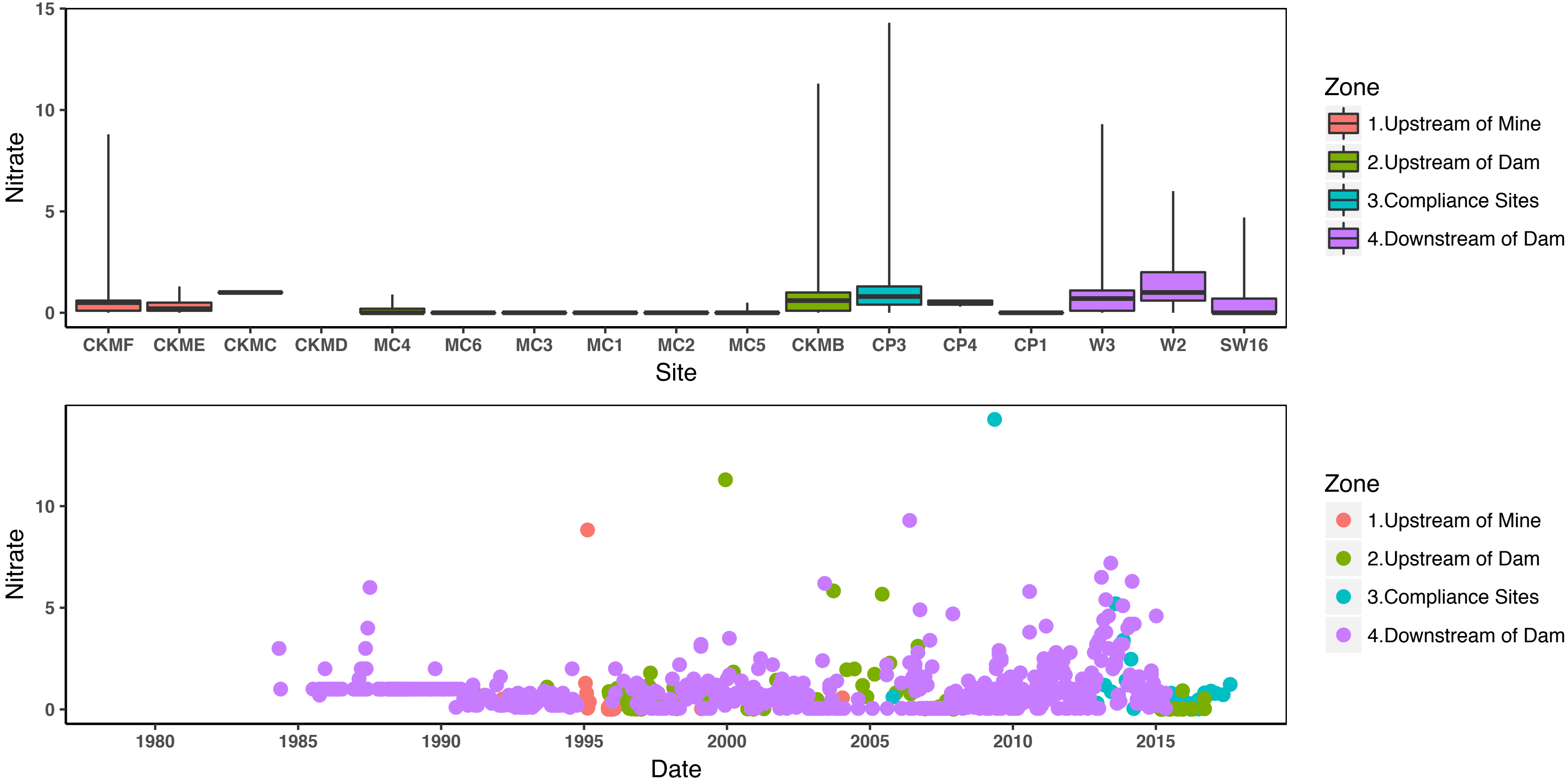
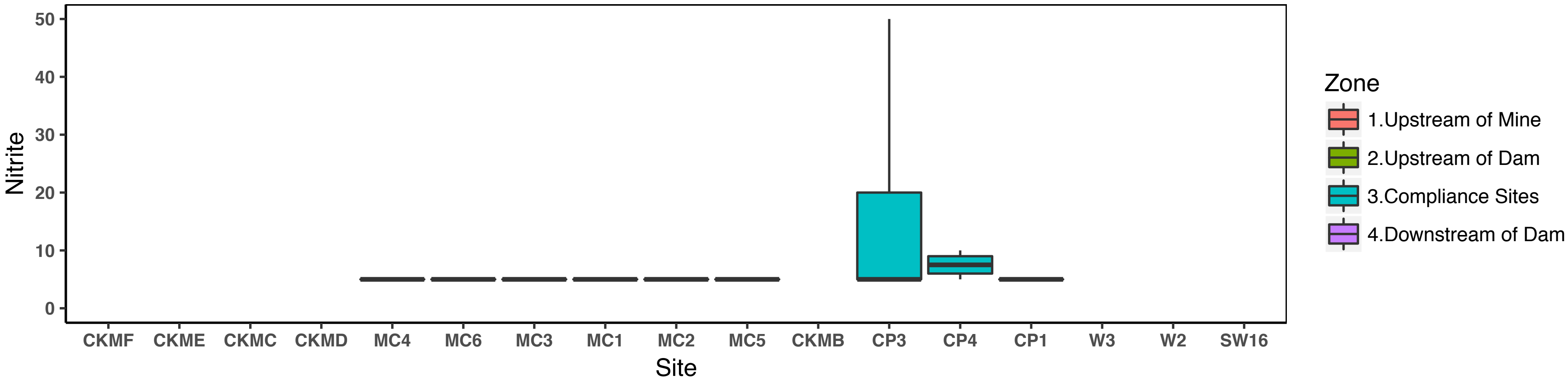


Table 15: Summary of data: Nitrate (mg/L)

Site	CKMF	CKME	CKMC	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	16	1	5	3	5	2	7	7	94	28	3	2	313	217	49
Min	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Max	8.8	1.3	1.0	0.9	0.0	0.0	0.0	0.1	0.5	11.3	14.3	0.6	0.0	9.3	6.0	4.7
Median	0.5	0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8	0.5	0.0	0.7	1.0	0.0
20th %ile	0.1	0.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.0	0.1	0.6	0.0
80th %ile	0.6	0.5	1.0	0.2	0.0	0.0	0.0	0.0	0.0	1.0	1.3	0.6	0.0	1.1	2.0	0.7
95th %ile	6.4	0.9	1.0	0.7	0.0	0.0	0.0	0.1	0.4	2.1	4.6	0.6	0.0	2.5	3.5	1.7

Figure 16: Boxplot and Time Series Plot of data: Nitrite (μg/L)



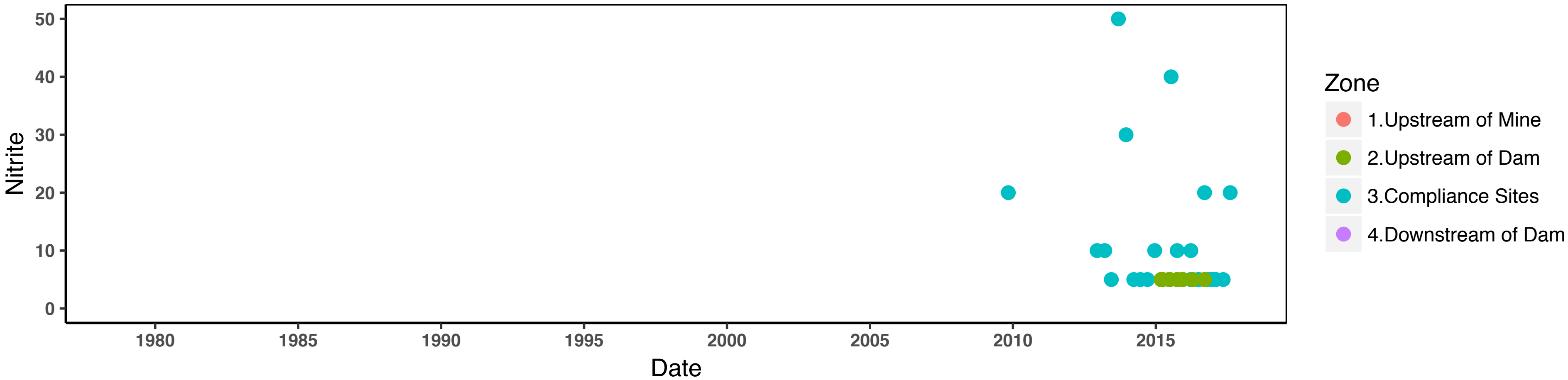


Table 16: Summary of data: Nitrite (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1
N	5	3	5	2	7	7	24	2	2
Min	5	5	5	5	5	5	5	5	5
Max	5	5	5	5	5	5	50	10	5
Median	5.0	5.0	5.0	5.0	5.0	5.0	5.0	7.5	5.0
20th %ile	5	5	5	5	5	5	5	6	5
80th %ile	5	5	5	5	5	5	20	9	5
95th %ile	5.0	5.0	5.0	5.0	5.0	5.0	38.5	9.8	5.0

Figure 17: Boxplot and Time Series Plot of data: NOX (mg/L)

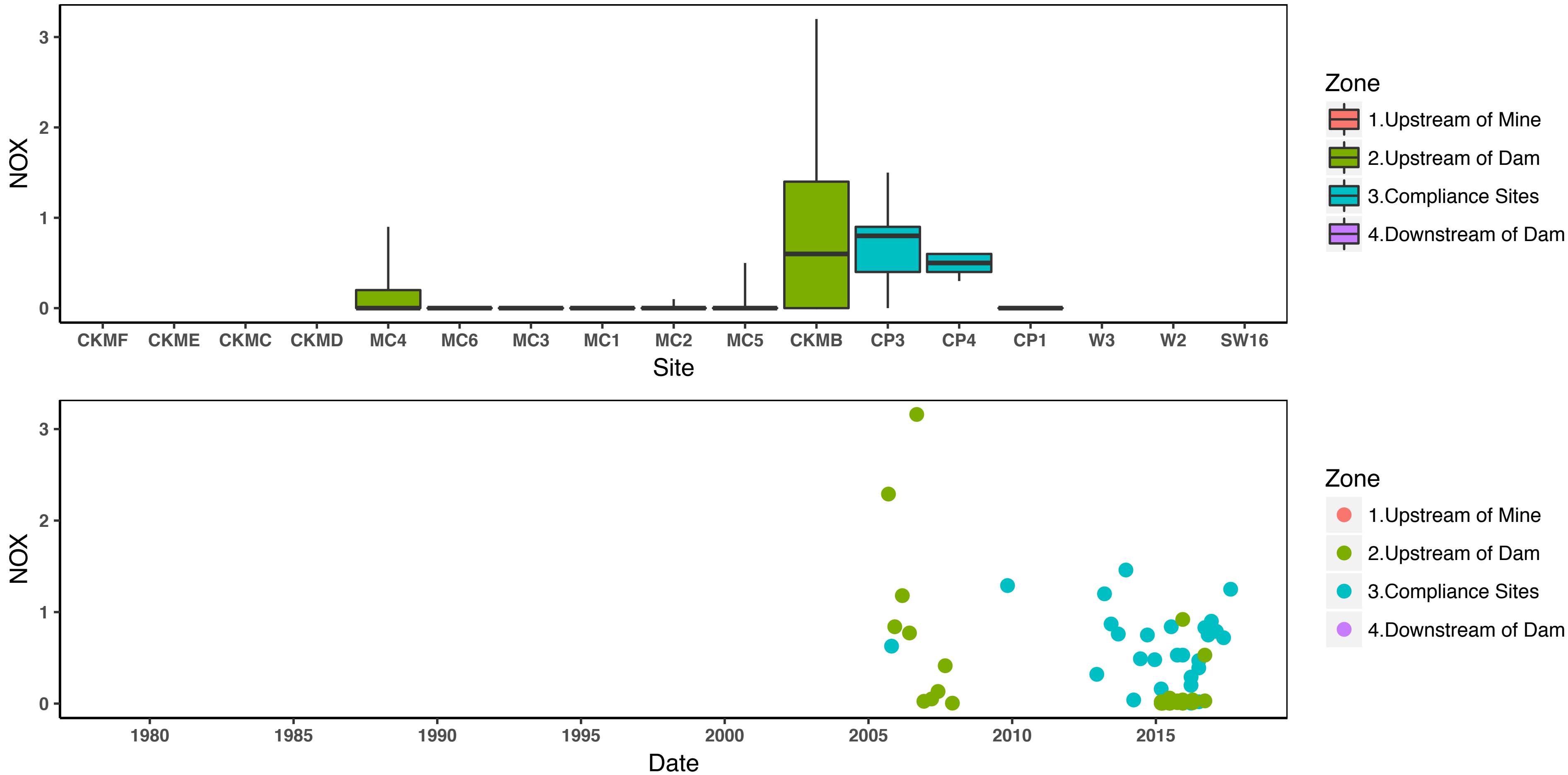


Table 17: Summary of data: NOX (mg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1
N	5	3	5	2	7	7	10	24	3	2
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Max	0.9	0.0	0.0	0.0	0.1	0.5	3.2	1.5	0.6	0.0
Median	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8	0.5	0.0
20th %ile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0
80th %ile	0.2	0.0	0.0	0.0	0.0	0.0	1.4	0.9	0.6	0.0
95th %ile	0.7	0.0	0.0	0.0	0.1	0.4	2.8	1.3	0.6	0.0

Figure 18: Boxplot and Time Series Plot of data: Dissolved Al ($\mu g/L$)

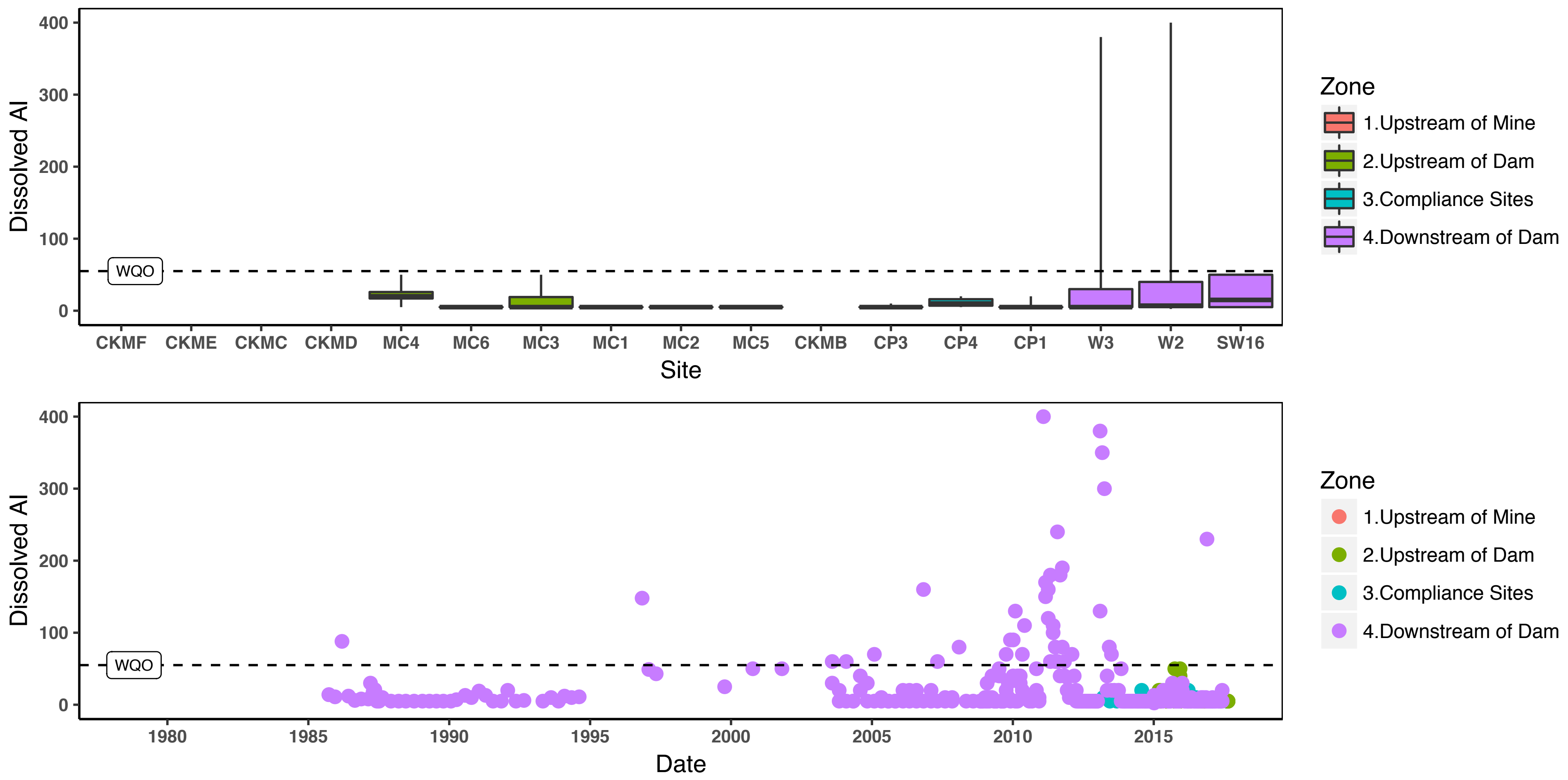


Table 18: Summary of data: Dissolved Al ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	22	3	9	115	163	6
Min	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.5	5.0
Max	50	5	50	5	5	5	10	20	20	380	400	50
Median	20	5	5	5	5	5	5	10	5	5	7	15
20th %ile	17	5	5	5	5	5	5	7	5	5	5	5
80th %ile	26	5	19	5	5	5	5	16	5	30	40	50
95th %ile	44	5	46	5	5	5	5	19	14	173	110	50

Figure 19: Boxplot and Time Series Plot of data: Dissolved As ($\mu g/L$)

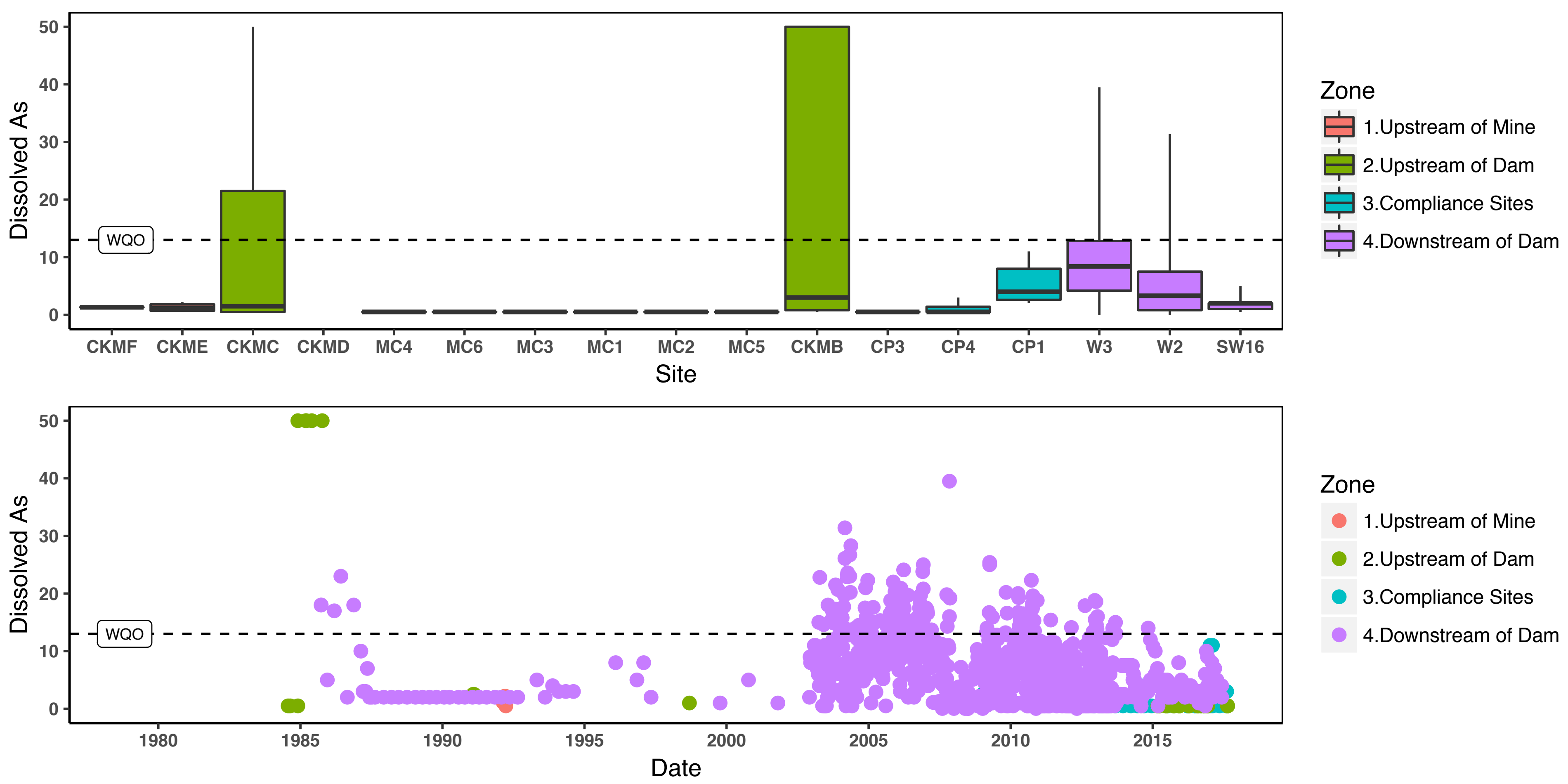


Table 19: Summary of data: Dissolved As ($\mu g/L$)

Site	CKMF	CKME	CKMC	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	1	3	4	5	7	9	6	11	11	9	23	5	9	658	331	38
Min	1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.0	0.0	0.5
Max	1.3	2.2	50.0	0.5	0.5	0.5	0.5	0.5	0.5	50.0	0.5	3.0	11.0	39.5	31.4	5.0
Median	1.3	1.1	1.5	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.5	0.5	4.0	8.4	3.3	2.0
20th %ile	1.3	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.5	0.5	2.6	4.2	0.8	1.0
80th %ile	1.3	1.8	21.5	0.5	0.5	0.5	0.5	0.5	0.5	50.0	0.5	1.4	8.0	12.8	7.5	2.0
95th %ile	1.3	2.1	42.9	0.5	0.5	0.5	0.5	0.5	0.5	50.0	0.5	2.6	11.0	18.2	14.9	3.1

Figure 20: Boxplot and Time Series Plot of data: Dissolved B (μg/L)

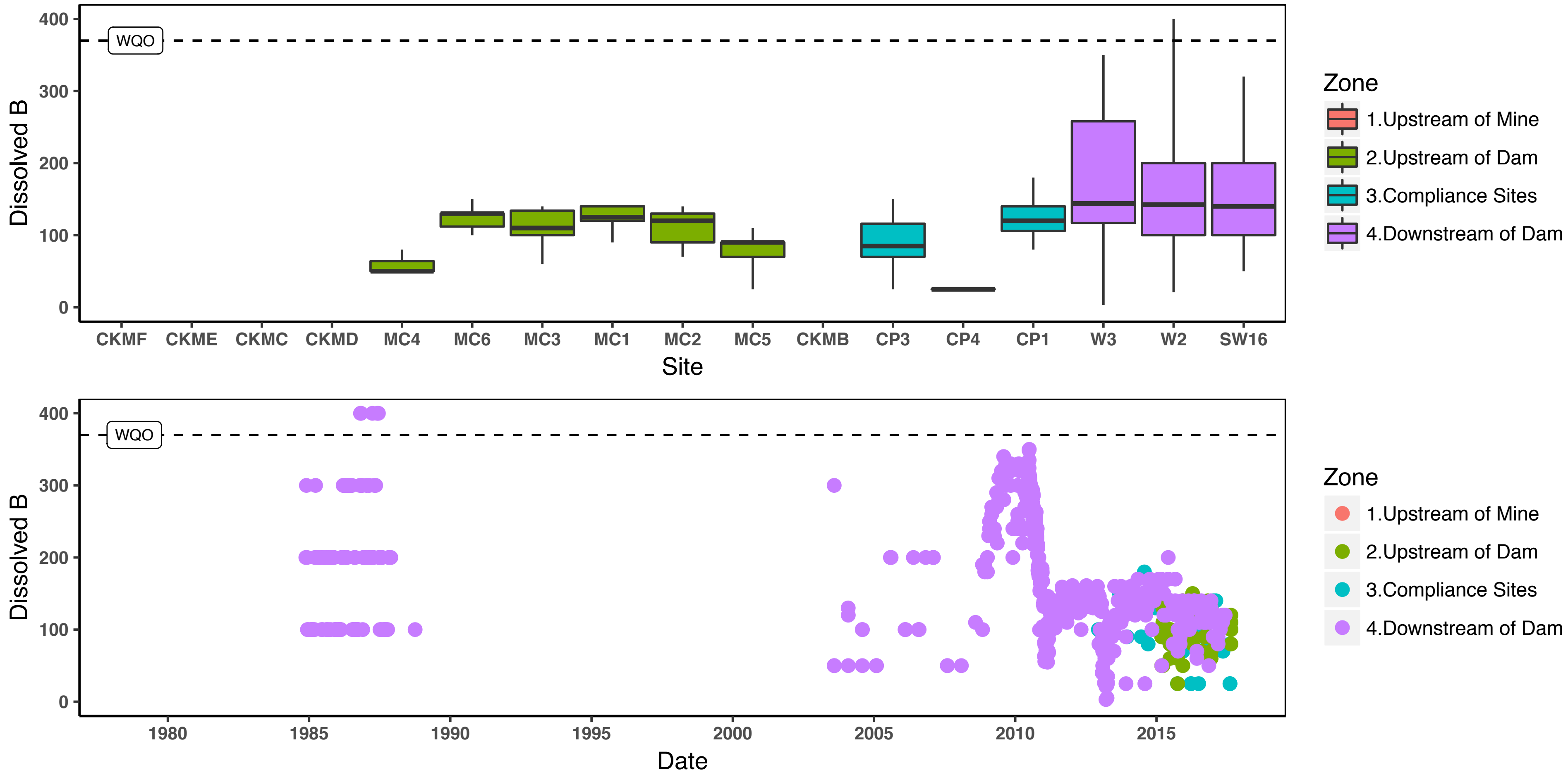


Table 20: Summary of data: Dissolved B (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	22	3	9	323	350	36
Min	50	100	60	90	70	25	25	25	80	3	21	50
Max	80	150	140	140	140	110	150	25	180	350	400	320
Median	50.0	130.0	110.0	125.0	120.0	90.0	85.0	25.0	120.0	144.0	142.5	140.0
20th %ile	50	112	100	120	90	70	70	25	106	117	100	100
80th %ile	64	130	134	140	130	90	116	25	140	258	200	200
95th %ile	76.0	144.0	140.0	140.0	135.0	100.0	130.0	25.0	164.0	312.9	300.0	272.5

Figure 21: Boxplot and Time Series Plot of data: Dissolved Cd (μg/L)

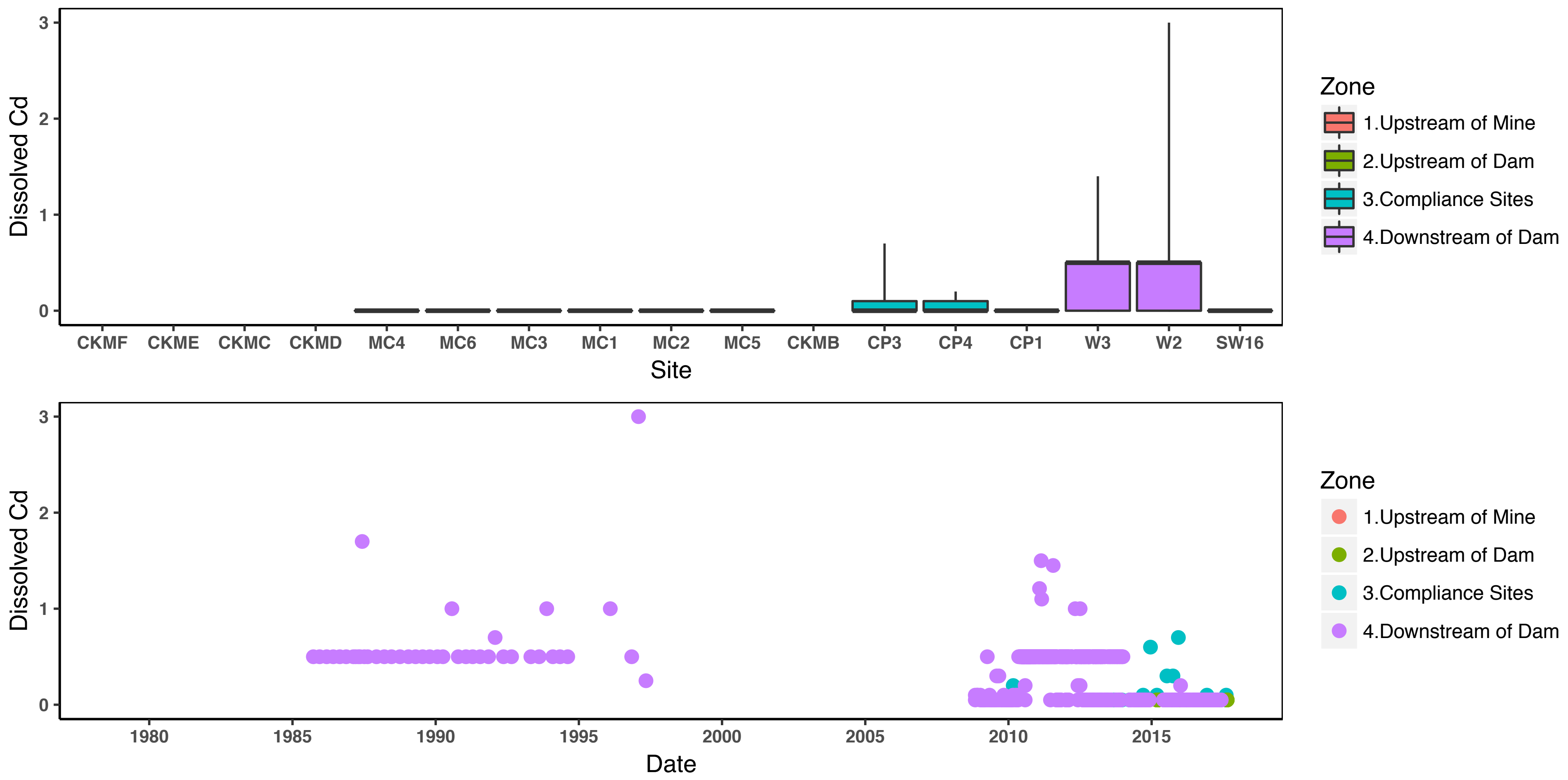


Table 21: Summary of data: Dissolved Cd (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	5	9	288	238	3
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	0.0	1.4	3.0	0.0
Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0
20th %ile	0	0	0	0	0	0	0	0	0	0	0	0
80th %ile	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.5	0.5	0.0
95th %ile	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	0.0	0.5	0.5	0.0

Figure 22: Boxplot and Time Series Plot of data: Dissolved Cr ($\mu g/L$)

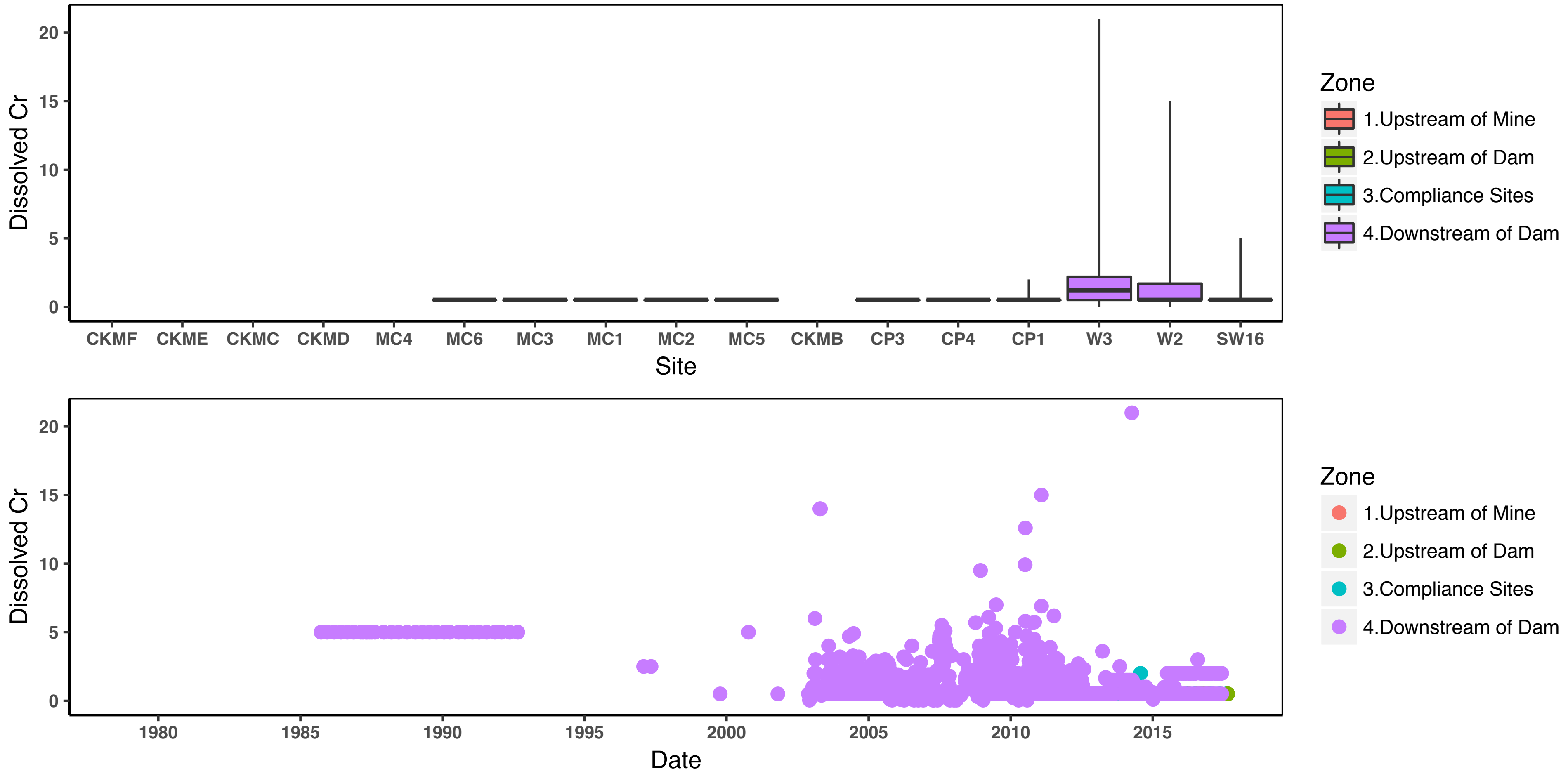
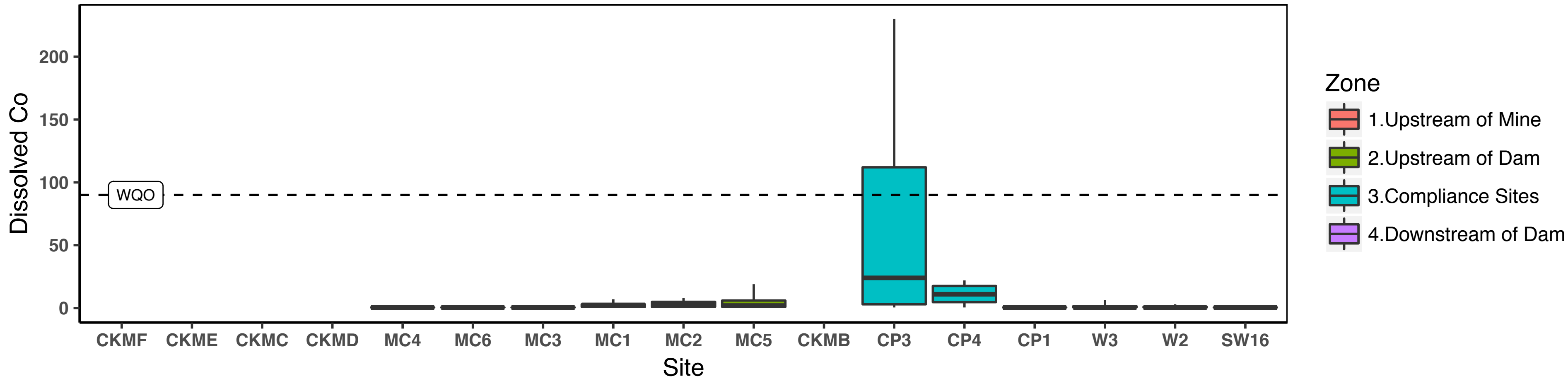


Table 22: Summary of data: Dissolved Cr ($\mu g/L$)

Site	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	3	9	6	11	3	23	2	9	658	320	38
Min	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.5
Max	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	21.0	15.0	5.0
Median	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.2	0.5	0.5
20th %ile	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
80th %ile	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.2	1.7	0.5
95th %ile	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.4	4.0	5.0	1.3

Figure 23: Boxplot and Time Series Plot of data: Dissolved Co ($\mu g/L$)



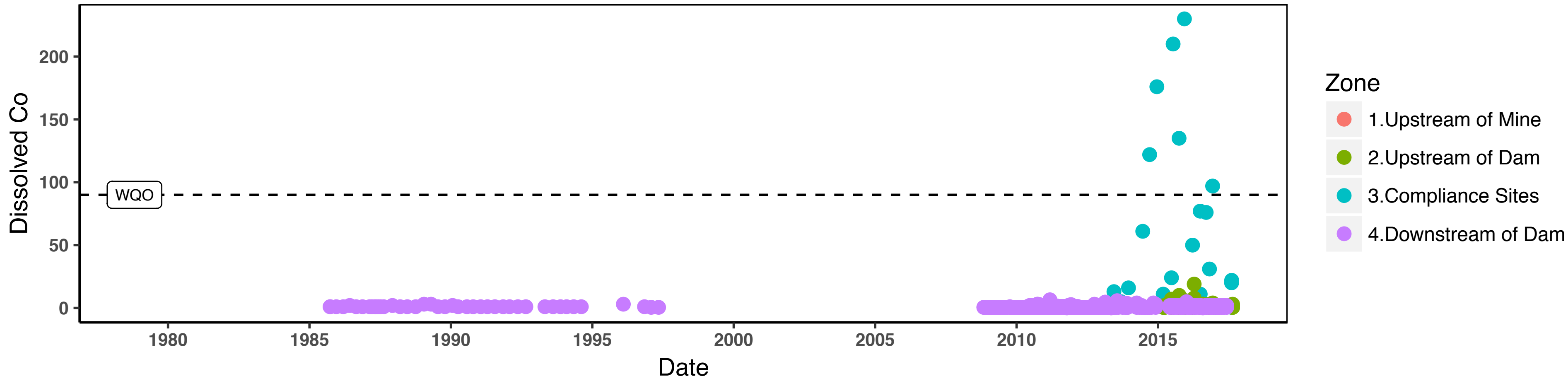


Table 23: Summary of data: Dissolved Co ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	301	249	3
Min	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.5
Max	0.5	2.0	2.0	7.0	8.0	19.0	230.0	22.0	1.0	6.5	3.0	0.5
Median	0.5	0.5	0.5	2.5	3.0	2.0	24.0	11.0	0.5	0.5	0.5	0.5
20th %ile	0.5	0.5	0.5	1.0	1.0	1.0	3.0	4.7	0.5	0.5	0.5	0.5
80th %ile	0.5	0.5	0.5	3.0	5.0	6.0	112.0	17.6	0.5	1.5	1.0	0.5
95th %ile	0.5	1.5	1.4	6.0	7.0	14.5	206.6	20.9	0.8	3.0	1.4	0.5

Figure 24: Boxplot and Time Series Plot of data: Dissolved Cu ($\mu g/L$)

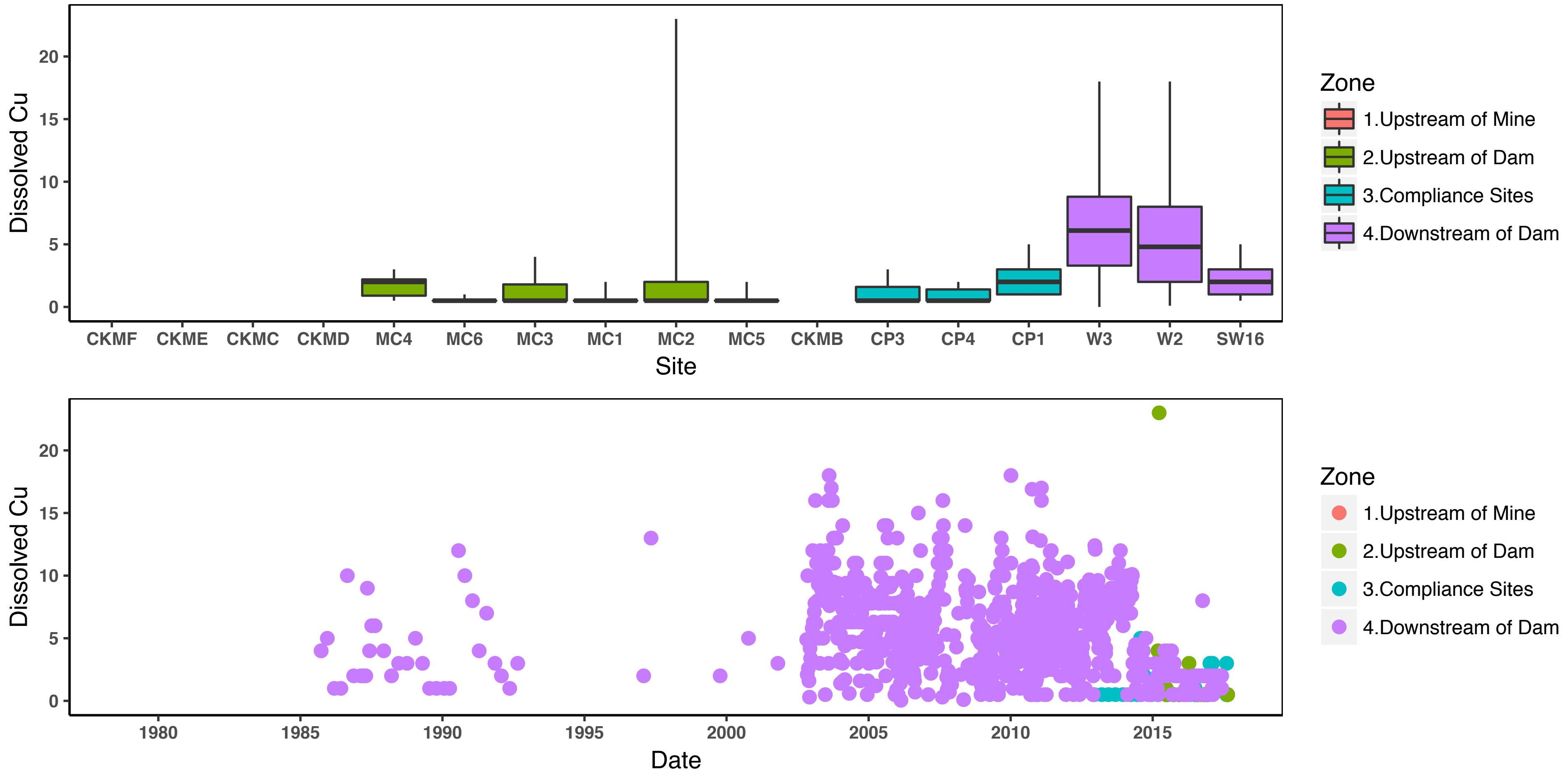


Table 24: Summary of data: Dissolved Cu ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	654	321	37
Min	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.0	0.1	0.5
Max	3	1	4	2	23	2	3	2	5	18	18	5
Median	2.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	6.1	4.8	2.0
20th %ile	0.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	3.3	2.0	1.0
80th %ile	2.2	0.5	1.8	0.5	2.0	0.5	1.6	1.4	3.0	8.8	8.0	3.0
95th %ile	2.8	0.8	3.6	1.6	12.5	1.5	2.9	1.8	4.2	11.9	11.0	4.0

Figure 25: Boxplot and Time Series Plot of data: Dissolved Fe ($\mu g/L$)

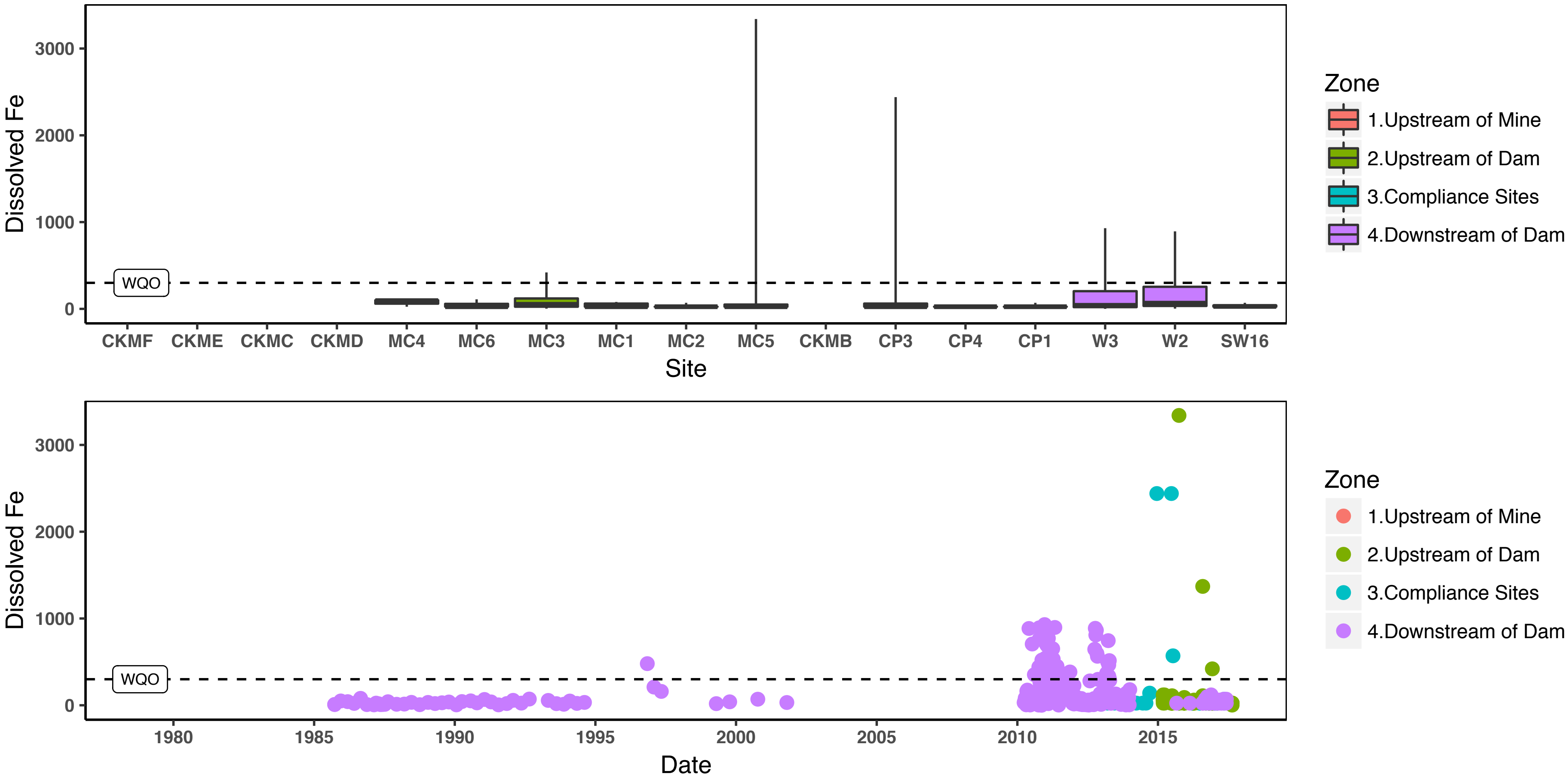


Table 25: Summary of data: Dissolved Fe ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	6	7	10	7	12	12	22	3	9	244	188	6
Min	25.0	25.0	2.5	25.0	25.0	25.0	25.0	25.0	25.0	0.5	2.8	25.0
Max	110	110	420	80	70	3340	2440	25	70	930	893	70
Median	95.0	25.0	52.5	25.0	25.0	25.0	25.0	25.0	25.0	41.1	66.0	28.5
20th %ile	60.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	20.0	33.9	25.0
80th %ile	100.0	58.0	120.0	61.0	25.0	50.0	61.0	25.0	25.0	204.0	254.6	40.0
95th %ile	107.5	95.0	285.0	77.0	45.2	2256.5	2346.5	25.0	52.0	492.2	518.9	62.5

Figure 26: Boxplot and Time Series Plot of data: Dissolved Pb ($\mu g/L$)

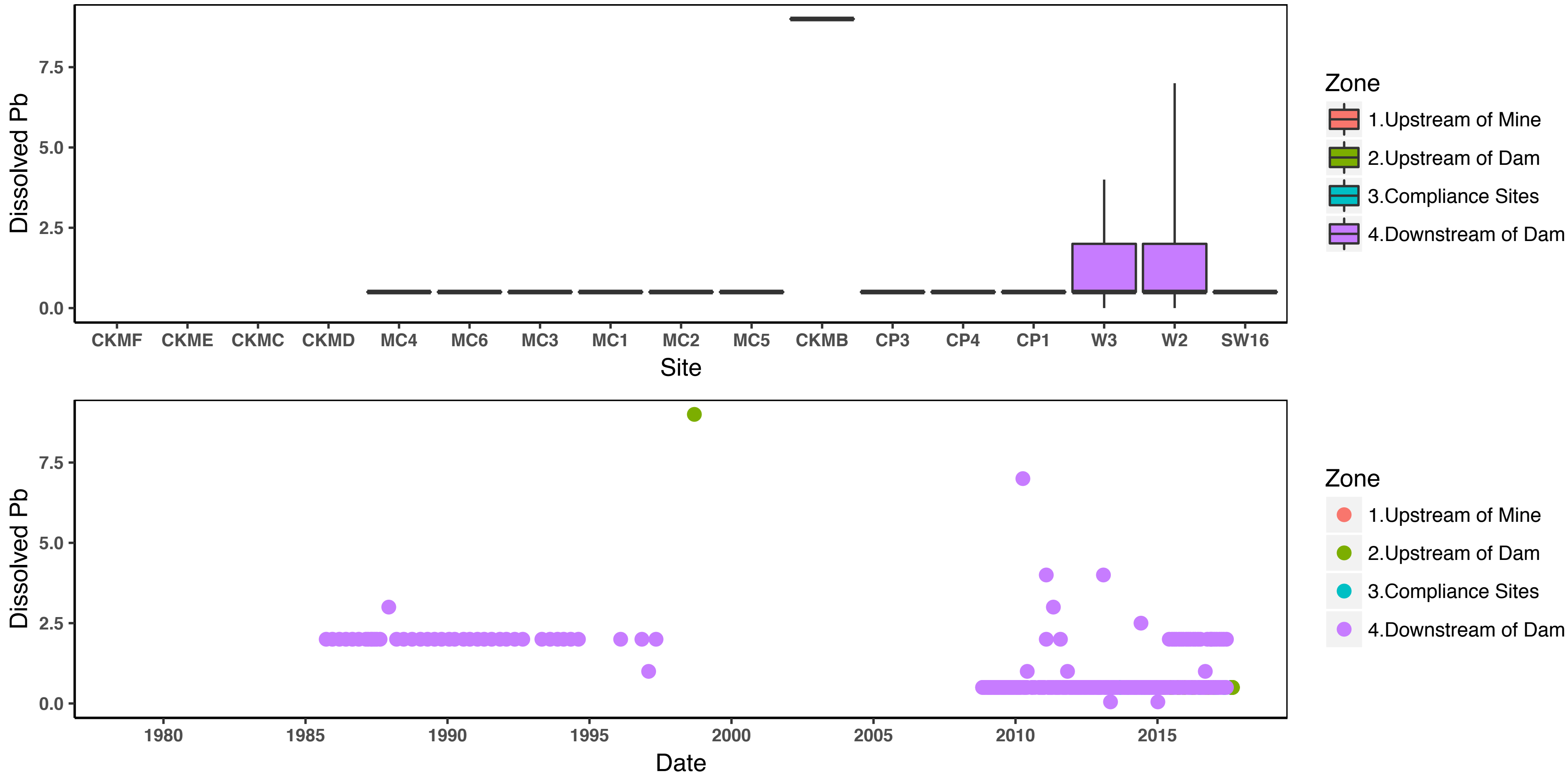
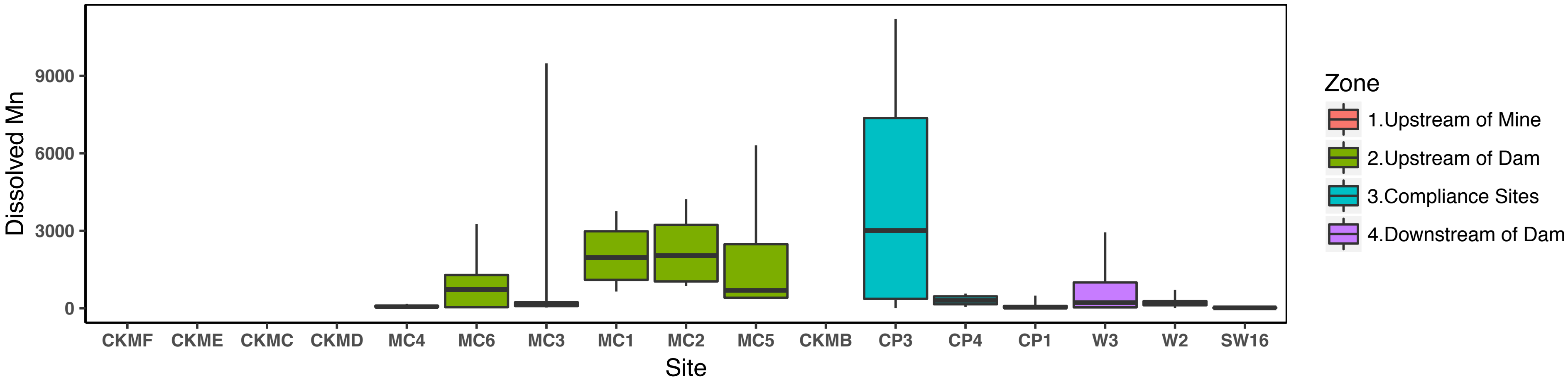


Table 26: Summary of data: Dissolved Pb ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	1	23	3	9	102	143	3
Min	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	0.0	0.0	0.5
Max	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	4.0	7.0	0.5
Median	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	0.5	0.5	0.5
20th %ile	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	0.5	0.5	0.5
80th %ile	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	2.0	2.0	0.5
95th %ile	0.5	0.5	0.5	0.5	0.5	0.5	9.0	0.5	0.5	0.5	2.0	2.0	0.5

Figure 27: Boxplot and Time Series Plot of data: Dissolved Mn (μg/L)



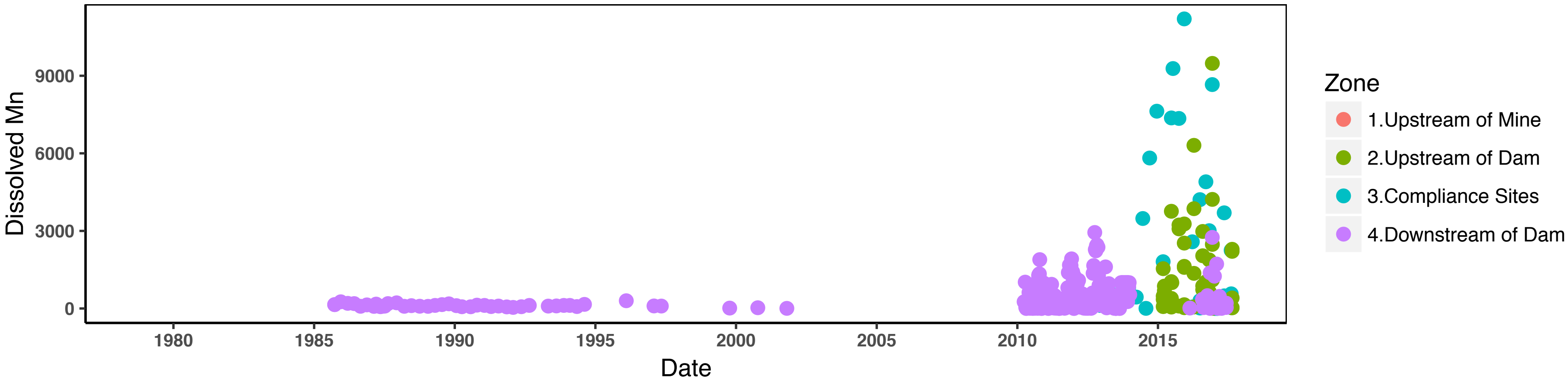


Table 27: Summary of data: Dissolved Mn (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	248	195	6
Min	32.0	6.0	27.0	648.0	865.0	390.0	0.5	53.0	6.0	0.5	0.5	6.0
Max	177	3270	9480	3760	4220	6310	11200	568	489	2940	714	34
Median	61.0	731.0	134.0	1960.0	2040.0	692.0	3010.0	304.0	39.0	219.5	181.0	17.0
20th %ile	51.2	38.6	86.6	1100.0	1040.0	409.0	366.0	153.4	19.6	34.7	114.8	8.0
80th %ile	94.6	1288.0	229.0	2980.0	3230.0	2480.0	7362.0	462.4	88.0	1000.0	275.6	30.0
95th %ile	156.4	2697.0	5828.8	3565.0	4040.0	4695.0	9218.0	541.6	328.6	1660.0	445.9	33.0

Figure 28: Boxplot and Time Series Plot of data: Dissolved Mo (μg/L)

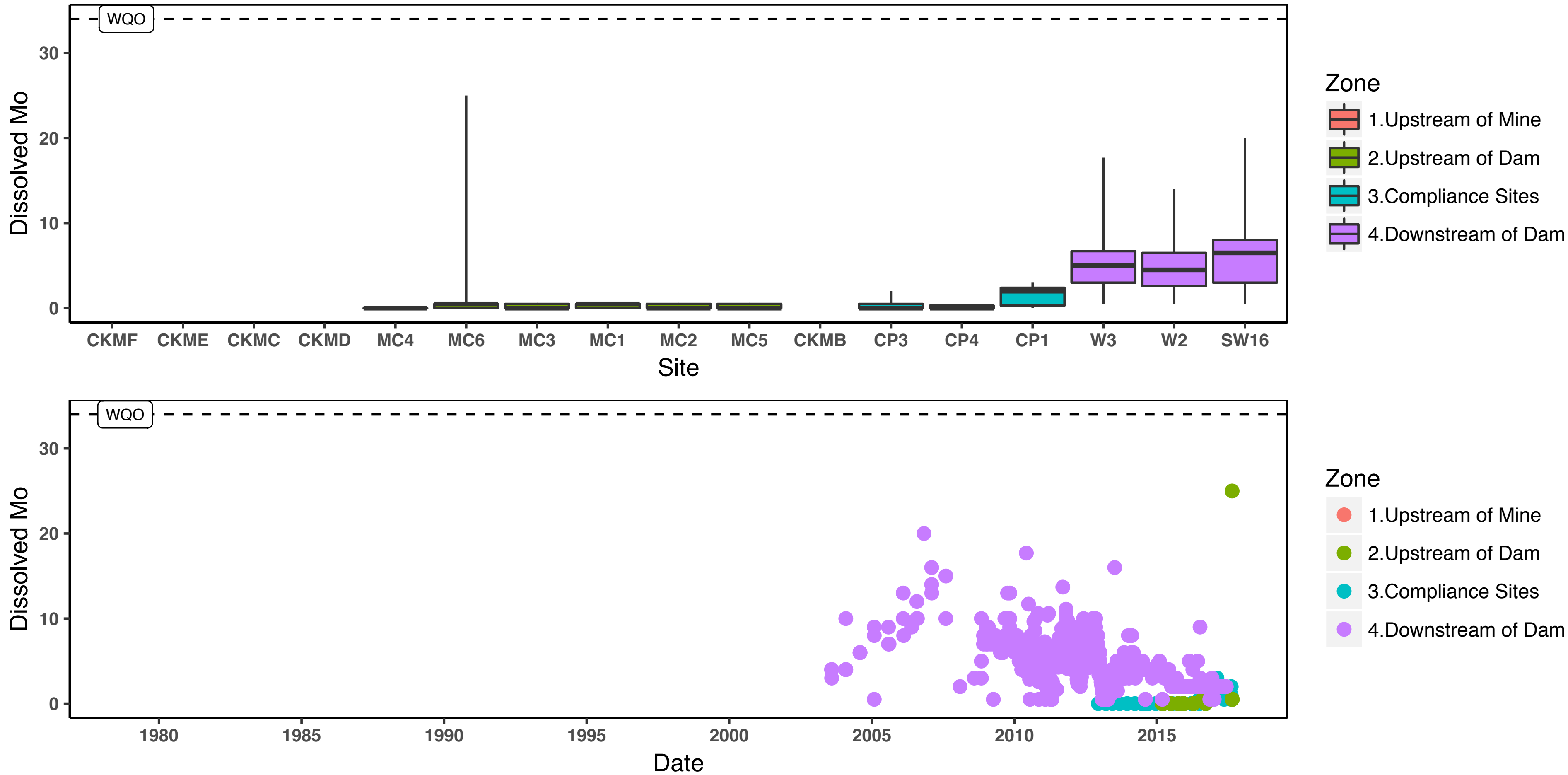
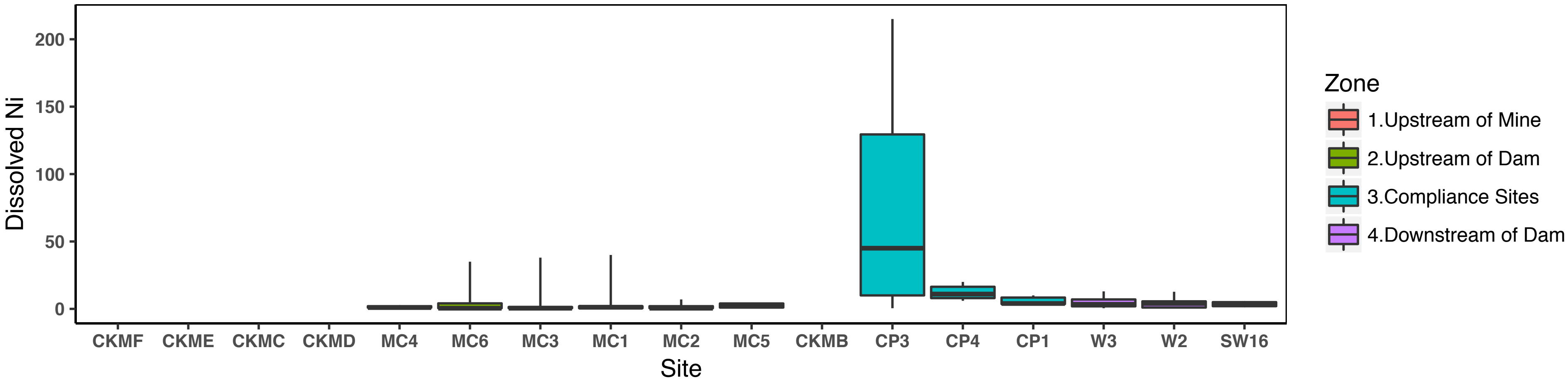


Table 28: Summary of data: Dissolved Mo (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	316	227	36
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5
Max	0.0	25.0	0.5	0.5	0.5	0.5	2.0	0.5	3.0	17.7	14.0	20.0
Median	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	2.0	5.0	4.5	6.5
20th %ile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.0	2.6	3.0
80th %ile	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.3	2.4	6.7	6.5	8.0
95th %ile	0.0	17.6	0.5	0.5	0.5	0.5	1.9	0.5	3.0	9.2	10.0	11.2

Figure 29: Boxplot and Time Series Plot of data: Dissolved Ni ($\mu g/L$)



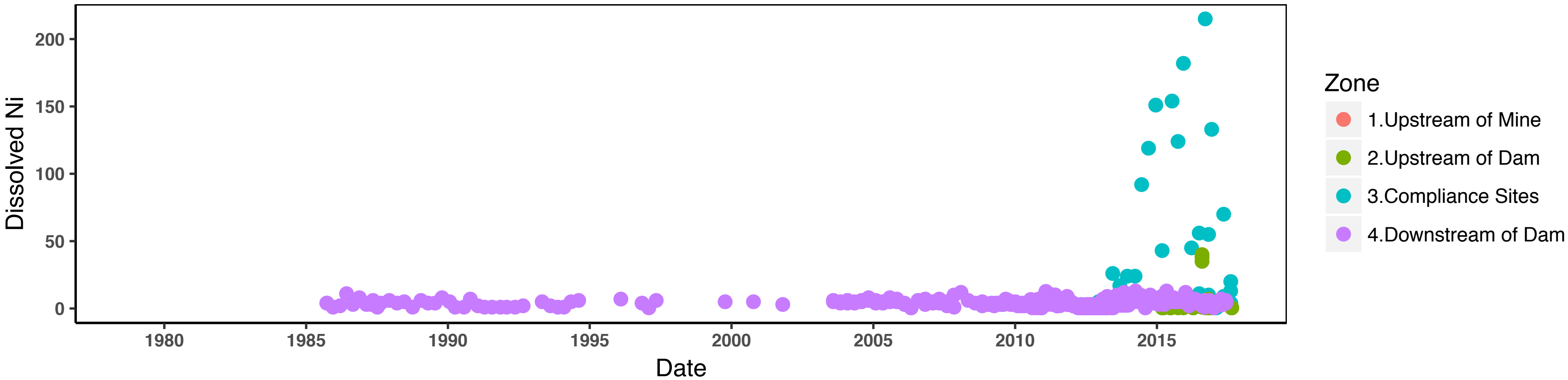


Table 29: Summary of data: Dissolved Ni ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	286	274	6
Min	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.0	3.0	0.5	0.5	2.0
Max	2.0	35.0	38.0	40.0	7.0	4.0	215.0	20.0	10.0	13.0	12.7	5.0
Median	1.0	0.5	0.5	1.2	0.5	2.0	45.0	11.0	4.0	3.4	4.0	3.0
20th %ile	0.9	0.5	0.5	0.5	0.5	1.0	10.0	8.0	3.6	1.9	1.0	2.0
80th %ile	2.0	4.1	1.4	2.0	2.0	4.0	129.4	16.4	8.4	7.0	5.6	5.0
95th %ile	2.0	26.0	23.6	30.5	4.5	4.0	179.2	19.1	9.6	8.9	7.3	5.0

Figure 30: Boxplot and Time Series Plot of data: Dissolved Se ($\mu g/L$)

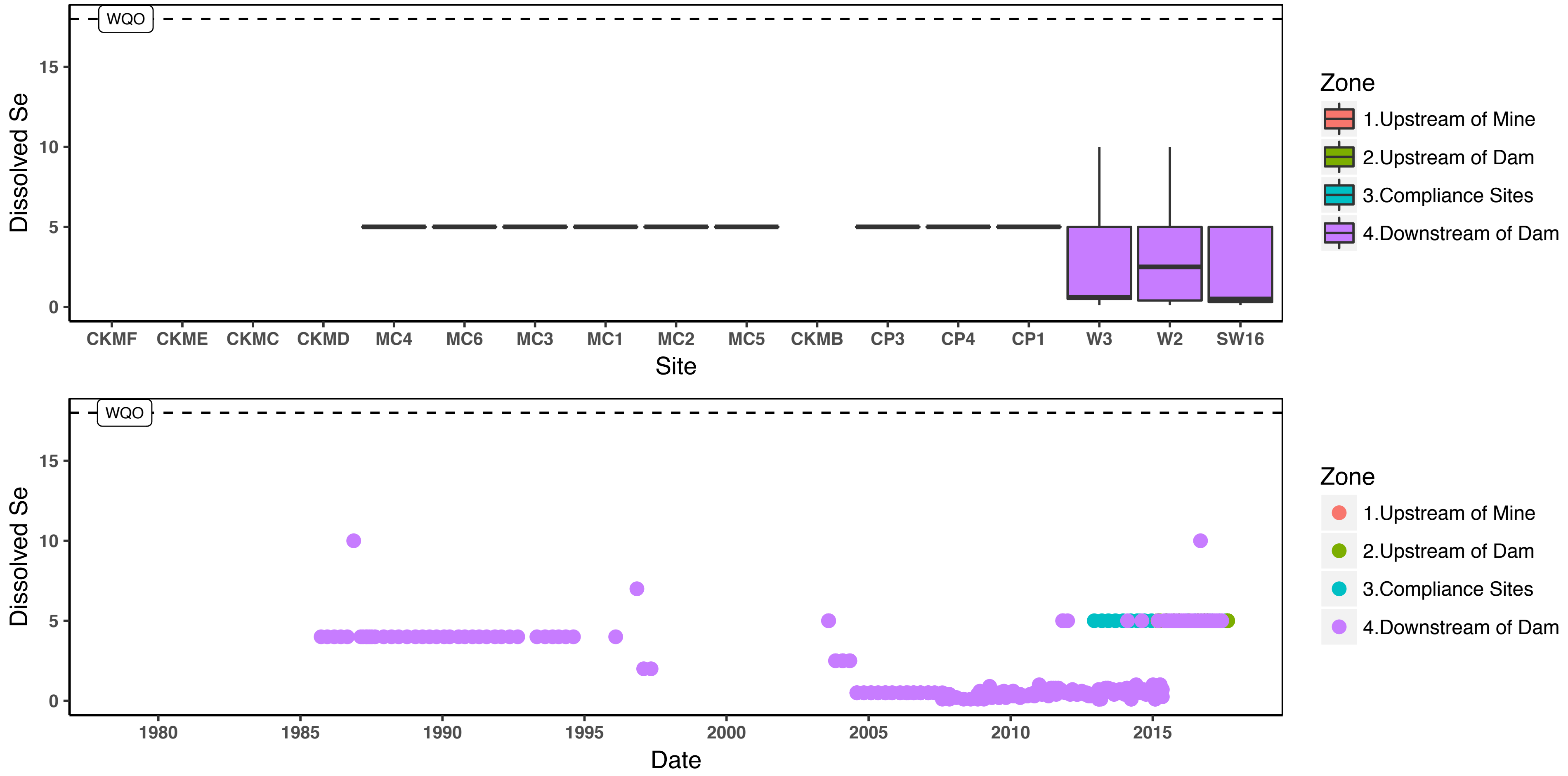


Table 30: Summary of data: Dissolved Se ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	119	140	36
Min	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.1	0.1	0.1
Max	5	5	5	5	5	5	5	5	5	10	10	5
Median	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.6	2.5	0.5
20th %ile	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.5	0.4	0.3
80th %ile	5	5	5	5	5	5	5	5	5	5	5	5
95th %ile	5	5	5	5	5	5	5	5	5	5	5	5

Figure 31: Boxplot and Time Series Plot of data: Dissolved V (μg/L)

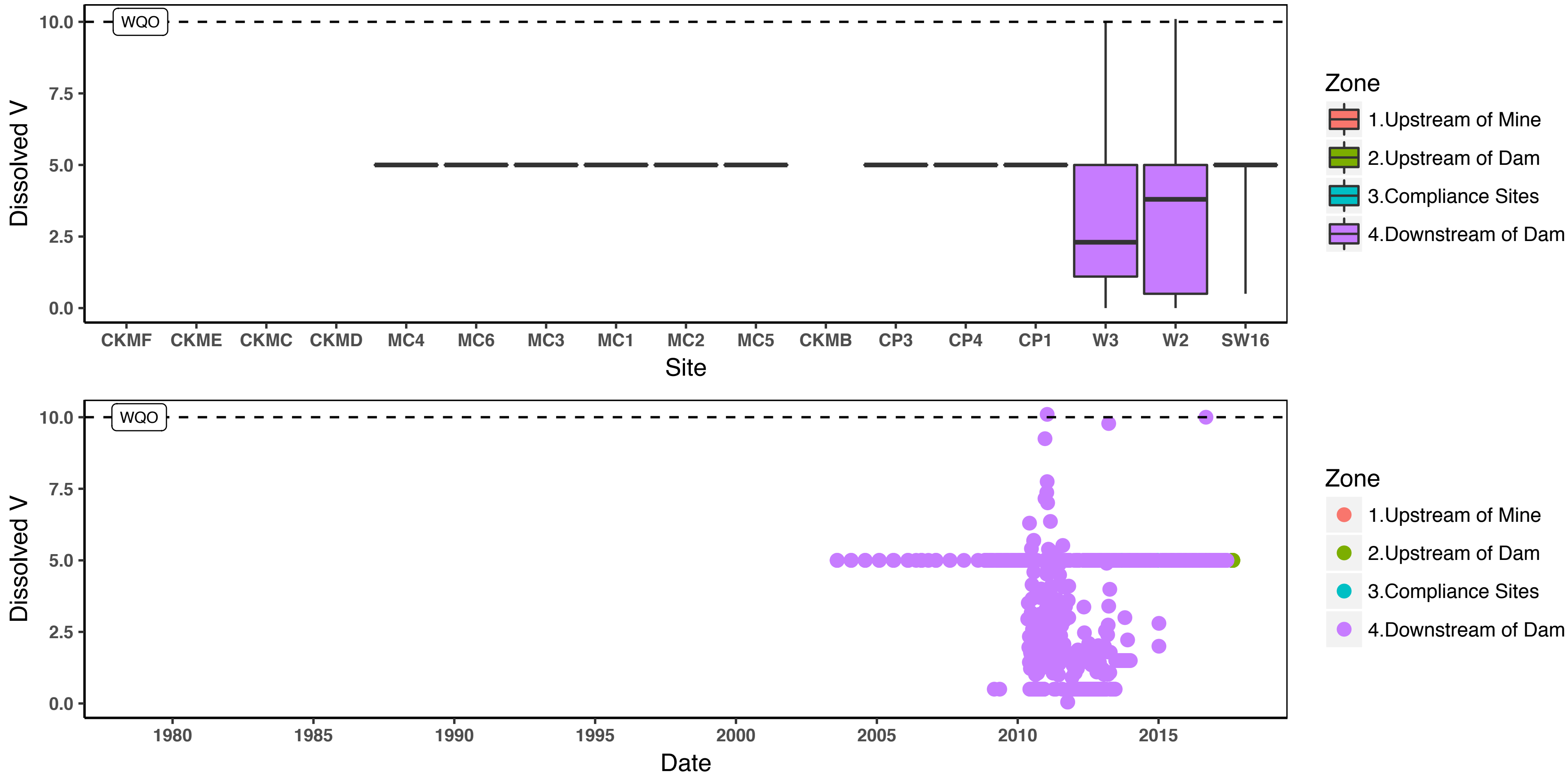


Table 31: Summary of data: Dissolved V (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	23	3	9	319	228	36
Min	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.0	0.0	0.5
Max	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	10.1	5.0
Median	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.3	3.8	5.0
20th %ile	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	1.1	0.5	5.0
80th %ile	5	5	5	5	5	5	5	5	5	5	5	5
95th %ile	5	5	5	5	5	5	5	5	5	5	5	5

Figure 32: Boxplot and Time Series Plot of data: Dissolved Zn ($\mu g/L$)

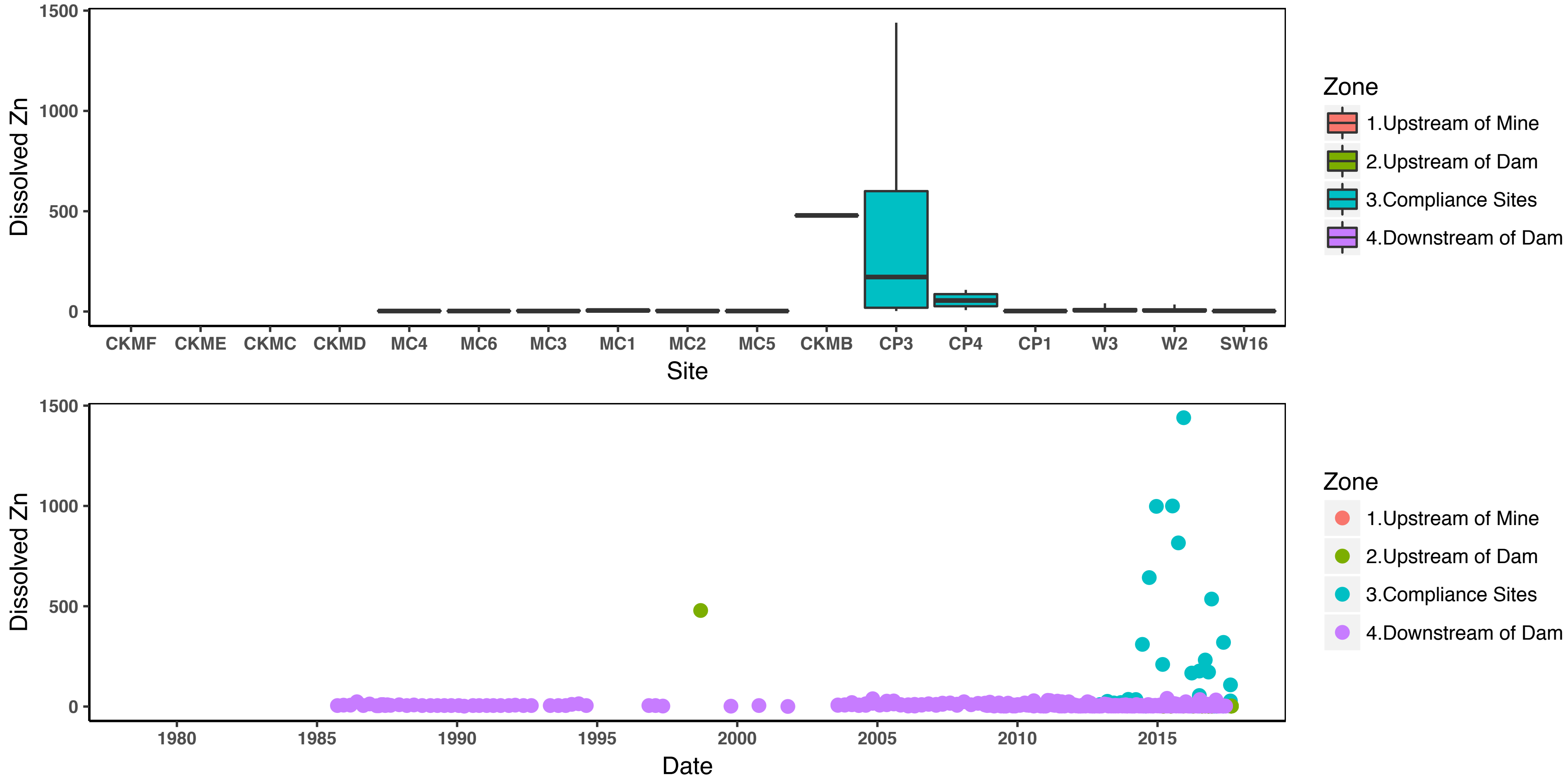


Table 32: Summary of data: Dissolved Zn ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	7	9	6	11	11	1	23	3	9	119	164	6
Min	2.5	2.5	2.5	2.5	2.5	2.5	479.0	2.5	7.0	2.5	2.5	2.0	0.5
Max	7.0	11.0	5.0	12.0	7.0	9.0	479.0	1440.0	108.0	2.5	41.0	35.0	5.0
Median	2.5	2.5	2.5	5.2	2.5	2.5	479.0	172.0	55.0	2.5	6.0	5.0	2.5
20th %ile	2.5	2.5	2.5	2.5	2.5	2.5	479.0	18.8	26.2	2.5	2.5	2.5	2.0
80th %ile	3.4	2.5	5.0	8.0	6.0	2.5	479.0	600.2	86.8	2.5	12.4	10.4	2.5
95th %ile	6.1	8.4	5.0	11.0	6.5	7.0	479.0	999.8	102.7	2.5	24.0	23.4	4.4

Figure 33: Boxplot and Time Series Plot of data: Total Al ($\mu g/L$)

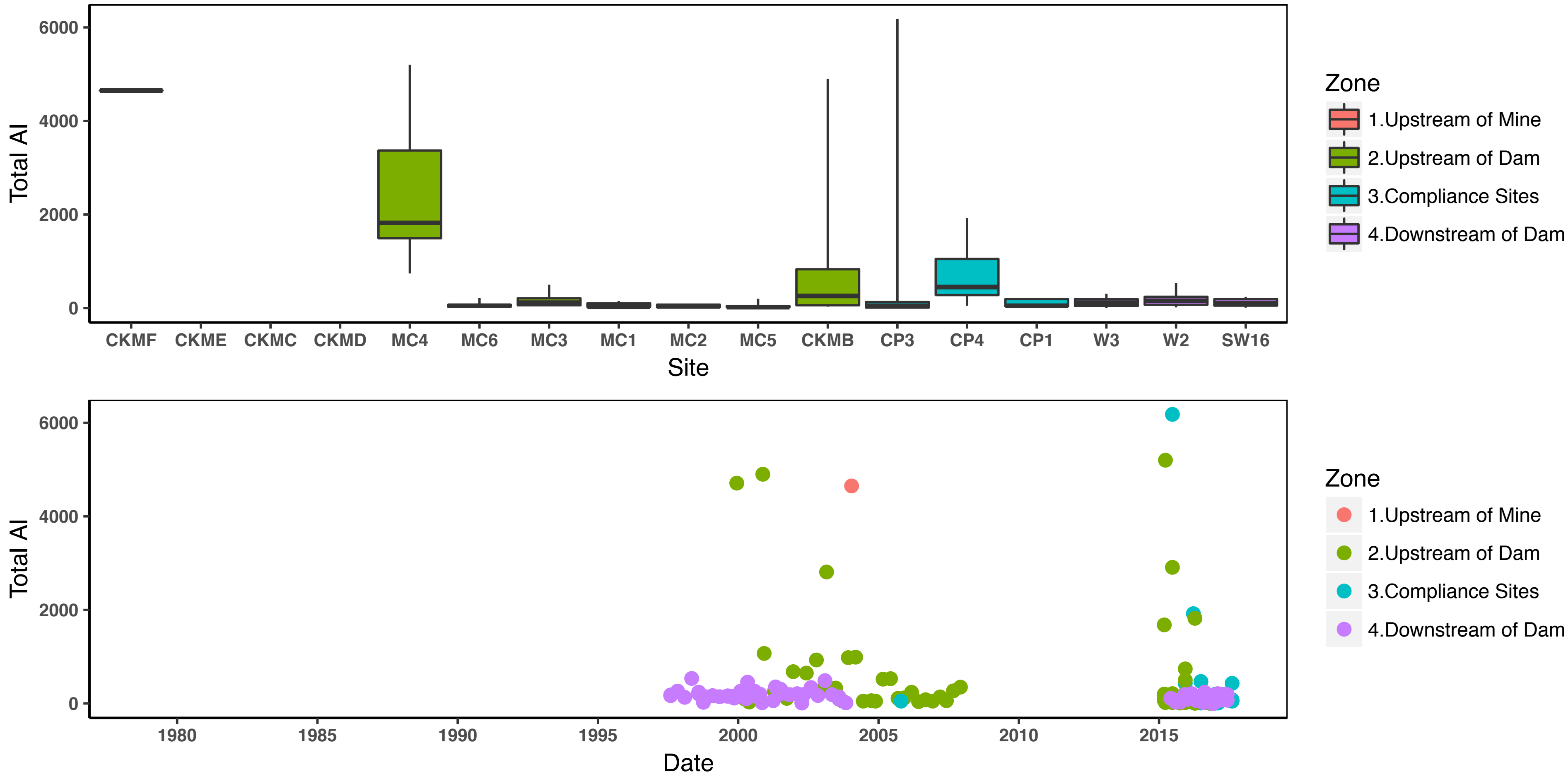


Table 33: Summary of data: Total Al ($\mu g/L$)

Site	CKMF	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	1	5	6	8	5	10	10	33	14	4	8	32	36	10
Min	4650.0	740.0	30.0	50.0	10.0	10.0	5.0	30.0	5.0	50.0	20.0	0.5	14.0	10.0
Max	4650	5200	220	500	150	90	200	4900	6180	1920	200	307	535	240
Median	4650.0	1820.0	50.0	115.0	30.0	35.0	20.0	260.0	50.0	450.0	50.0	115.0	155.5	105.0
20th %ile	4650	1492	30	60	26	18	17	60	10	278	38	44	70	53
80th %ile	4650.0	3368.0	70.0	210.0	102.0	74.0	44.0	830.0	132.0	1050.0	192.0	190.0	242.0	191.2
95th %ile	4650.0	4742.0	182.5	398.5	138.0	90.0	155.0	3570.0	2442.5	1702.5	200.0	273.3	463.2	222.0

Figure 34: Boxplot and Time Series Plot of data: Total As (μg/L)

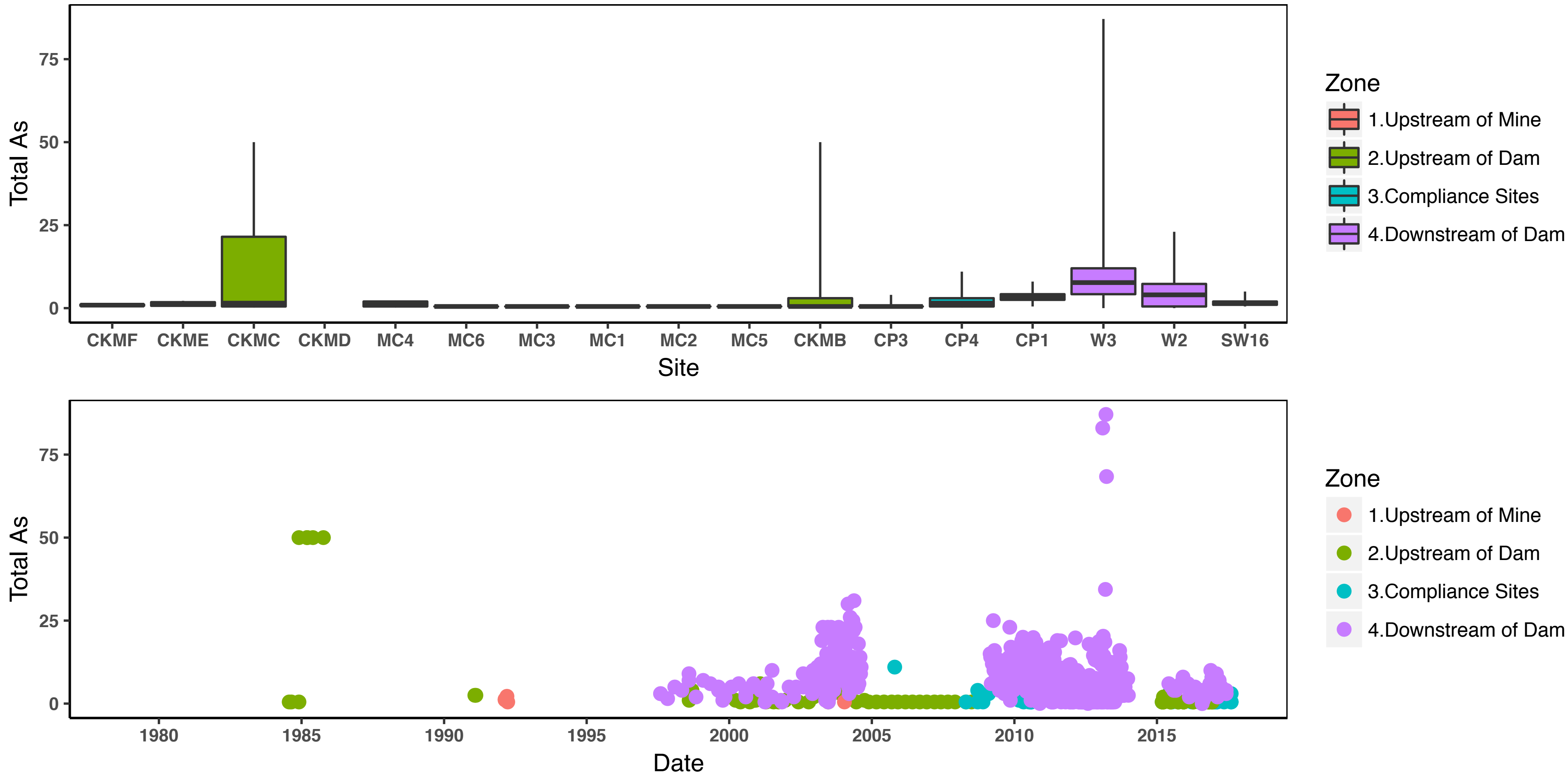


Table 34: Summary of data: Total As (μg/L)

Site	CKMF	CKME	CKMC	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	2	3	4	5	6	8	5	10	10	44	26	6	10	434	185	8
Min	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	0.0	0.0	0.5
Max	1.3	2.2	50.0	2.0	0.5	1.0	0.5	0.5	0.5	50.0	4.0	11.0	8.0	87.1	23.0	5.0
Median	0.9	1.1	1.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	3.5	7.7	4.0	1.5
20th %ile	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.5	4.2	0.5	1.0
80th %ile	1.1	1.8	21.5	2.0	0.5	0.5	0.5	0.5	0.5	3.0	0.5	3.0	4.2	12.0	7.3	2.0
95th %ile	1.3	2.1	42.9	2.0	0.5	0.8	0.5	0.5	0.5	50.0	2.8	9.0	6.6	20.0	10.3	3.9

Figure 35: Boxplot and Time Series Plot of data: Total B ($\mu g/L$)

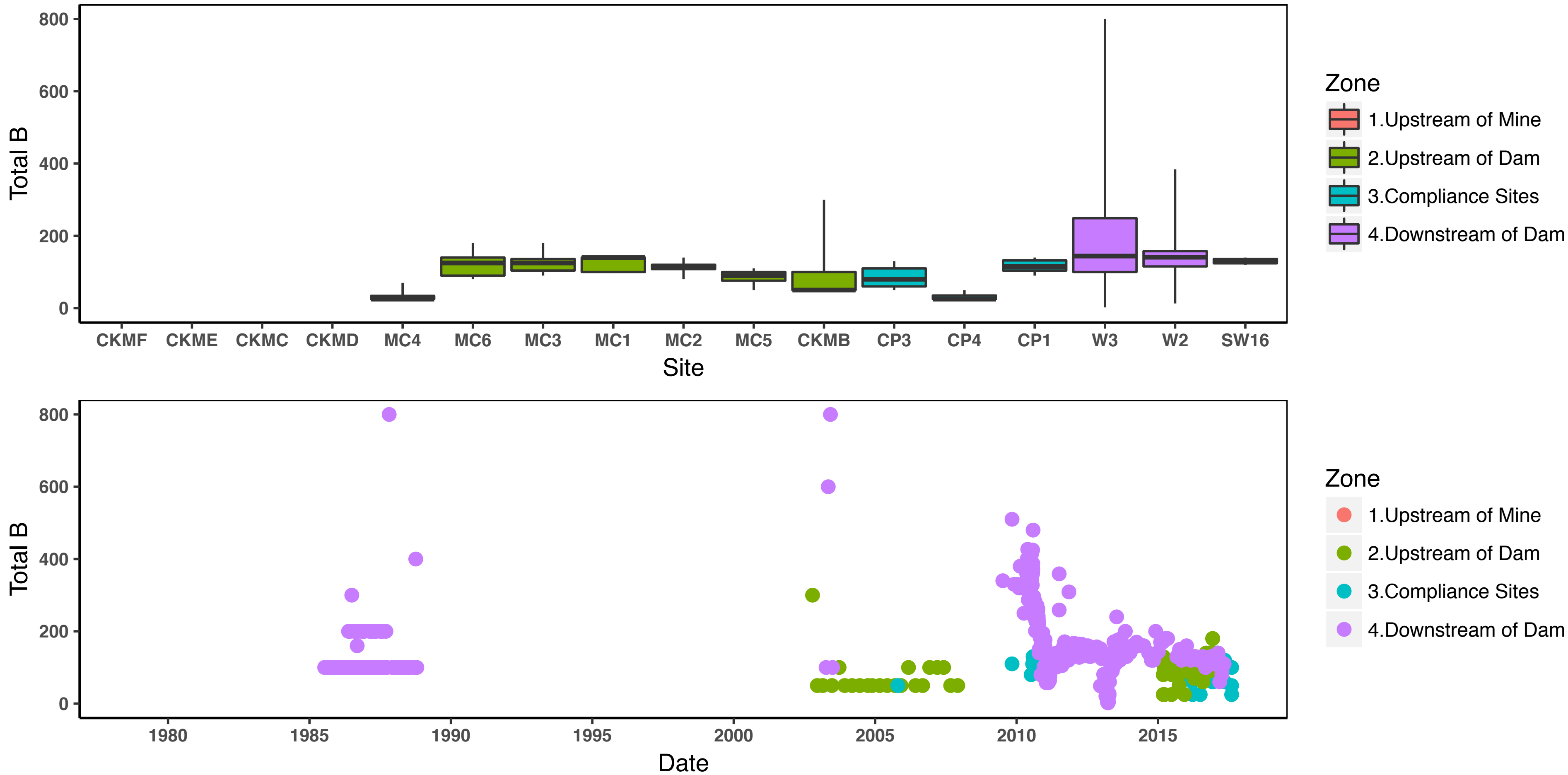


Table 35: Summary of data: Total B ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	6	8	5	10	10	22	19	4	8	404	153	3
Min	25	80	90	100	80	50	50	50	25	90	2	13	120
Max	70	180	180	140	140	110	300	130	50	140	800	384	140
Median	25	125	125	140	115	90	50	80	25	115	144	141	130
20th %ile	25.0	90.0	104.0	100.0	108.0	76.0	50.0	60.0	25.0	104.0	100.0	115.4	124.0
80th %ile	34.0	140.0	136.0	140.0	120.0	100.0	100.0	110.0	35.0	132.0	248.8	157.6	136.0
95th %ile	61.0	170.0	166.0	140.0	131.0	105.5	100.0	130.0	46.2	140.0	373.0	297.6	139.0

Figure 36: Boxplot and Time Series Plot of data: Total Cd ($\mu g/L$)

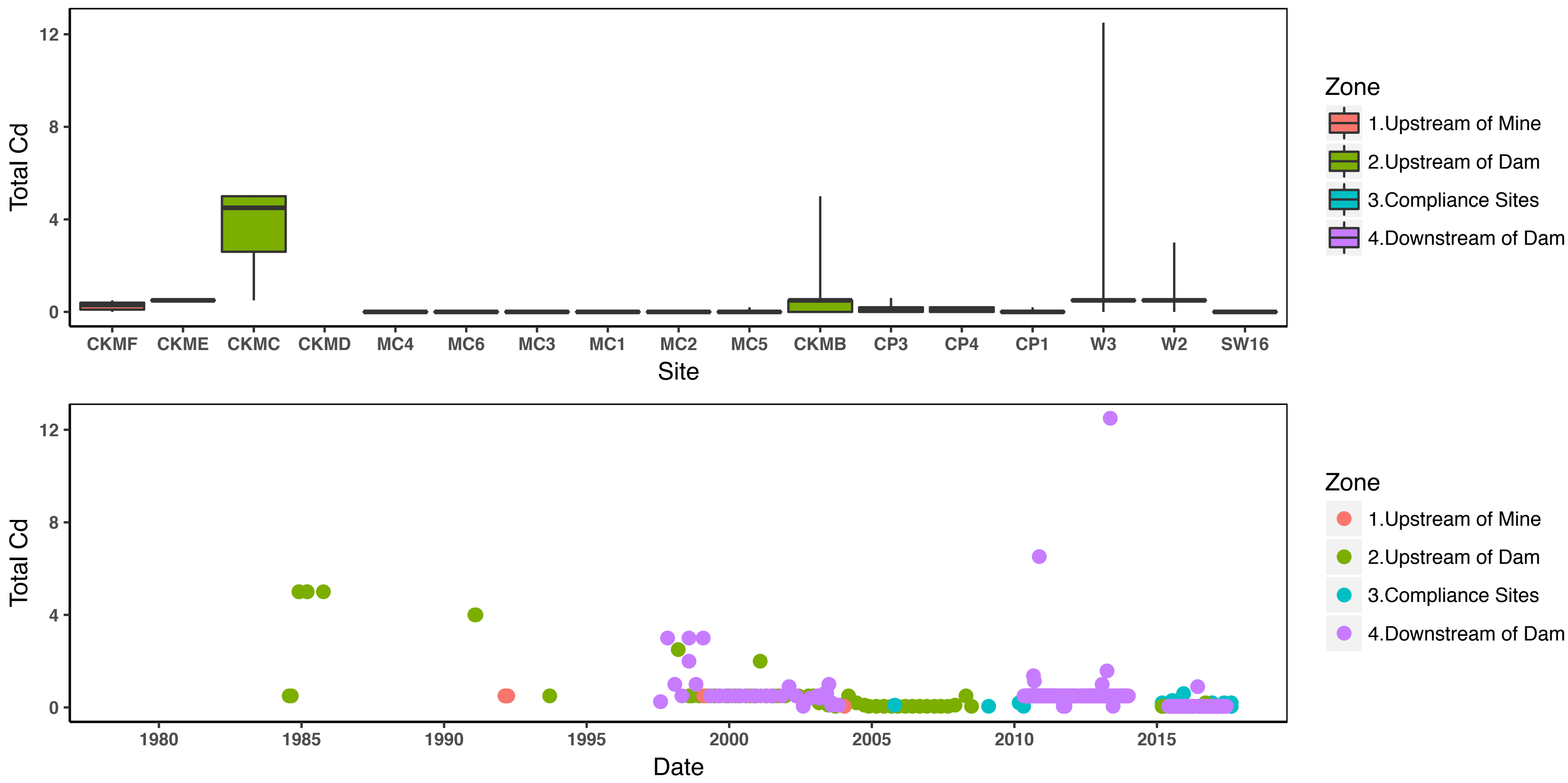


Table 36: Summary of data: Total Cd ($\mu g/L$)

Site	CKMF	CKME	CKMC	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	2	4	4	5	6	8	5	10	10	49	15	6	8	256	169	3
Min	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max	0.5	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.2	5.0	0.6	0.2	0.2	12.5	3.0	0.0
Median	0.3	0.5	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.0	0.5	0.5	0.0
20th %ile	0.1	0.5	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0
80th %ile	0.4	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.2	0.0	0.5	0.5	0.0
95th %ile	0.5	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.1	4.6	0.4	0.2	0.1	0.5	0.5	0.0

Figure 37: Boxplot and Time Series Plot of data: Total Cr ($\mu g/L$)

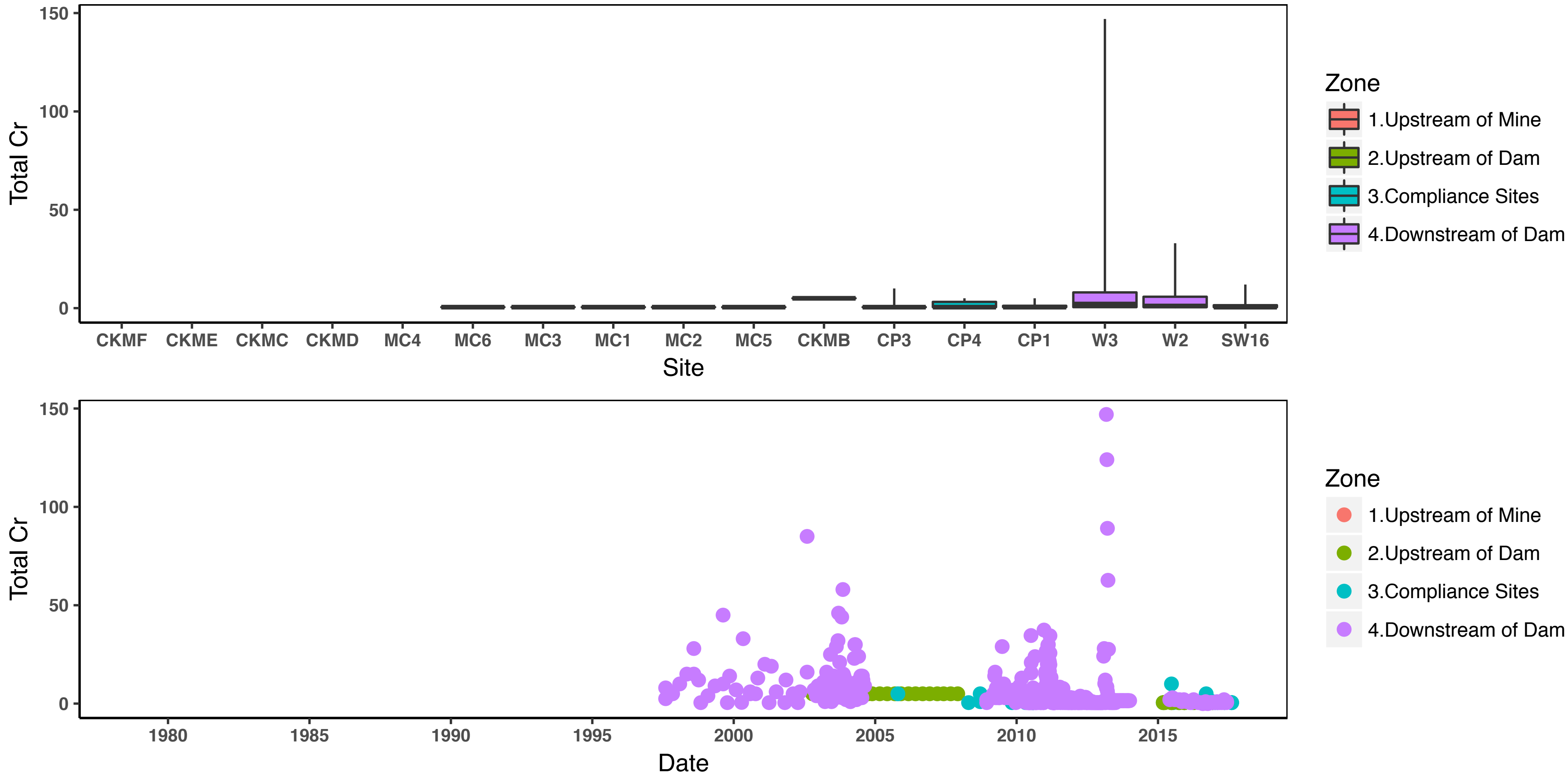
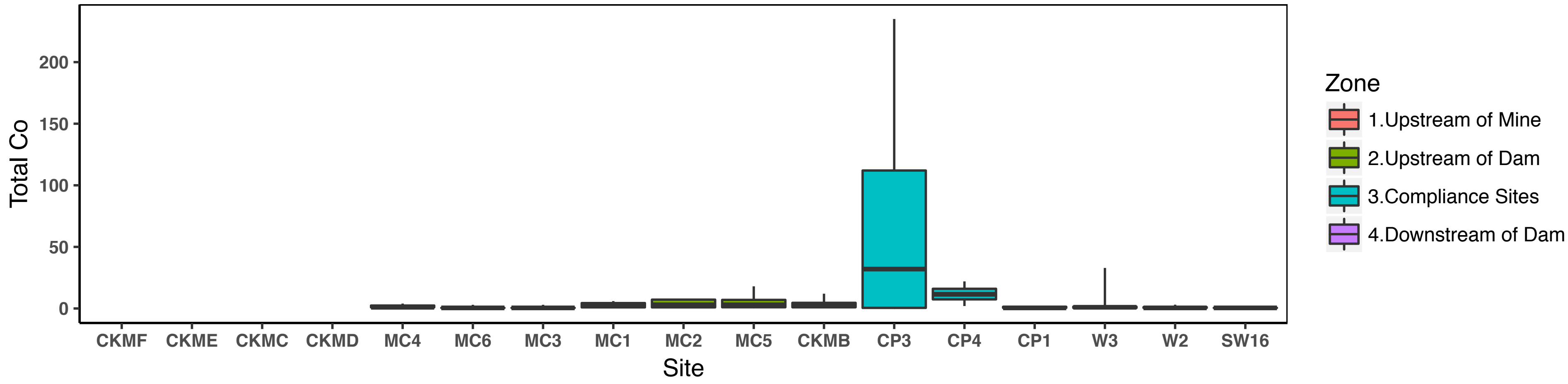


Table 37: Summary of data: Total Cr ($\mu g/L$)

Site	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	2	8	5	10	2	22	26	3	10	437	185	10
Min	0.5	0.5	0.5	0.5	0.5	5.0	0.5	0.5	0.5	0.0	0.5	0.5
Max	0.5	0.5	0.5	0.5	0.5	5.0	10.0	5.0	5.0	147.0	33.0	12.0
Median	0.5	0.5	0.5	0.5	0.5	5.0	0.5	0.5	0.5	2.1	1.1	0.5
20th %ile	0.5	0.5	0.5	0.5	0.5	5.0	0.5	0.5	0.5	0.5	0.5	0.5
80th %ile	0.5	0.5	0.5	0.5	0.5	5.0	0.5	3.2	1.2	8.0	5.8	1.5
95th %ile	0.5	0.5	0.5	0.5	0.5	5.0	6.5	4.5	3.6	26.9	16.4	8.8

Figure 38: Boxplot and Time Series Plot of data: Total Co (μg/L)



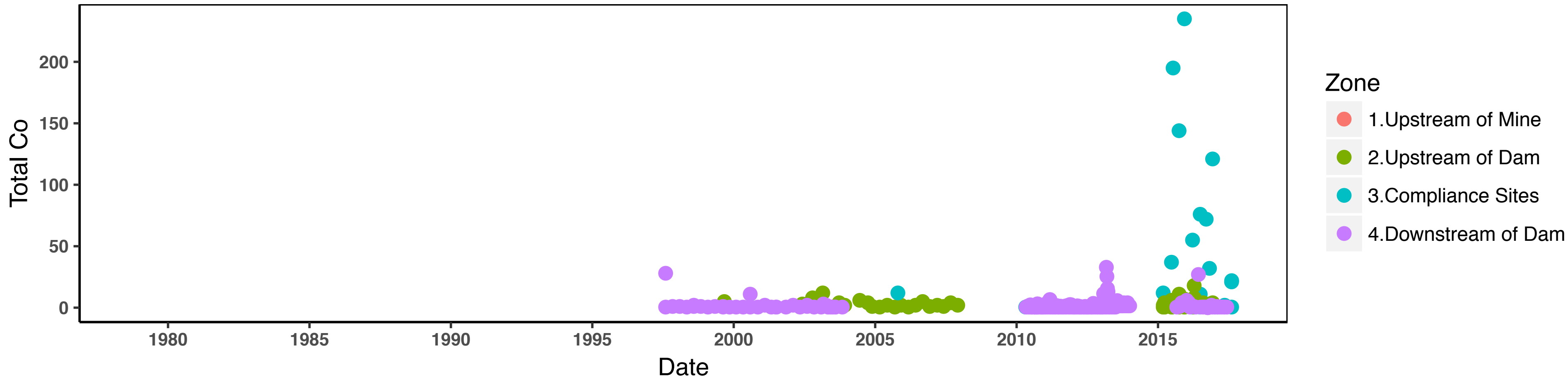


Table 38: Summary of data: Total Co (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	6	8	5	10	10	23	17	4	8	265	177	3
Min	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	2.0	0.5	0.0	0.5	0.5
Max	4.0	3.0	3.0	6.0	8.0	18.0	12.0	235.0	22.0	2.0	32.9	3.1	0.5
Median	1.0	0.5	0.5	3.0	3.0	3.0	2.0	32.0	11.5	0.5	1.0	0.5	0.5
20th %ile	0.9	0.5	0.5	0.9	0.9	1.0	1.0	0.5	7.4	0.5	0.5	0.5	0.5
80th %ile	2.4	0.5	0.5	4.4	7.2	7.0	4.6	112.0	16.0	1.4	1.5	1.1	0.5
95th %ile	3.6	2.4	2.1	5.6	8.0	14.8	7.8	203.0	20.5	2.0	5.6	1.8	0.5

Figure 39: Boxplot and Time Series Plot of data: Total Cu (μg/L)

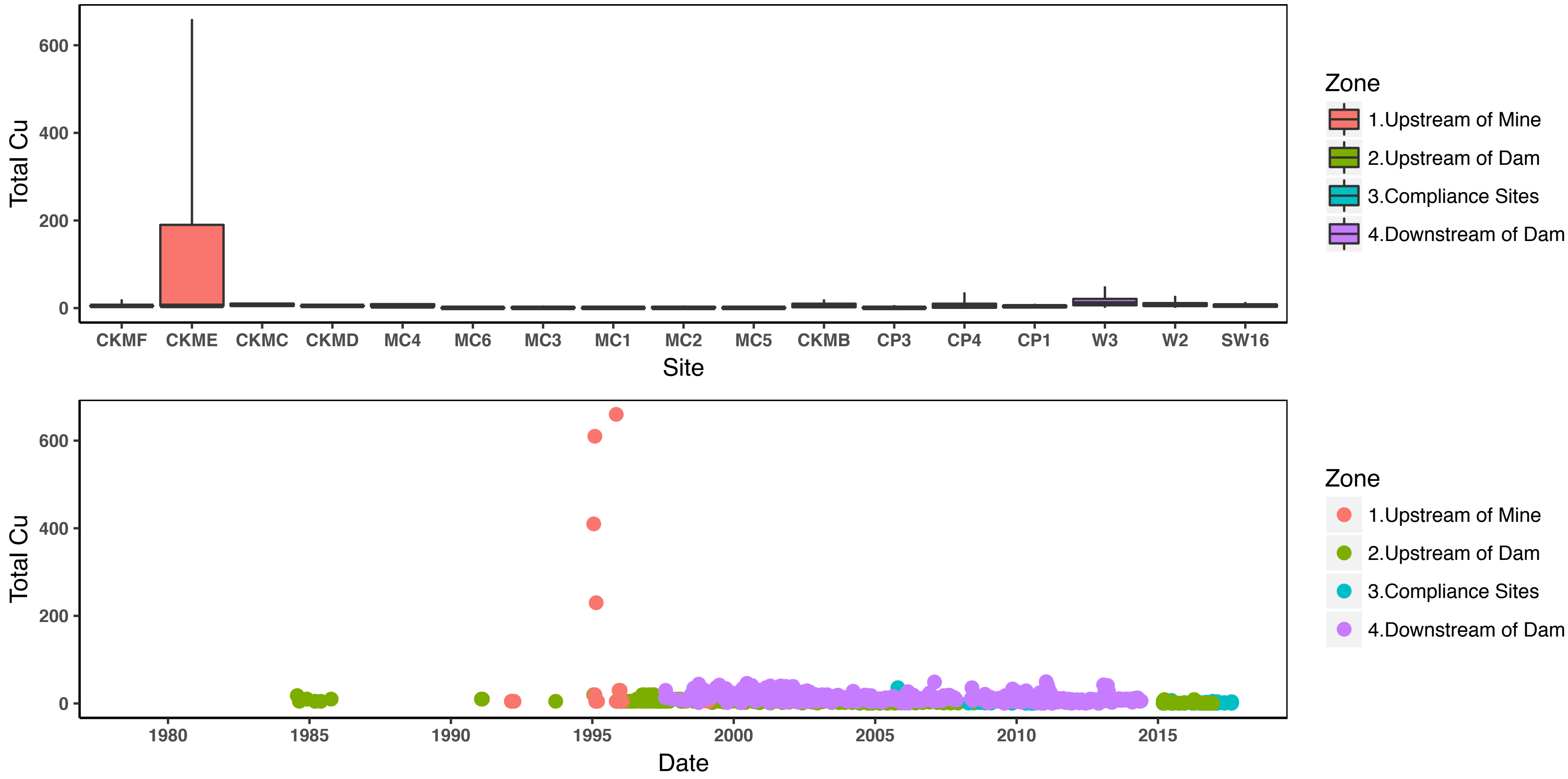


Table 39: Summary of data: Total Cu (μg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	17	4	1	5	6	8	5	10	10	105	25	6	10	854	191	25
Min	5.0	5.0	5.0	5.0	2.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	0.5	0.5	1.8
Max	20.0	660.0	10.0	5.0	9.0	1.0	6.0	0.5	6.0	4.0	20.0	7.0	36.0	10.0	49.7	28.1	14.0
Median	5.0	5.0	7.5	5.0	4.0	0.5	0.5	0.5	0.5	0.5	5.0	0.5	3.5	4.0	10.5	7.4	6.0
20th %ile	5.0	5.0	5.0	5.0	3.6	0.5	0.5	0.5	0.5	0.5	2.0	0.5	1.0	2.0	6.4	4.8	3.0
80th %ile	5.0	190.0	10.0	5.0	9.0	0.5	1.6	0.5	2.4	0.8	10.0	1.2	10.0	5.6	21.0	11.3	8.0
95th %ile	15.5	620.0	10.0	5.0	9.0	0.9	4.6	0.5	5.1	3.1	19.6	2.8	29.5	9.1	34.0	23.2	11.6

Figure 40: Boxplot and Time Series Plot of data: Total Fe ($\mu g/L$)

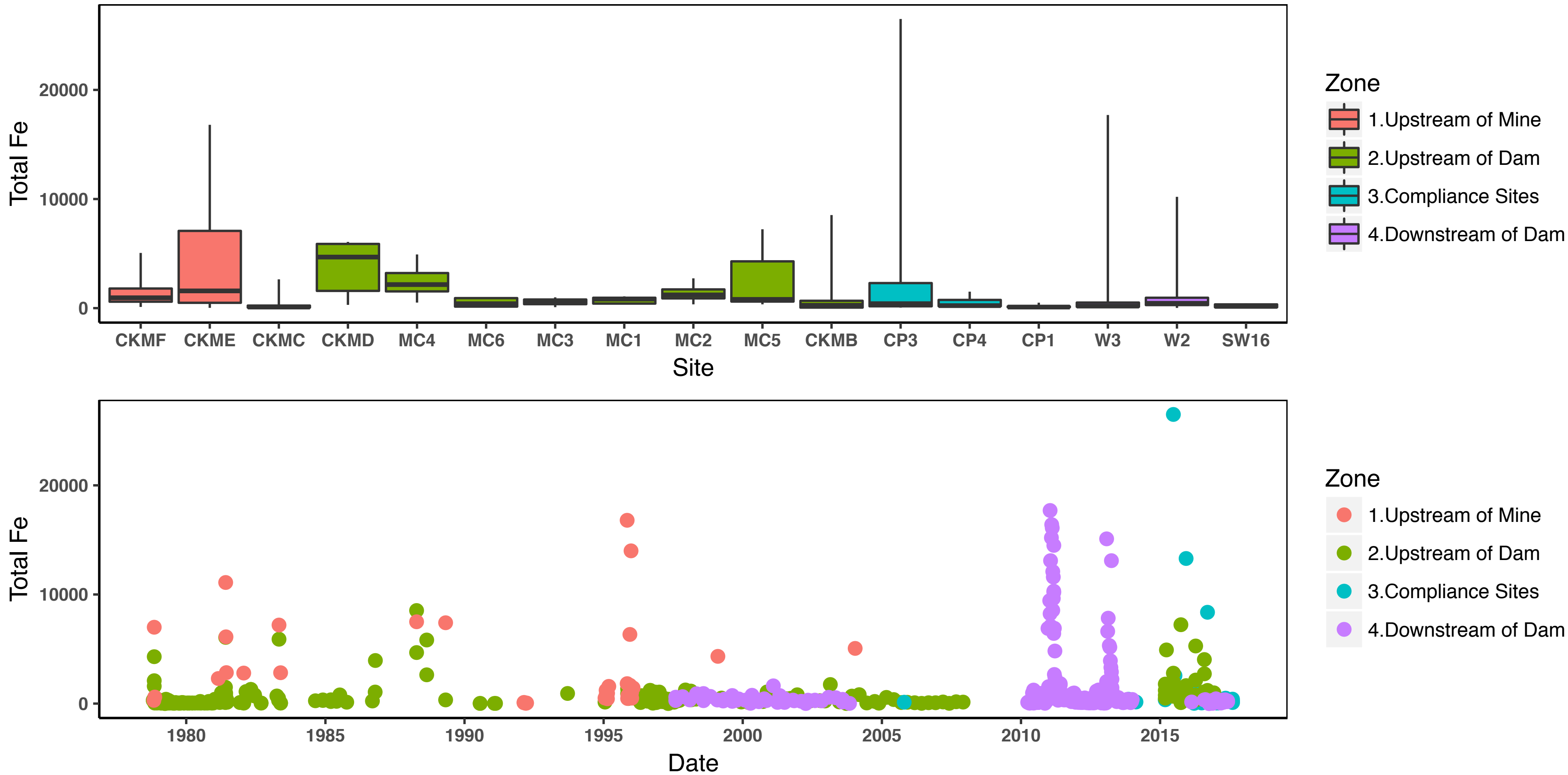


Table 40: Summary of data: Total Fe ($\mu g/L$)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	29	108	7	5	6	8	5	10	10	147	17	4	8	244	169	9
Min	110.0	28.0	20.0	300.0	510.0	130.0	90.0	400.0	350.0	350.0	5.0	50.0	130.0	25.0	0.2	22.0	10.0
Max	5060	16800	2640	6070	4920	950	990	1080	2730	7230	8530	26500	1510	500	17700	10200	440
Median	950	1580	100	4680	2160	405	485	830	1210	800	260	410	230	100	190	445	160
20th %ile	590	488	50	1580	1534	140	364	416	892	602	50	170	178	76	116	280	78
80th %ile	1800.0	7080.0	236.0	5886.0	3216.0	920.0	790.0	952.0	1718.0	4288.0	676.0	2298.0	754.0	160.0	511.0	952.4	342.4
95th %ile	4091.0	12840.0	800.0	6019.0	4494.0	942.5	920.0	1048.0	2397.0	6352.5	1285.0	15940.0	1321.0	395.0	6898.5	4674.0	412.0

Figure 41: Boxplot and Time Series Plot of data: Total Pb (μg/L)

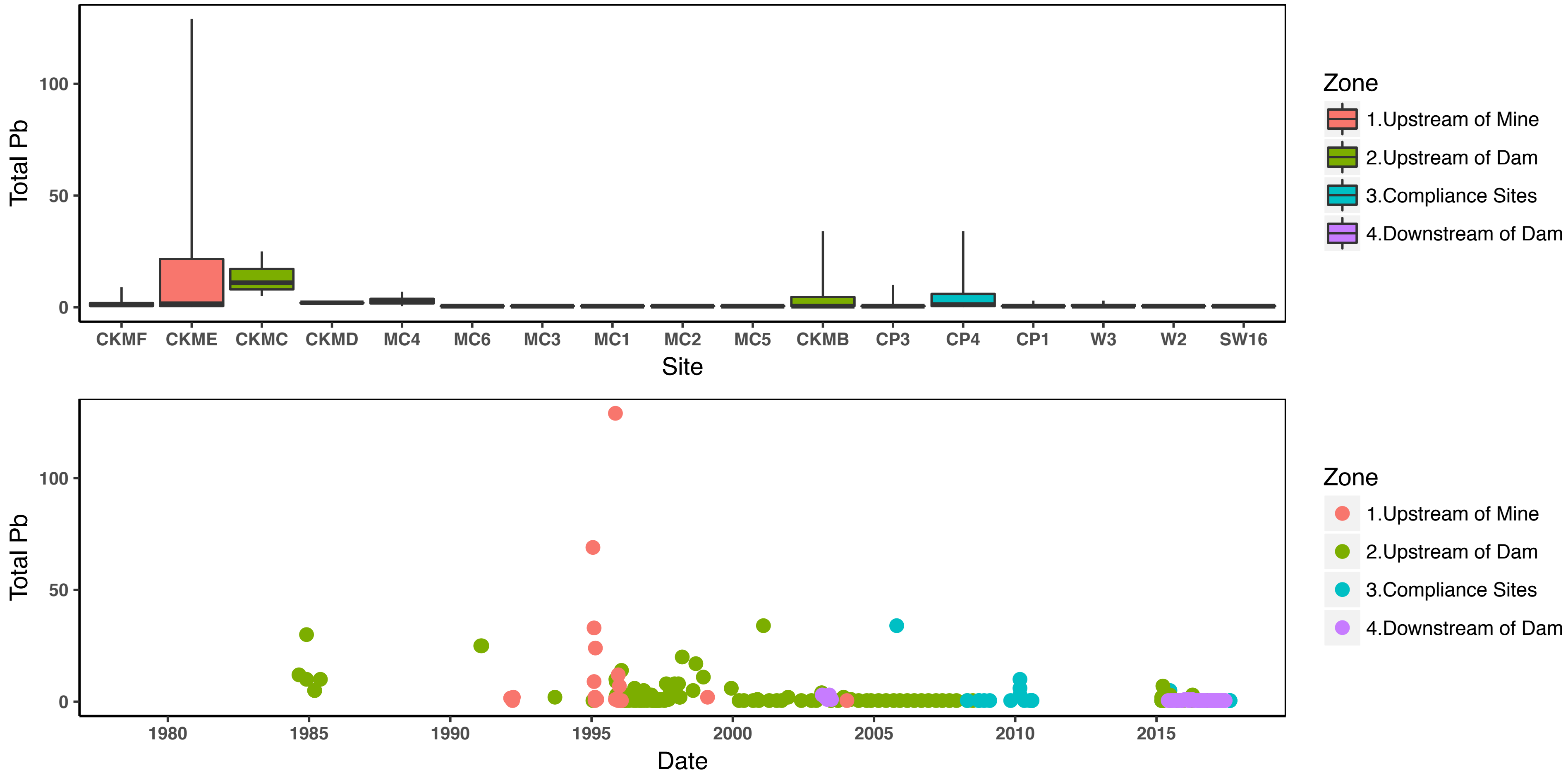


Table 41: Summary of data: Total Pb (μg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	17	4	1	5	6	8	5	10	10	98	25	6	10	29	11	3
Min	0.5	0.5	5.0	2.0	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
Max	9.0	129.0	25.0	2.0	7.0	0.5	0.5	0.5	0.5	0.5	34.0	10.0	34.0	3.0	3.0	0.5	0.5
Median	1.0	1.6	11.0	2.0	3.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.2	0.5	0.5	0.5	0.5
20th %ile	0.6	0.5	8.0	2.0	1.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
80th %ile	1.9	21.6	17.2	2.0	3.8	0.5	0.5	0.5	0.5	0.5	4.6	0.5	6.0	0.5	1.0	0.5	0.5
95th %ile	6.9	81.0	23.0	2.0	6.2	0.5	0.5	0.5	0.5	0.5	14.4	4.1	27.0	1.9	2.6	0.5	0.5

Figure 42: Boxplot and Time Series Plot of data: Total Mn ($\mu g/L$)

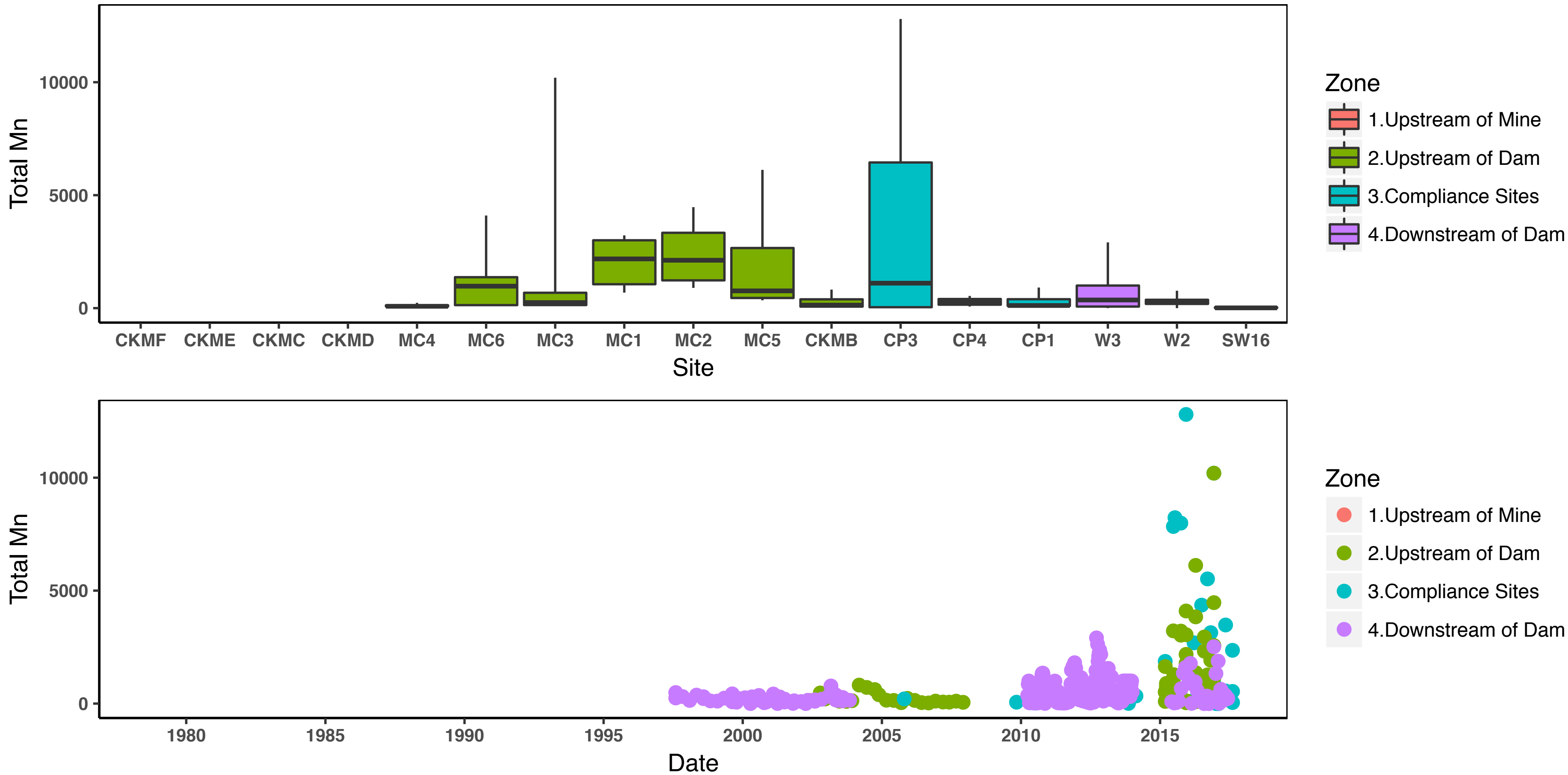


Table 42: Summary of data: Total Mn ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	5	6	8	5	10	10	24	24	4	8	271	176	9
Min	39.0	118.0	96.0	687.0	896.0	348.0	30.0	0.5	70.0	47.0	1.2	0.4	3.0
Max	236	4100	10200	3220	4470	6120	820	12800	540	912	2910	771	63
Median	83.0	973.0	247.0	2180.0	2120.0	764.0	134.0	1105.0	261.0	116.5	361.0	258.5	12.0
20th %ile	72.6	133.0	136.0	1057.4	1230.0	449.0	67.6	41.6	152.8	98.8	69.6	187.0	4.4
80th %ile	125.6	1370.0	681.4	3004.0	3336.0	2662.0	391.2	6448.0	404.4	395.8	1000.0	370.0	38.8
95th %ile	208.4	3417.5	6908.2	3166.0	4186.5	4729.5	702.7	9904.5	506.1	788.4	1630.0	488.5	53.8

Figure 43: Boxplot and Time Series Plot of data: Total Mo (μg/L)

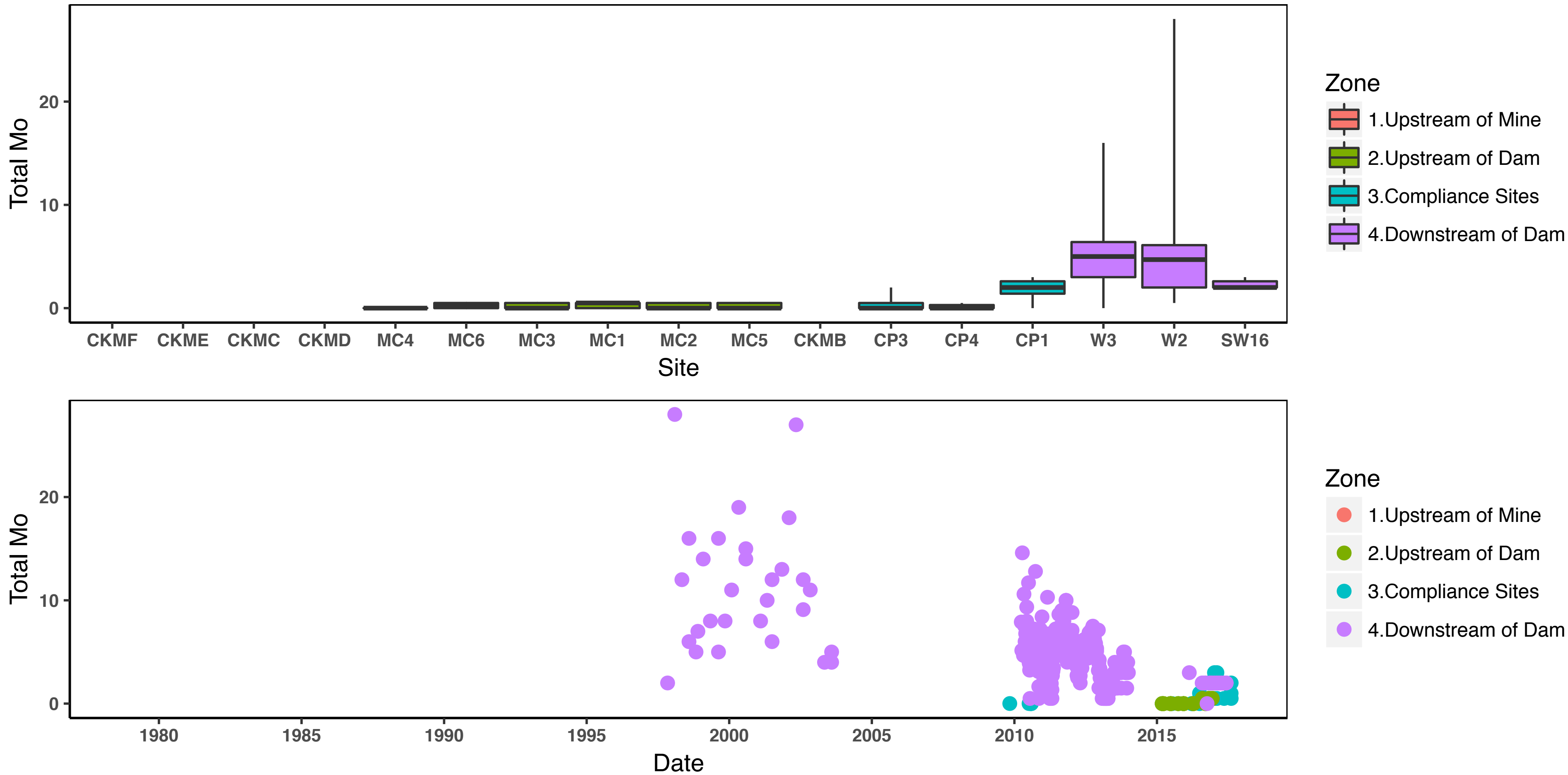


Table 43: Summary of data: Total Mo (μg/L)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	6	8	5	10	10	20	3	8	253	175	3
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.0
Max	0.0	0.5	0.5	0.5	0.5	0.5	2.0	0.5	3.0	16.0	28.0	3.0
Median	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.0	2.0	5.0	4.7	2.0
20th %ile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	3.0	2.0	2.0
80th %ile	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.3	2.6	6.4	6.1	2.6
95th %ile	0.0	0.5	0.5	0.5	0.5	0.5	1.1	0.5	3.0	8.5	12.0	2.9

Figure 44: Boxplot and Time Series Plot of data: Total Ni (μg/L)

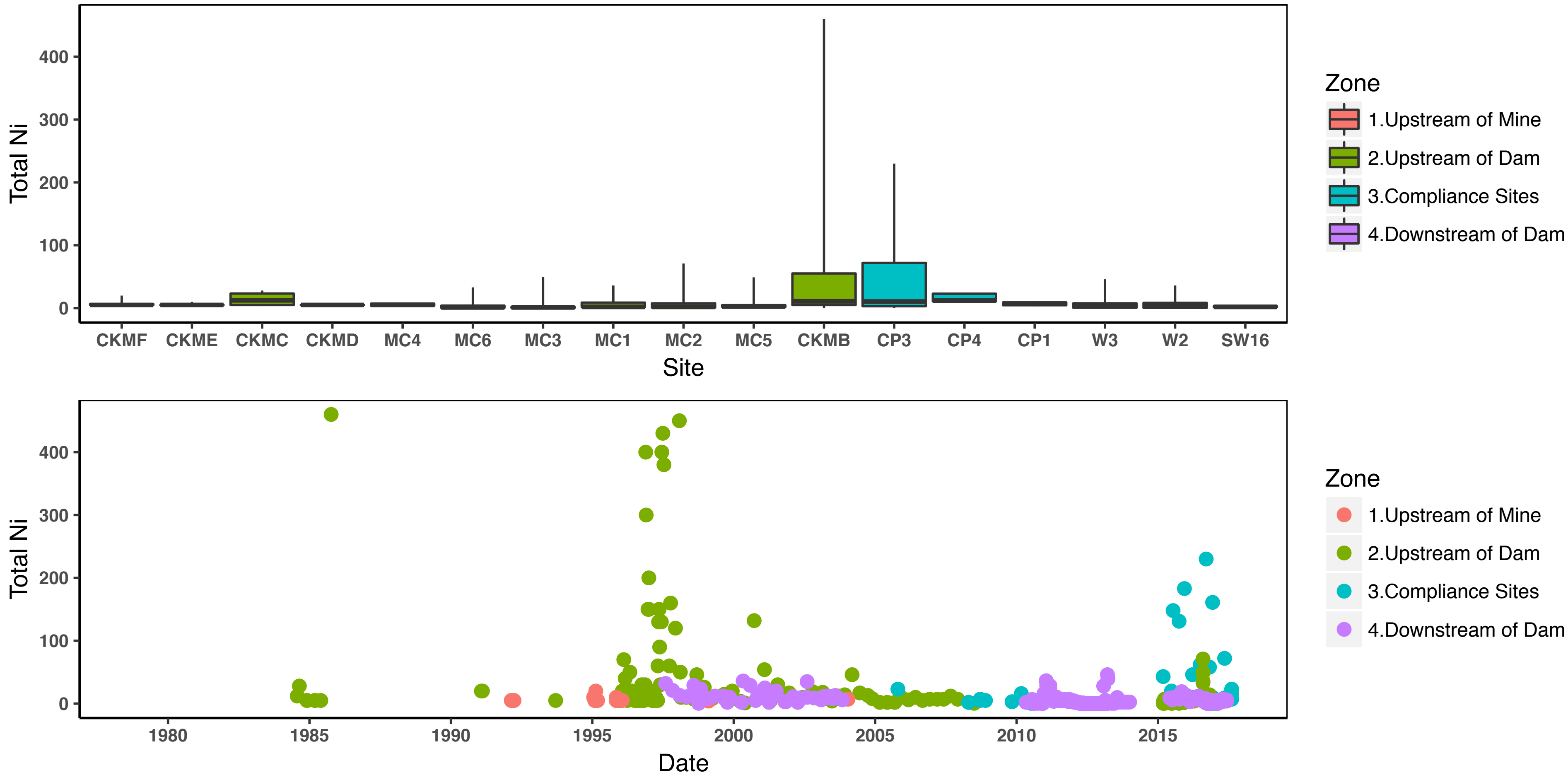


Table 44: Summary of data: Total Ni (μg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	17	4	1	5	6	8	5	10	10	100	26	5	10	222	164	10
Min	5.0	4.0	5.0	5.0	3.0	0.5	0.5	1.0	0.5	2.0	0.5	0.5	10.0	3.0	0.0	0.5	0.5
Max	20	10	28	5	8	33	50	36	71	49	460	230	23	11	46	36	5
Median	5.0	5.0	12.5	5.0	5.0	1.2	1.2	2.0	2.0	2.5	11.0	10.5	12.0	7.0	2.8	3.5	2.0
20th %ile	5.0	5.0	5.0	5.0	3.8	0.5	0.5	1.8	0.9	2.0	5.0	3.0	10.8	4.6	0.6	0.5	1.7
80th %ile	6.6	5.0	23.2	5.0	7.2	4.0	2.0	8.8	7.6	4.8	55.2	72.0	23.0	9.2	7.7	8.4	3.0
95th %ile	16.1	10.0	26.8	5.0	7.8	25.8	33.2	29.2	45.3	30.5	381.0	177.5	23.0	10.5	24.2	21.3	4.1

Figure 45: Boxplot and Time Series Plot of data: Total Se ($\mu g/L$)

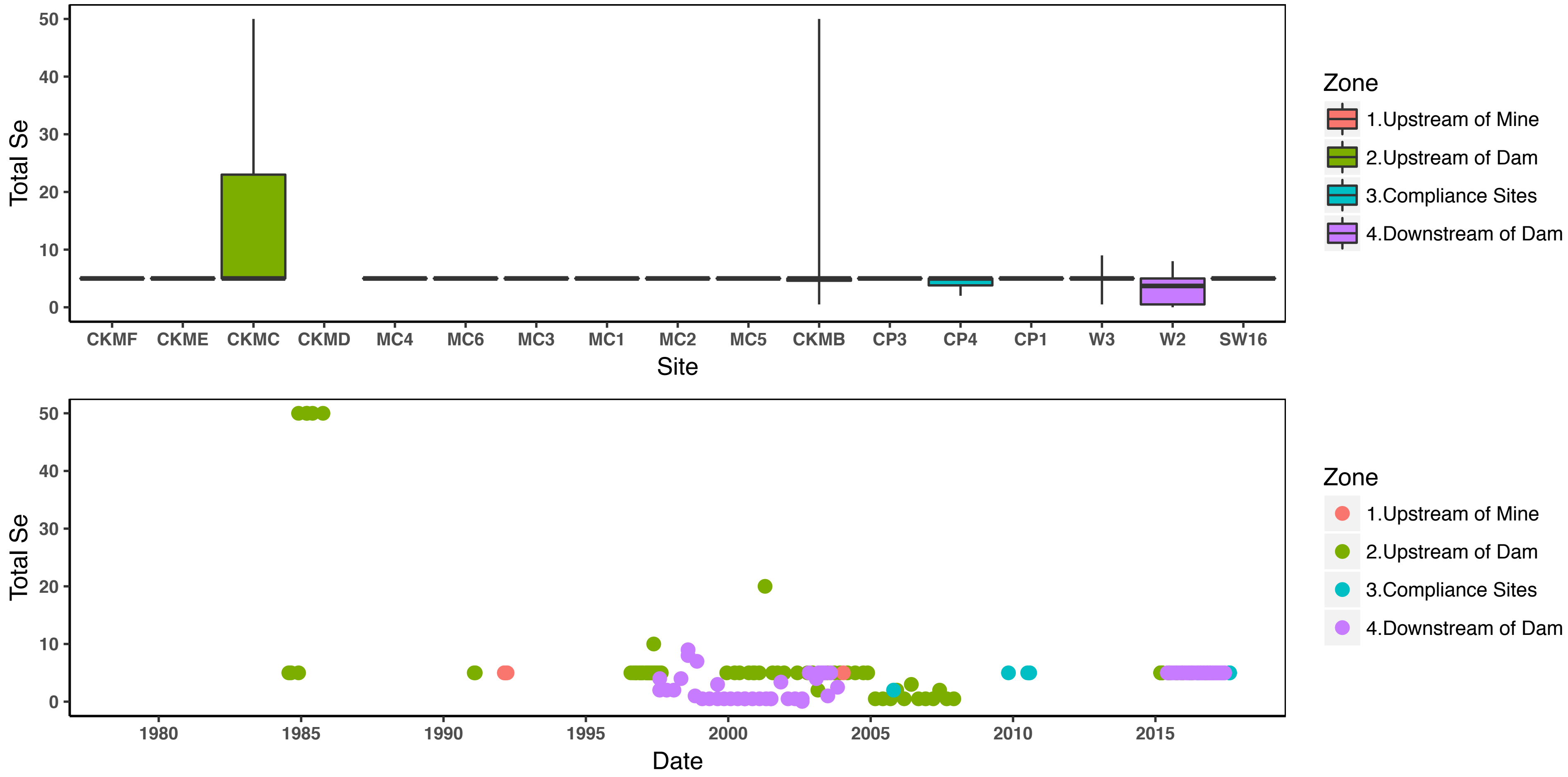


Table 45: Summary of data: Total Se ($\mu g/L$)

Site	CKMF	CKME	CKMC	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	2	3	4	5	6	8	5	10	10	65	18	4	8	38	38	3
Min	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.5	5.0	2.0	5.0	0.5	0.0	5.0
Max	5	5	50	5	5	5	5	5	5	50	5	5	5	9	8	5
Median	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	3.7	5.0
20th %ile	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.6	5.0	3.8	5.0	5.0	0.5	5.0
80th %ile	5	5	23	5	5	5	5	5	5	5	5	5	5	5	5	5
95th %ile	5.0	5.0	43.2	5.0	5.0	5.0	5.0	5.0	5.0	44.0	5.0	5.0	5.0	5.0	5.3	5.0

Figure 46: Boxplot and Time Series Plot of data: Total V ($\mu g/L$)

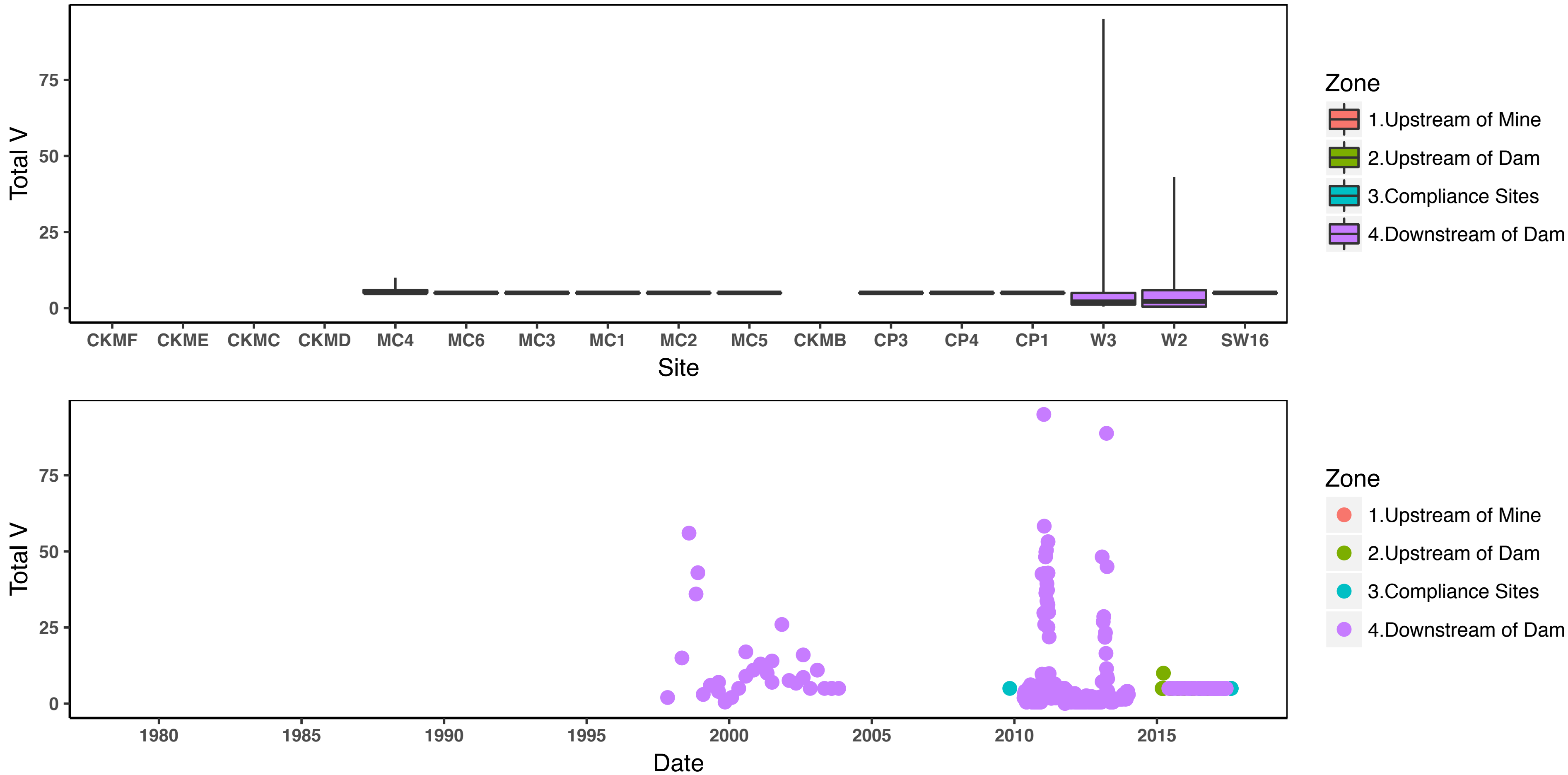


Table 46: Summary of data: Total V ($\mu g/L$)

Site	MC4	MC6	MC3	MC1	MC2	MC5	CP3	CP4	CP1	W3	W2	SW16
N	5	6	8	5	10	10	17	3	8	264	177	3
Min	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.5	0.0	5.0
Max	10	5	5	5	5	5	5	5	5	95	43	5
Median	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.1	2.2	5.0
20th %ile	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	1.2	0.5	5.0
80th %ile	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.9	5.0
95th %ile	9.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	36.6	29.6	5.0

Figure 47: Boxplot and Time Series Plot of data: Total Zn (μg/L)

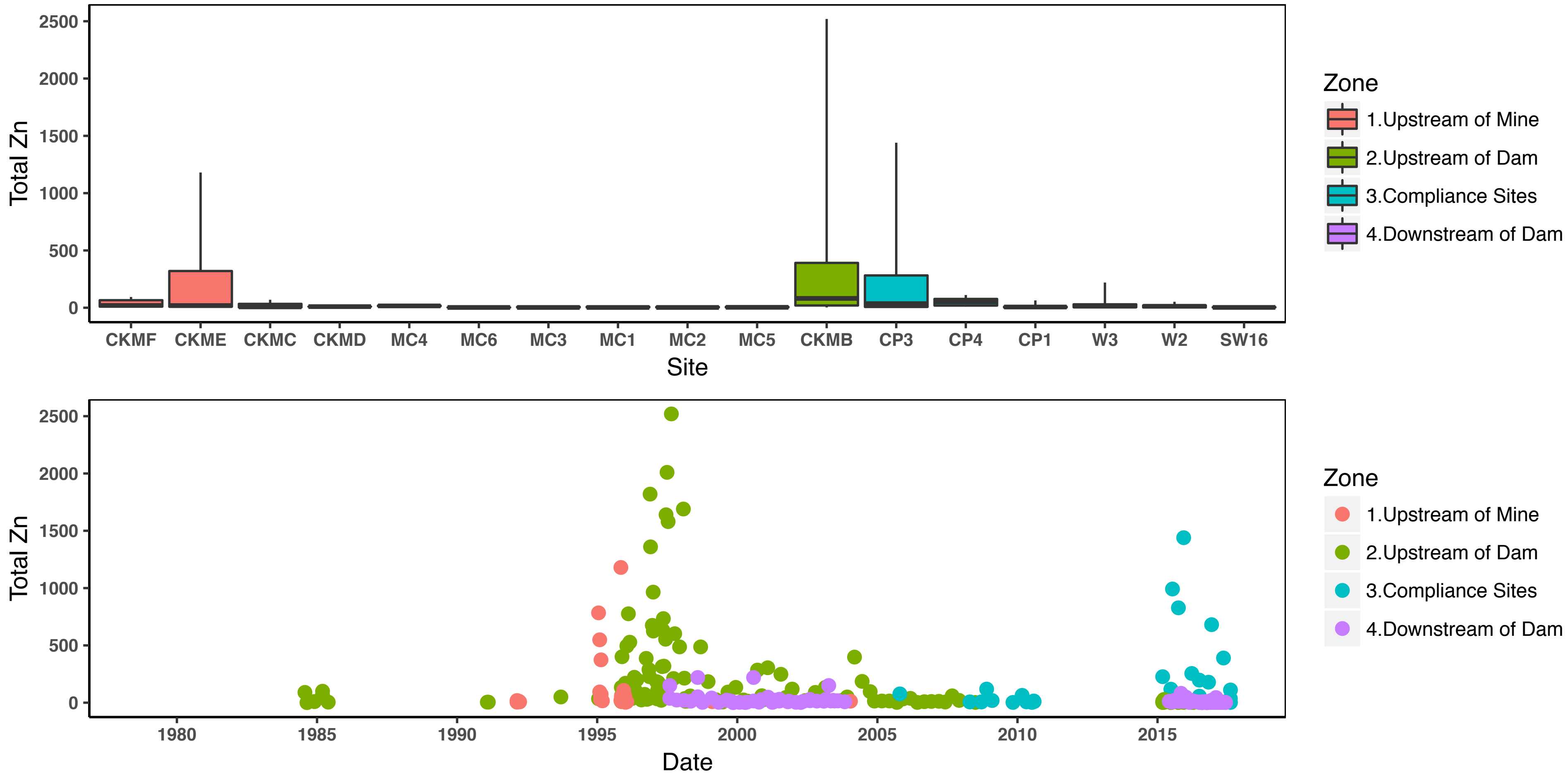


Table 47: Summary of data: Total Zn (μg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1	W3	W2	SW16
N	7	17	4	1	5	6	8	5	10	10	104	25	6	10	38	36	10
Min	4.9	3.5	0.5	10.0	11.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	19.0	2.5	0.0	0.5	1.5
Max	94	1180	70	10	28	15	10	12	8	16	2520	1440	111	64	220	52	15
Median	20.0	19.0	7.5	10.0	16.0	2.5	2.5	2.5	2.5	3.8	81.5	36.0	51.0	6.5	14.5	13.0	3.0
20th %ile	9.8	9.0	3.2	10.0	13.4	2.5	2.5	2.5	2.5	2.5	19.6	7.0	19.0	2.5	3.9	2.5	2.4
80th %ile	65.8	320.6	34.0	10.0	19.2	2.5	7.8	8.8	7.0	8.0	391.4	282.0	77.0	9.6	30.0	21.0	5.6
95th %ile	87.7	863.2	61.0	10.0	25.8	11.9	9.6	11.2	7.5	12.4	1547.0	959.2	102.5	44.2	160.5	42.7	11.8

Figure 48: Boxplot and Time Series Plot of data: Acidity (mg/L)

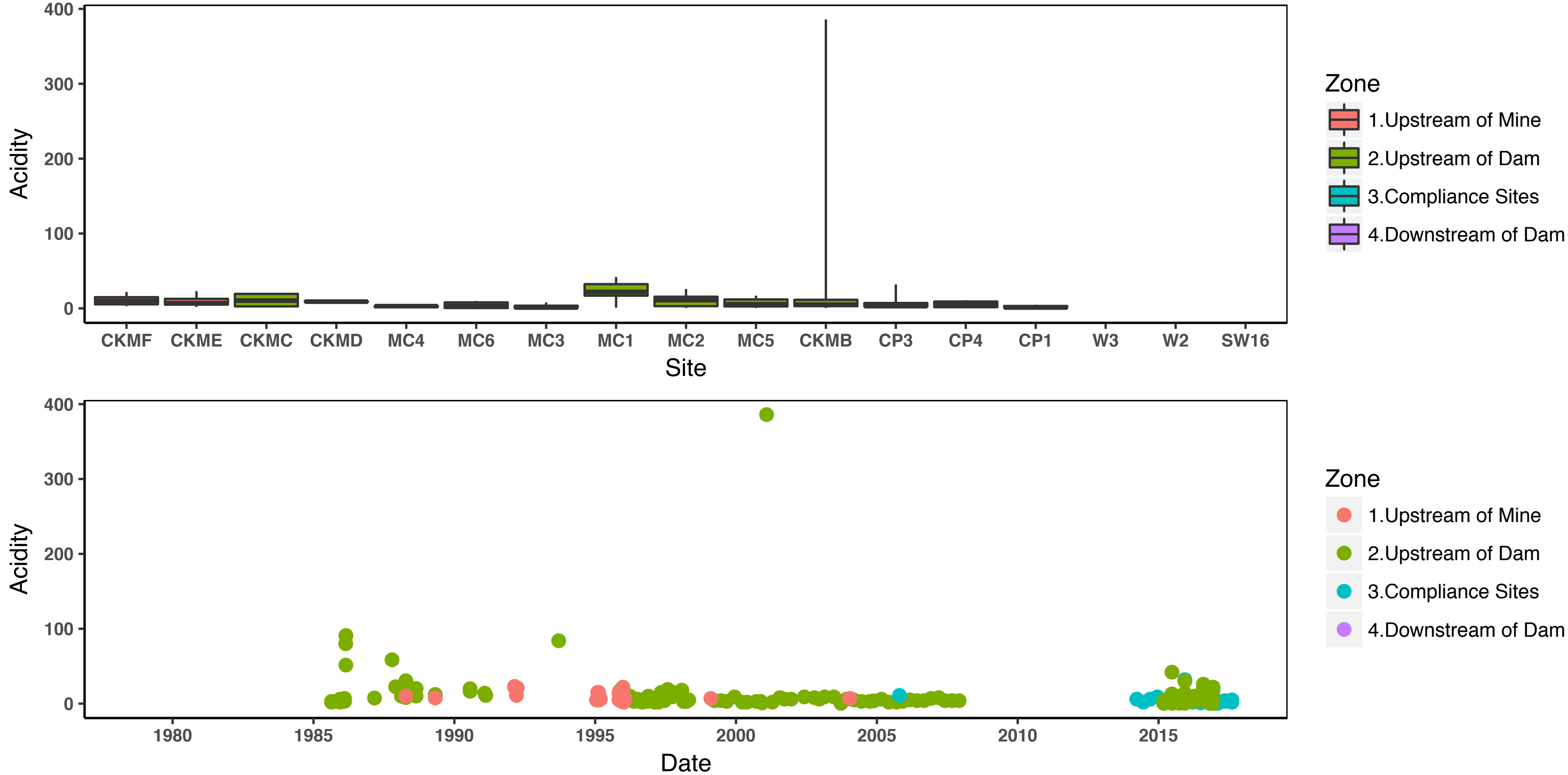


Table 48: Summary of data: Acidity (mg/L)

Site	CKMF	CKME	CKMC	CKMD	MC4	MC6	MC3	MC1	MC2	MC5	CKMB	CP3	CP4	CP1
N	7	19	8	3	5	6	8	5	10	10	113	18	4	8
Min	3.0	2.0	2.0	8.2	0.5	0.5	0.5	1.0	0.5	0.5	0.5	2.0	1.0	0.5
Max	22.0	23.0	20.2	10.1	5.0	10.0	8.0	42.0	26.0	17.0	386.0	32.0	11.0	5.0
Median	10.0	7.0	10.4	9.0	3.0	3.2	1.2	22.0	11.0	5.5	5.0	3.0	5.0	1.2
20th %ile	5.4	5.0	2.7	8.5	1.7	0.5	0.5	17.0	3.0	2.6	3.0	2.4	1.6	0.5
80th %ile	15.0	12.8	19.4	9.7	3.4	8.0	3.6	32.4	15.6	12.0	11.5	7.2	9.2	3.2
95th %ile	19.9	22.1	20.1	10.0	4.6	9.5	6.6	39.6	24.2	14.7	39.0	12.4	10.5	4.6

APPENDIX C

MARCH 2017 SURVEY WATER QUALITY RESULTS

C1 MARCH 2017 SURVEY WATER QUALITY RESULTS

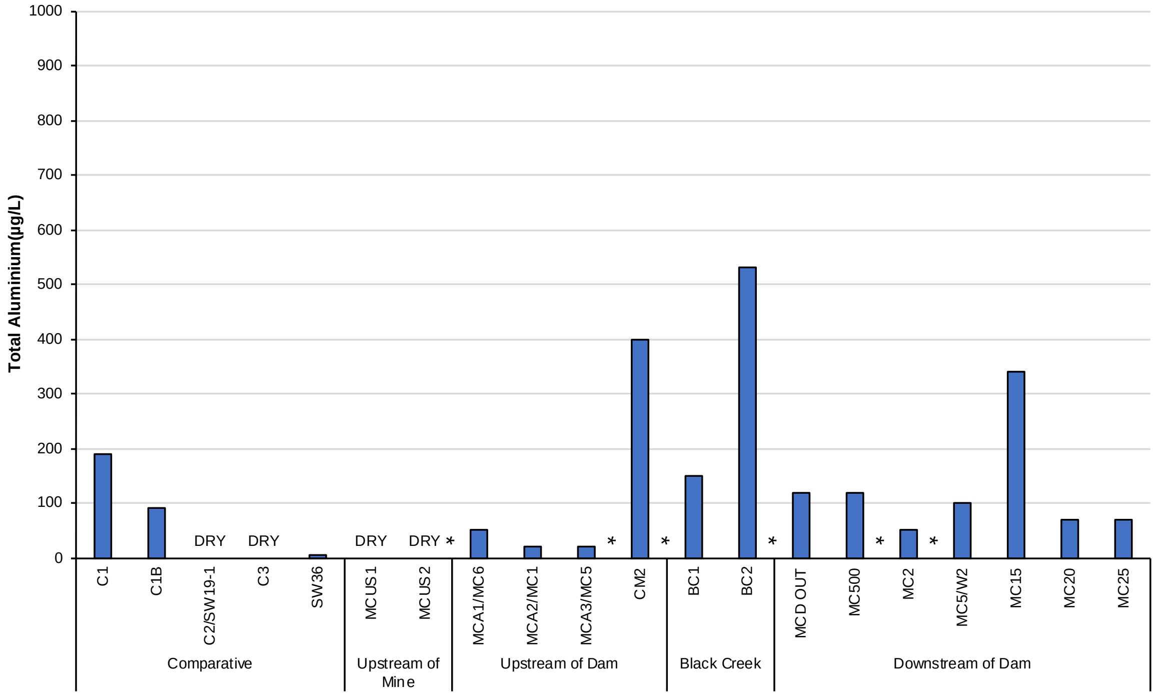


Figure 1 Total aluminium concentrations in water (March 2017 survey)

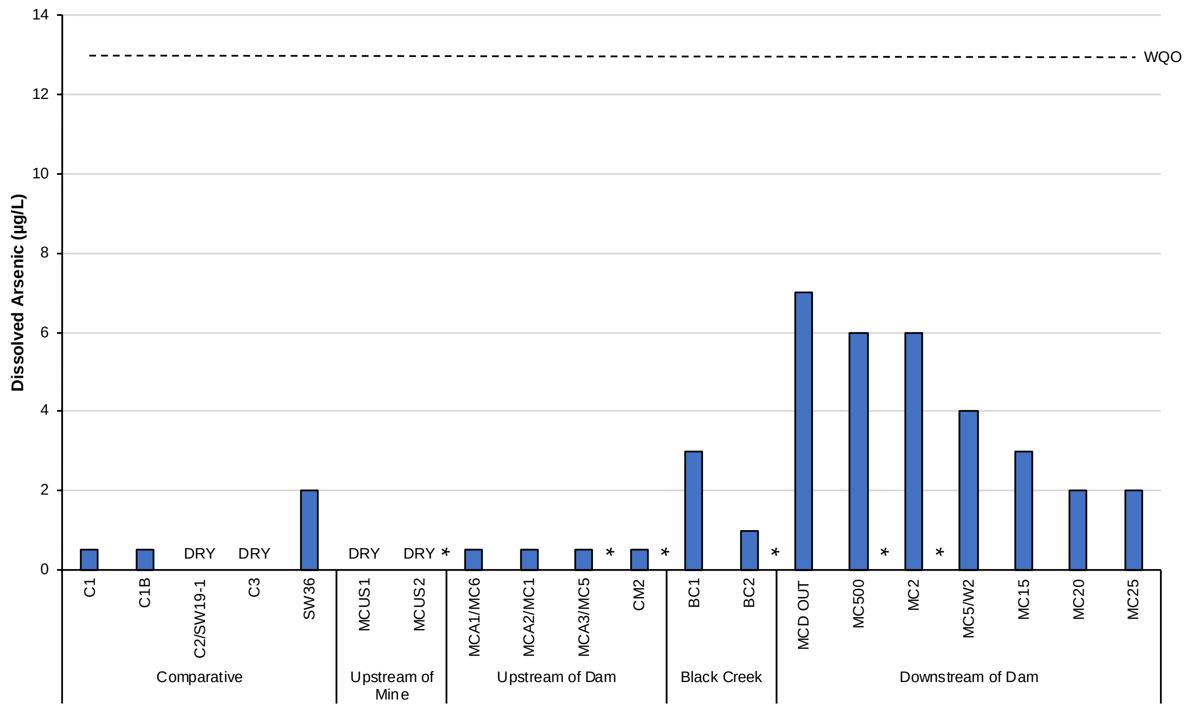


Figure 2 Dissolved arsenic concentrations in water (March 2017 survey)

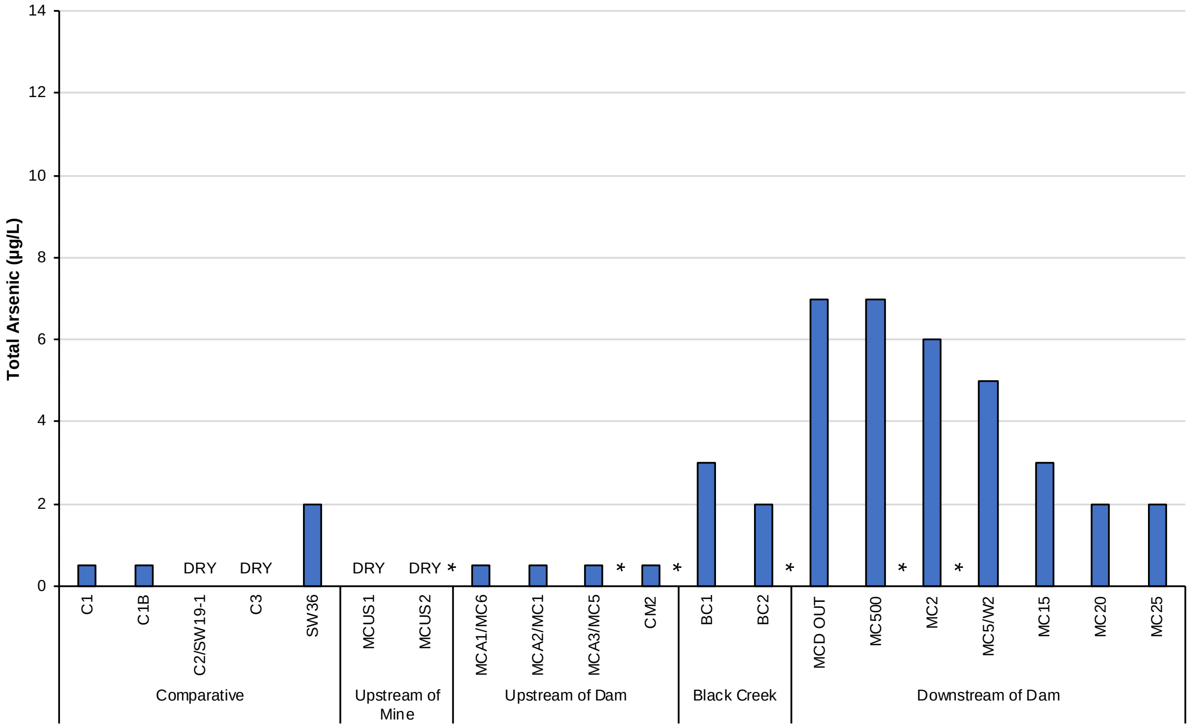


Figure 3 Total arsenic concentrations in water (March 2017 survey)

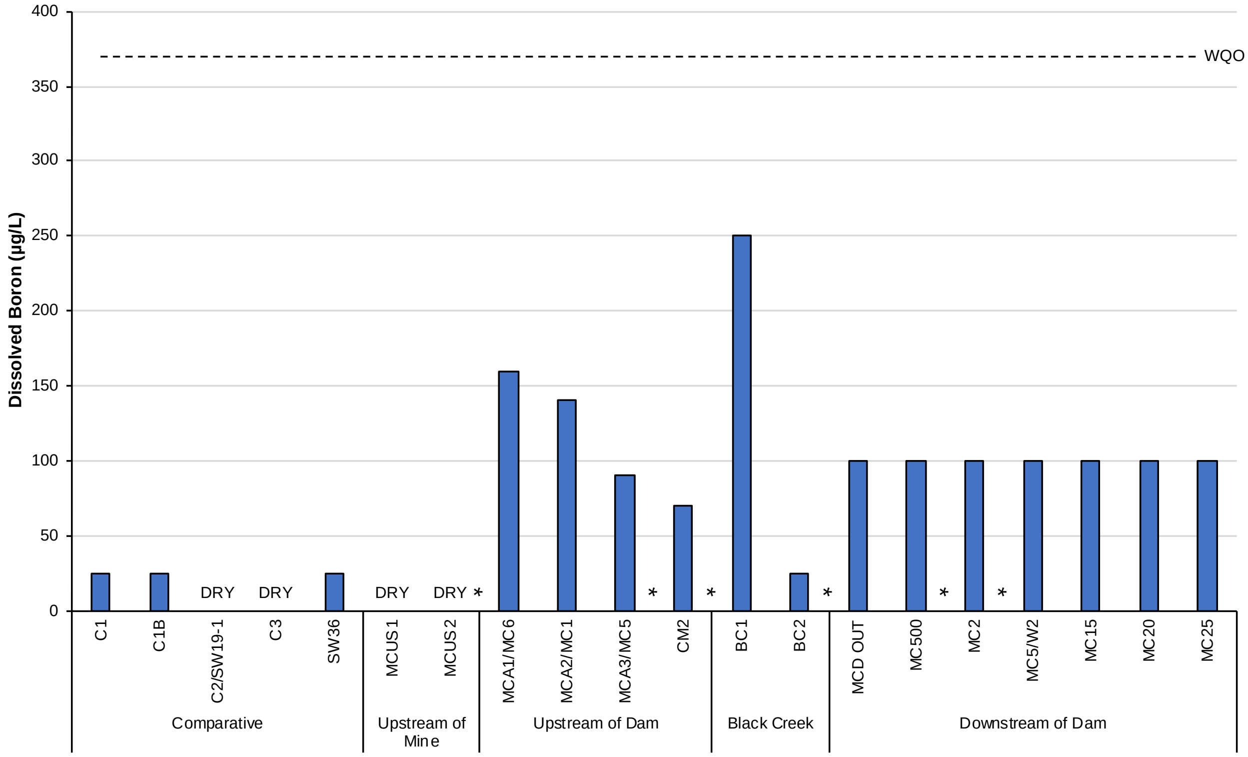


Figure 4 Dissolved boron concentrations in water (March 2017 survey)

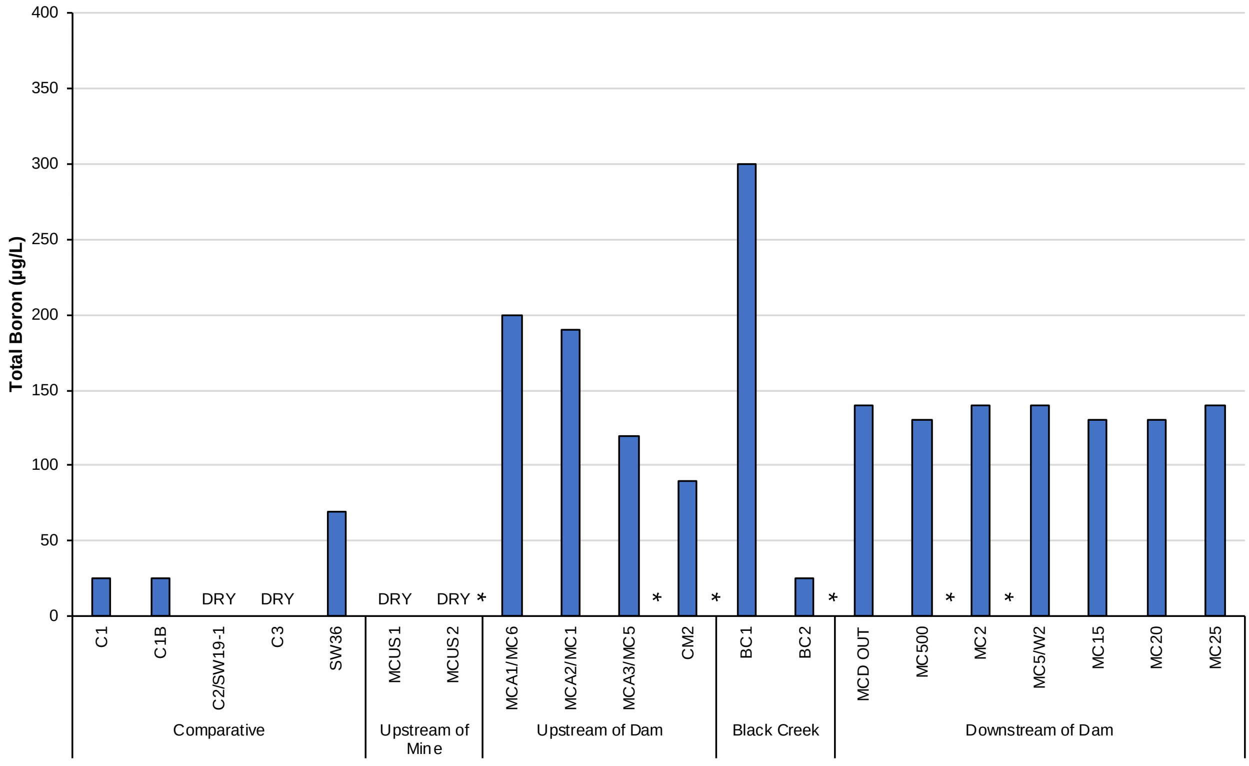


Figure 5 Total boron concentrations in water (March 2017 survey)

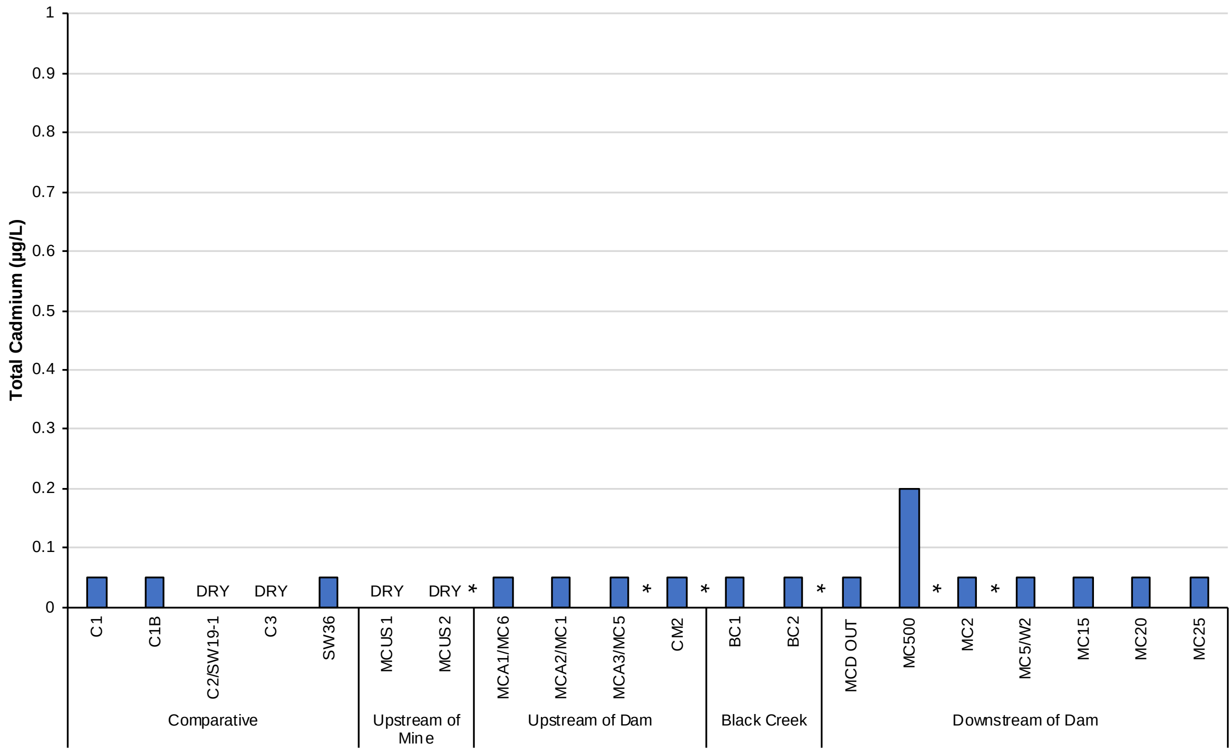


Figure 6 Total cadmium concentrations in water (March 2017 survey)

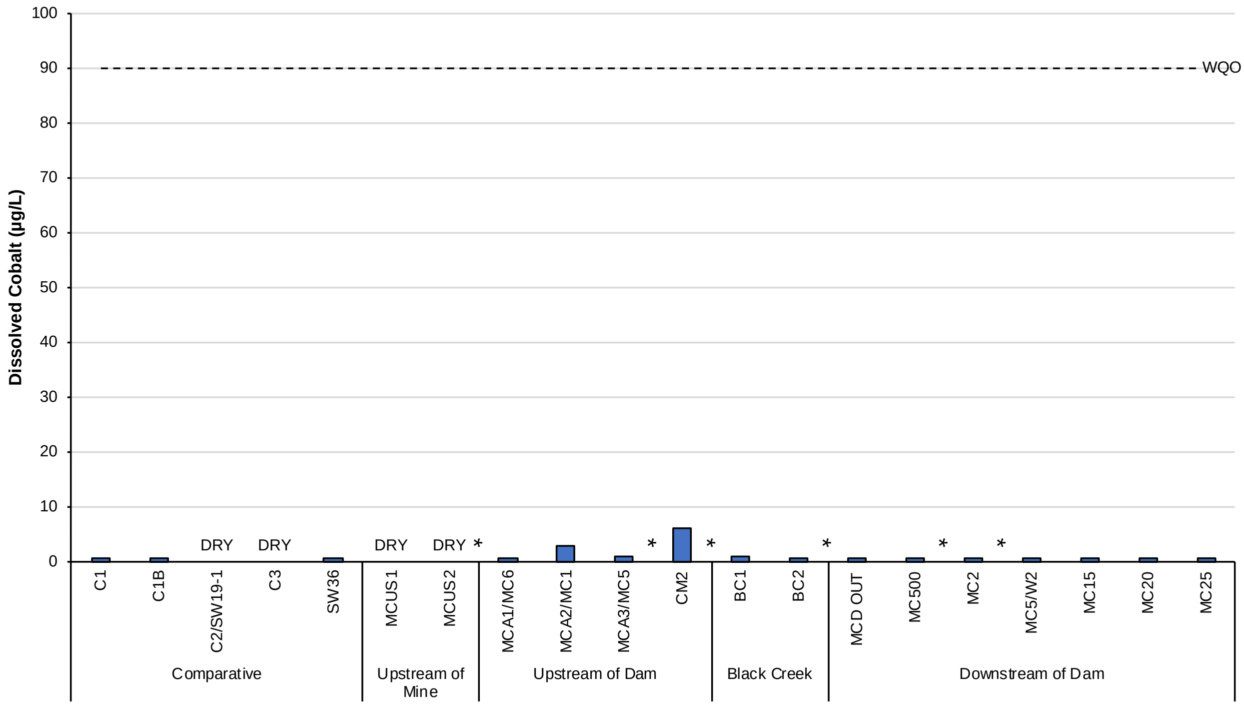


Figure 7 Dissolved cobalt concentrations in water (March 2017 survey)

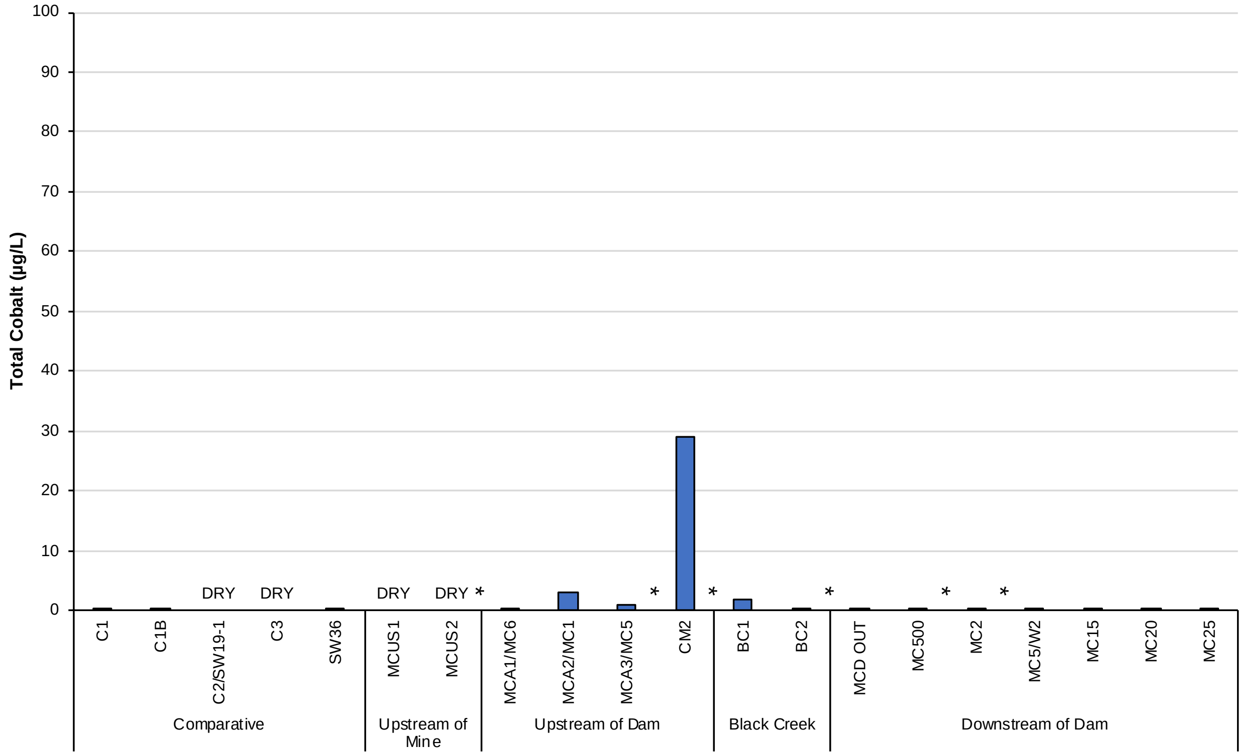


Figure 8 Total cobalt concentrations in water (March 2017 survey)

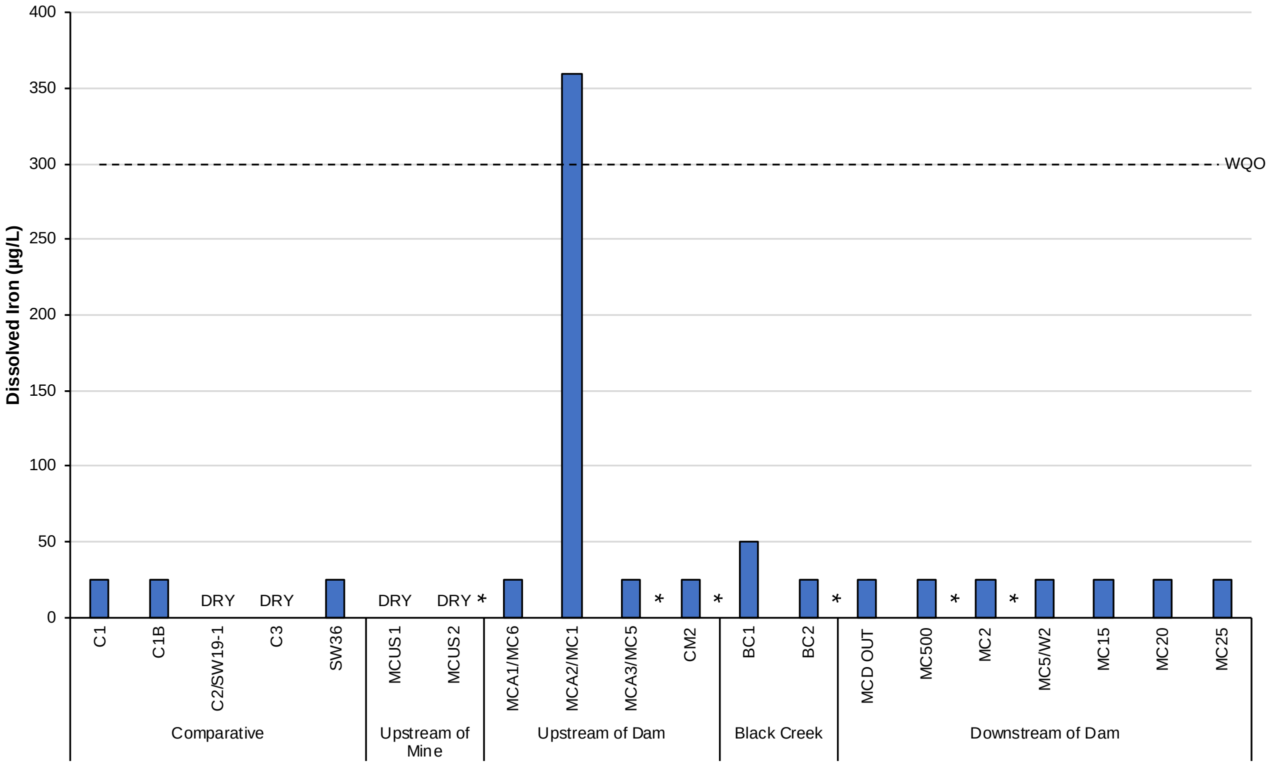


Figure 9 Dissolved iron concentrations in water (March 2017 survey)

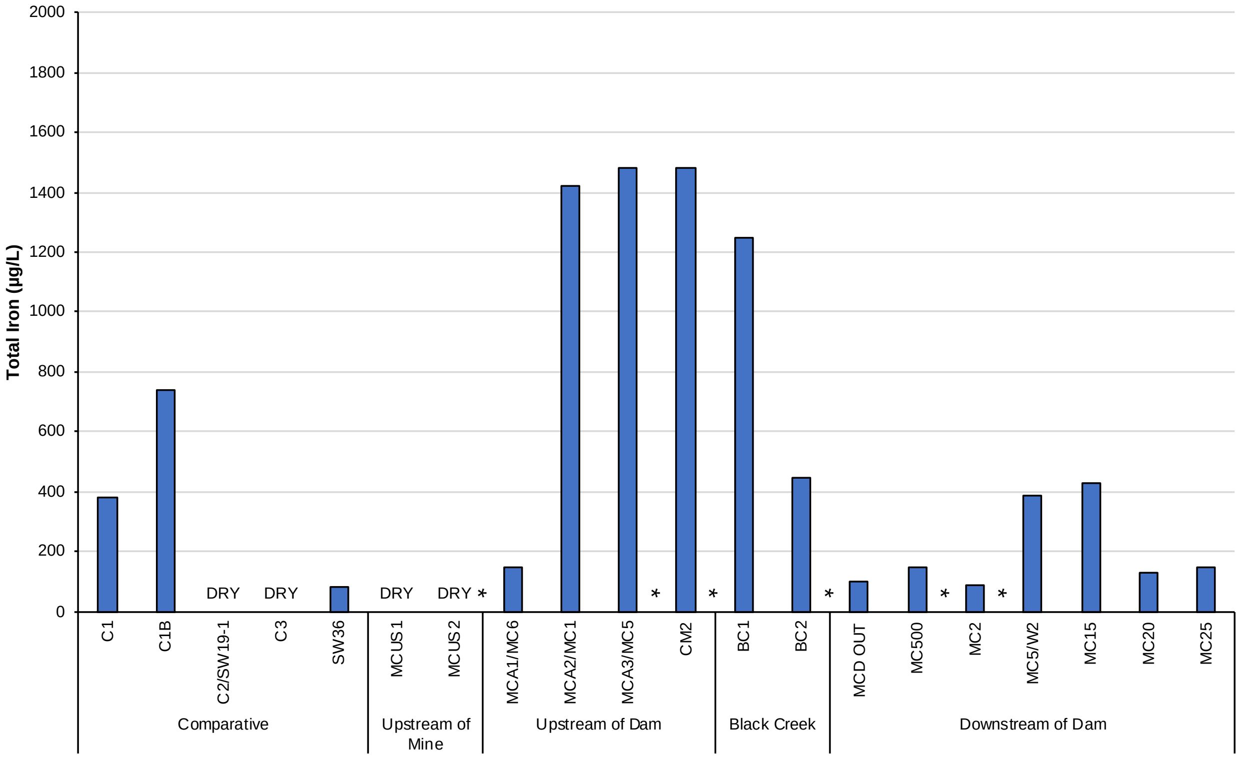


Figure 10 Total iron concentrations in water (March 2017 survey)

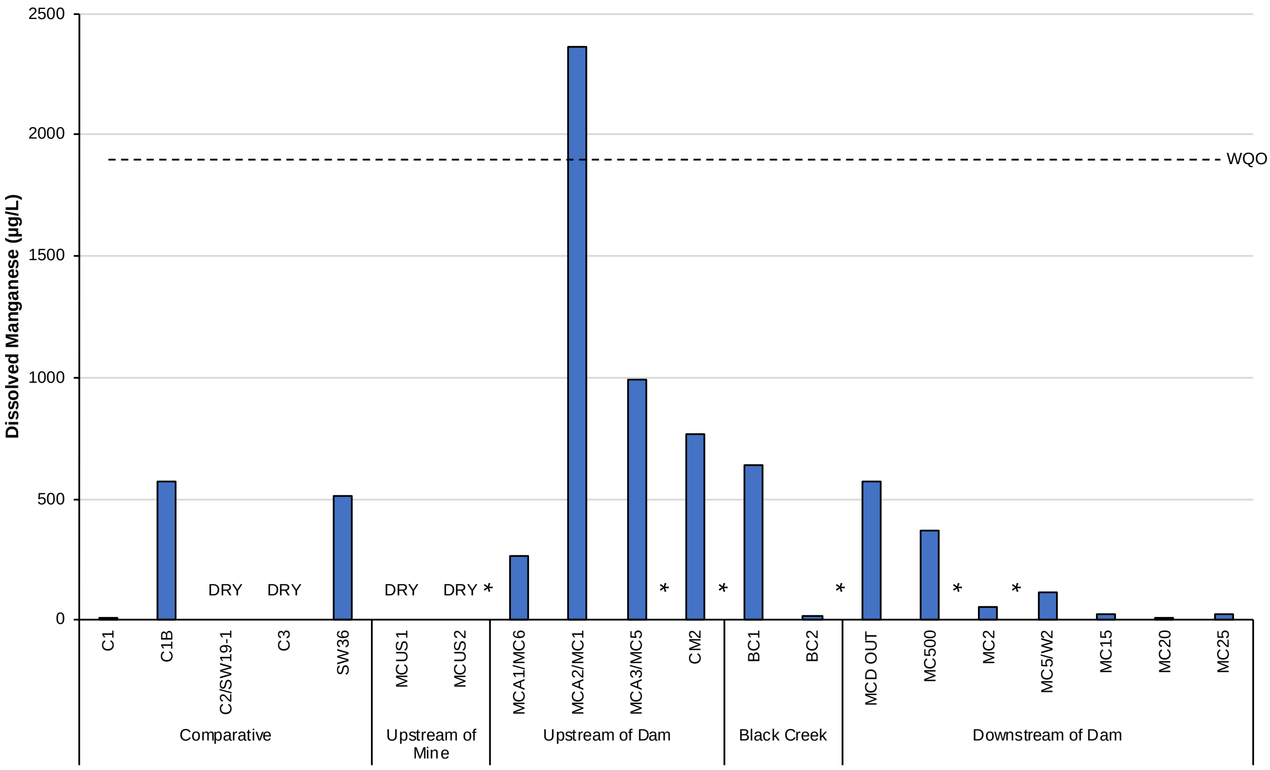


Figure 11 Dissolved manganese concentrations in water (March 2017 survey)

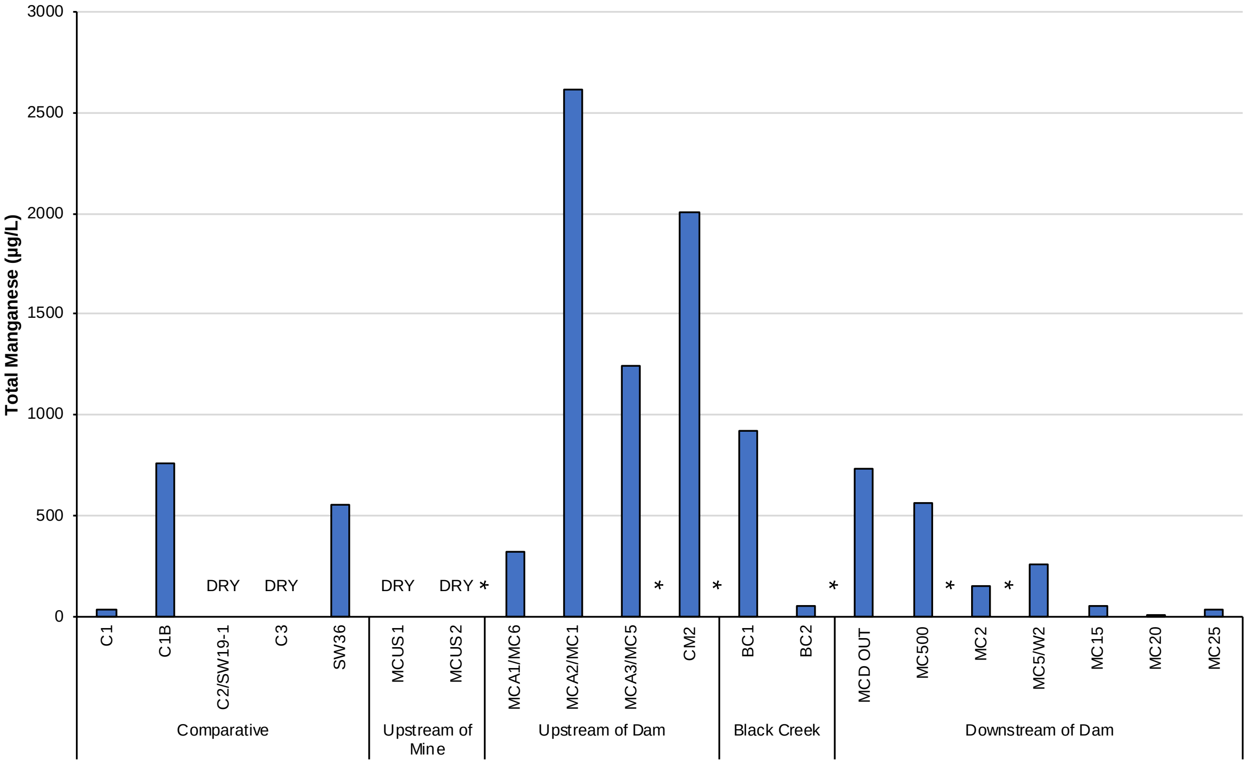


Figure 12 Total manganese concentrations in water (March 2017 survey)

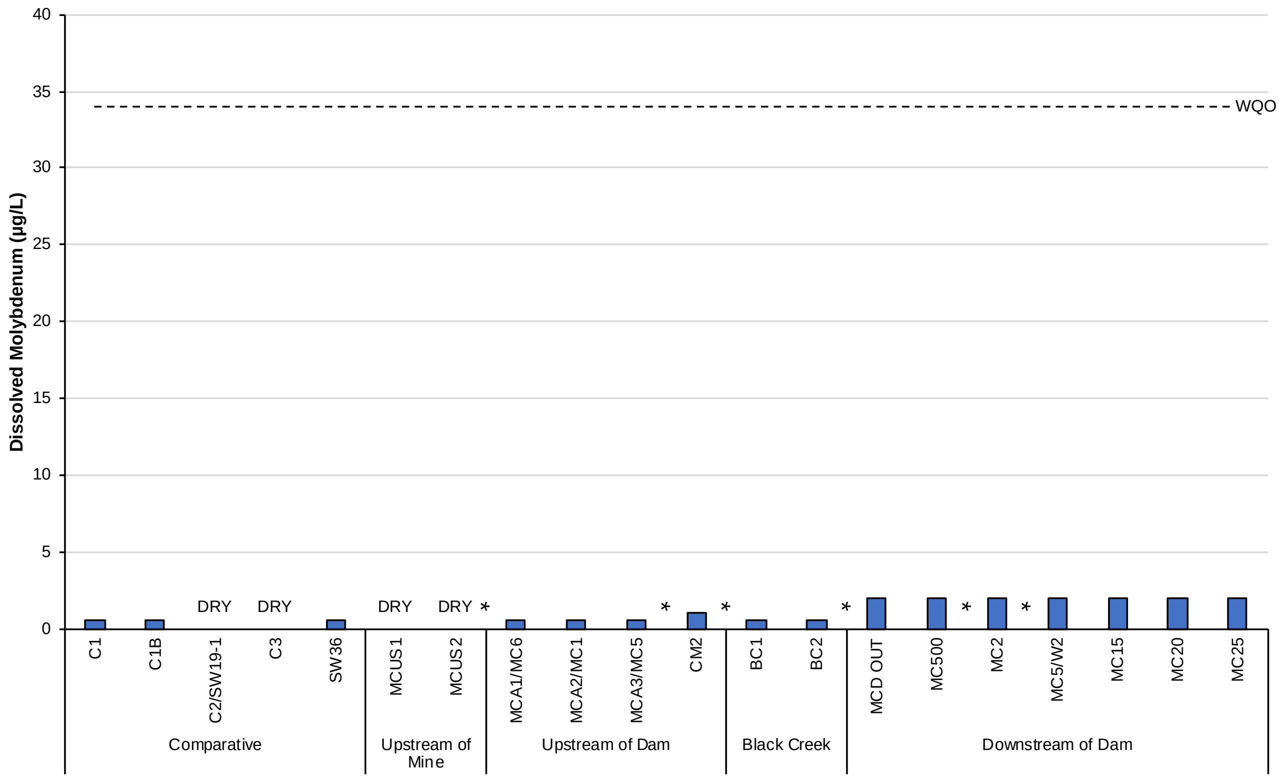


Figure 13 Dissolved molybdenum concentrations in water (March 2017 survey)

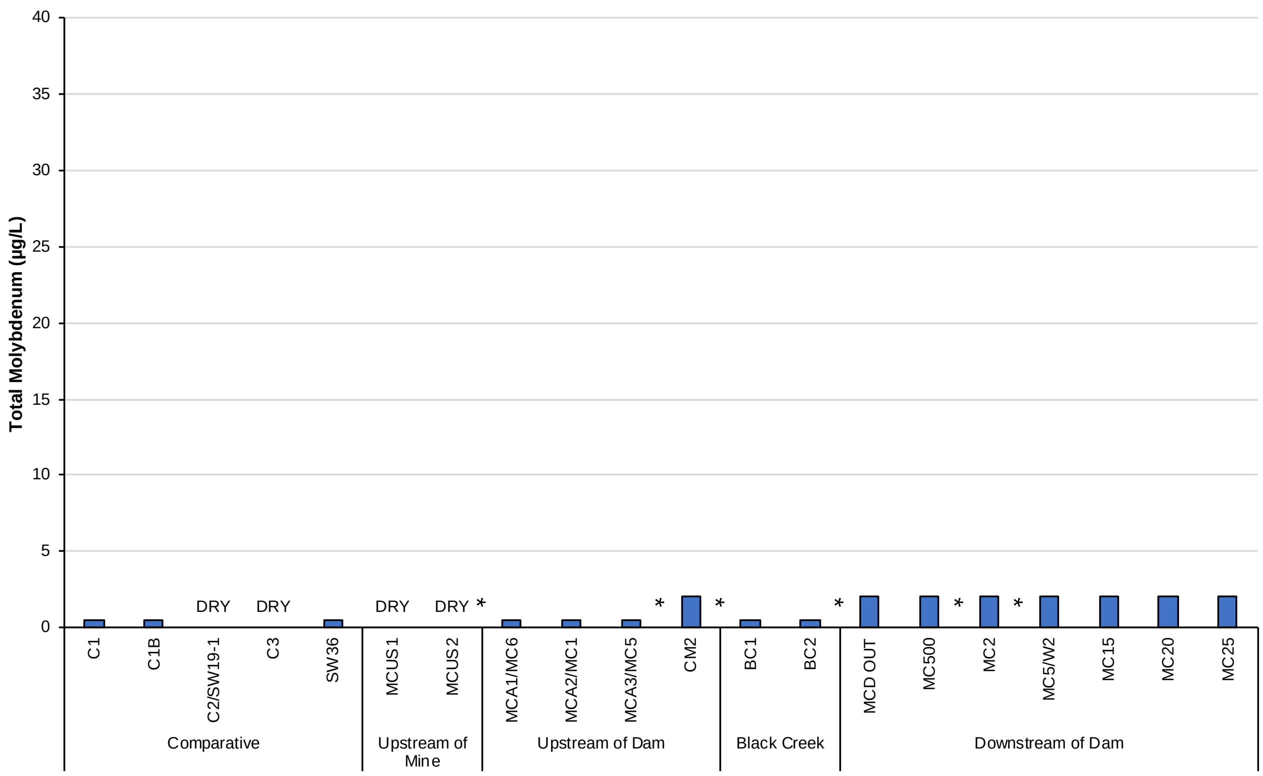


Figure 14 Total molybdenum concentrations in water (March 2017 survey)

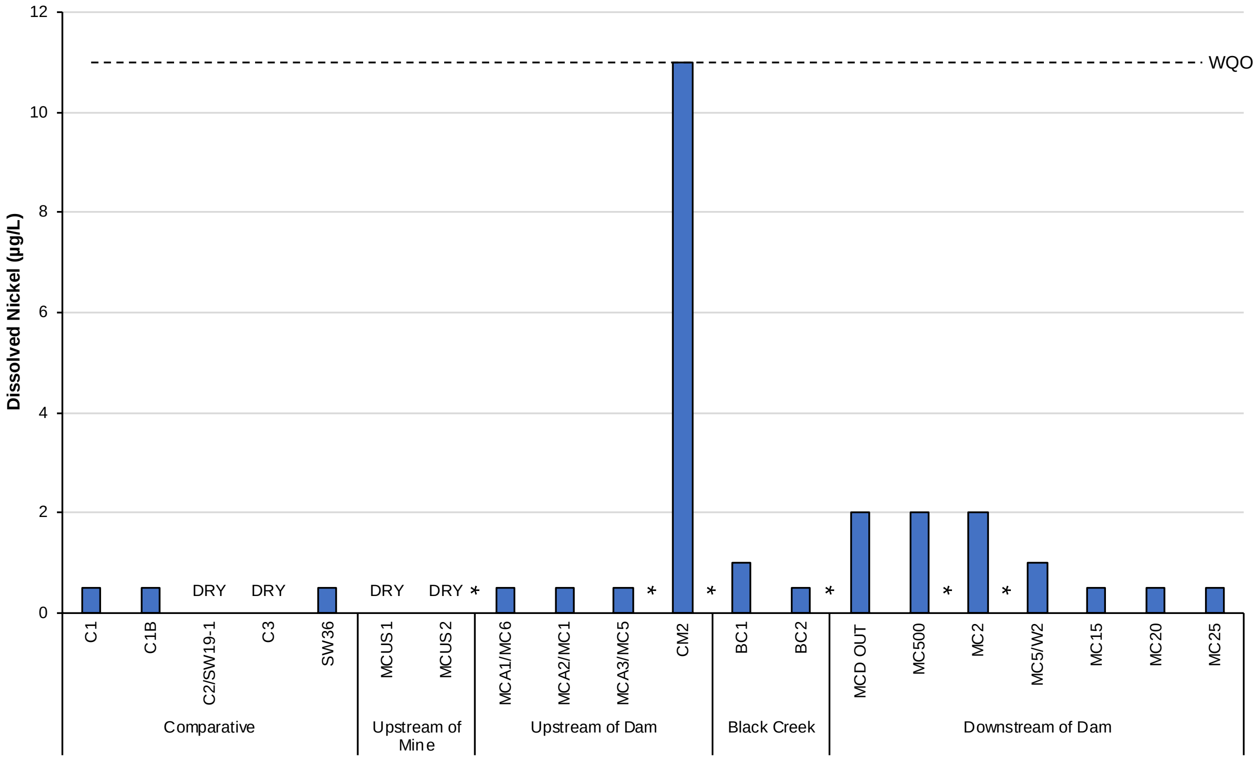


Figure 15 Dissolved nickel concentrations in water (March 2017 survey)

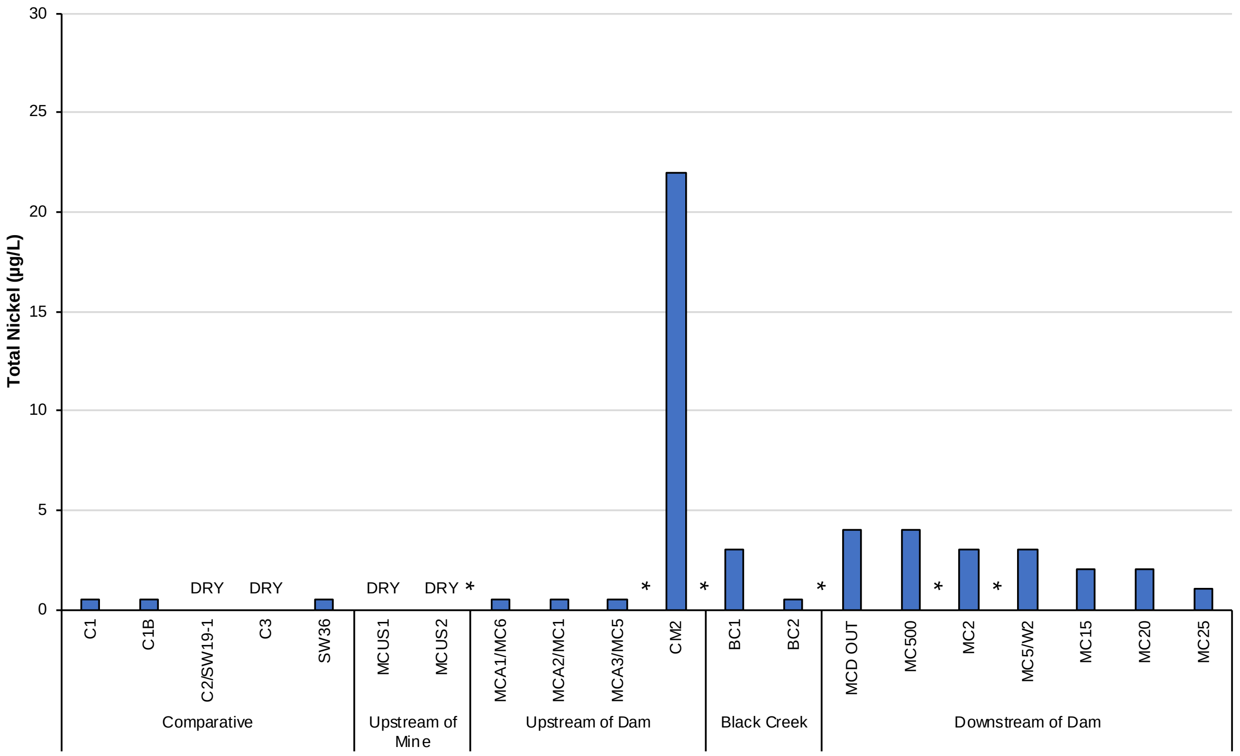


Figure 16 Total nickel concentrations in water (March 2017 survey)

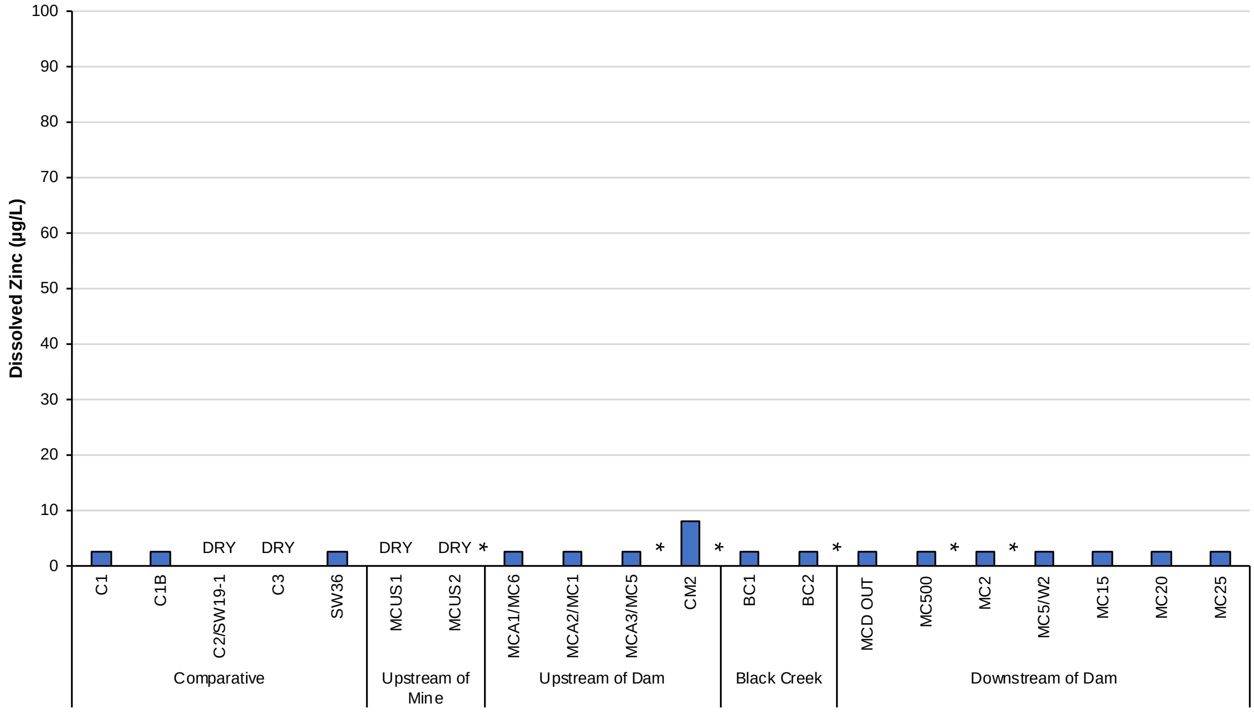


Figure 17 Dissolved zinc concentrations in water (March 2017 survey)

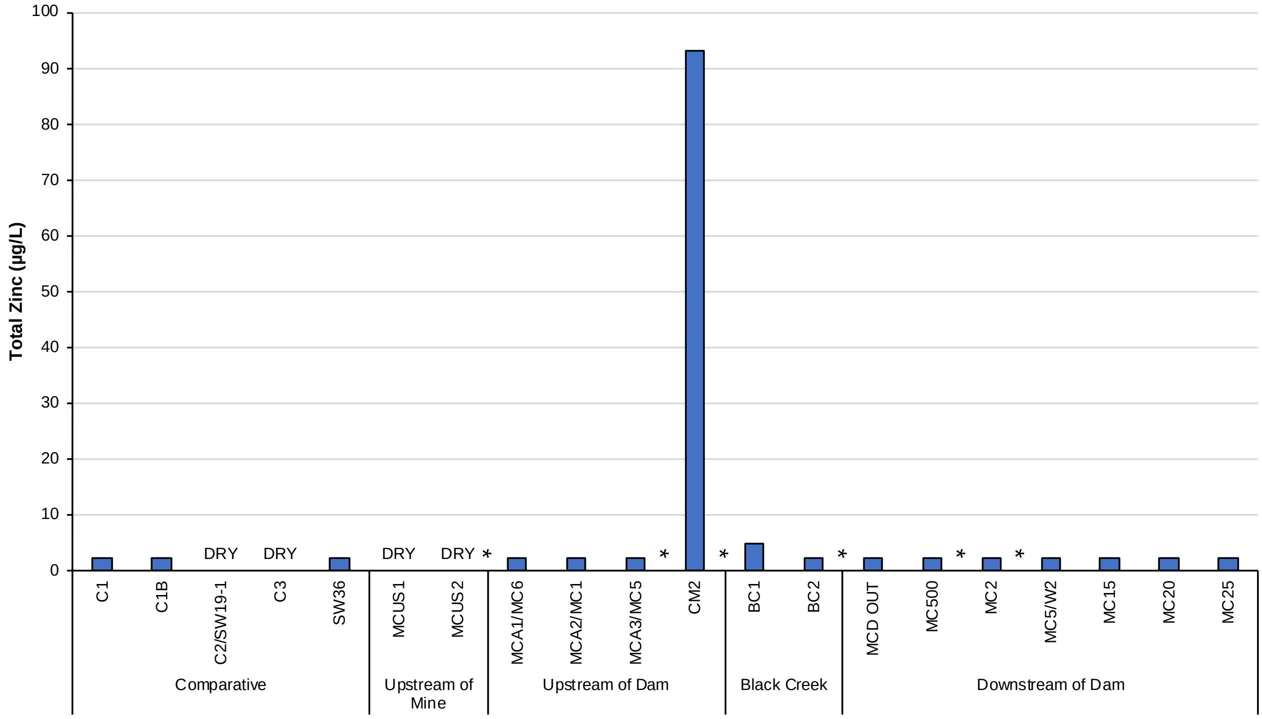
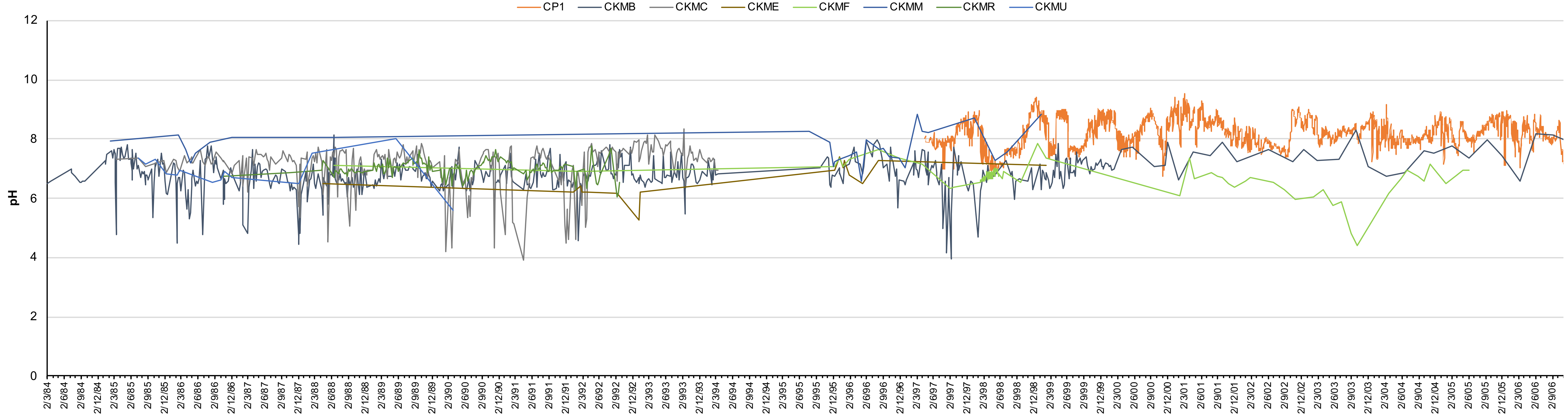


Figure 18 Total zinc concentrations in water (March 2017 survey)

APPENDIX D

REVISED WATER QUALITY FIGURES

a)



b)

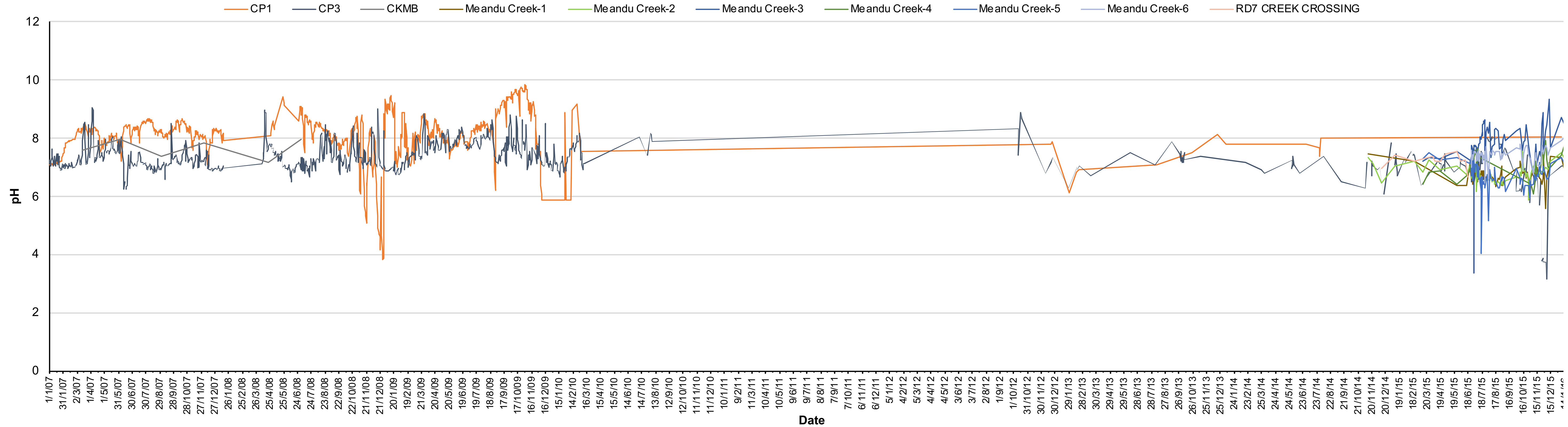


Figure 1 pH in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)

b)

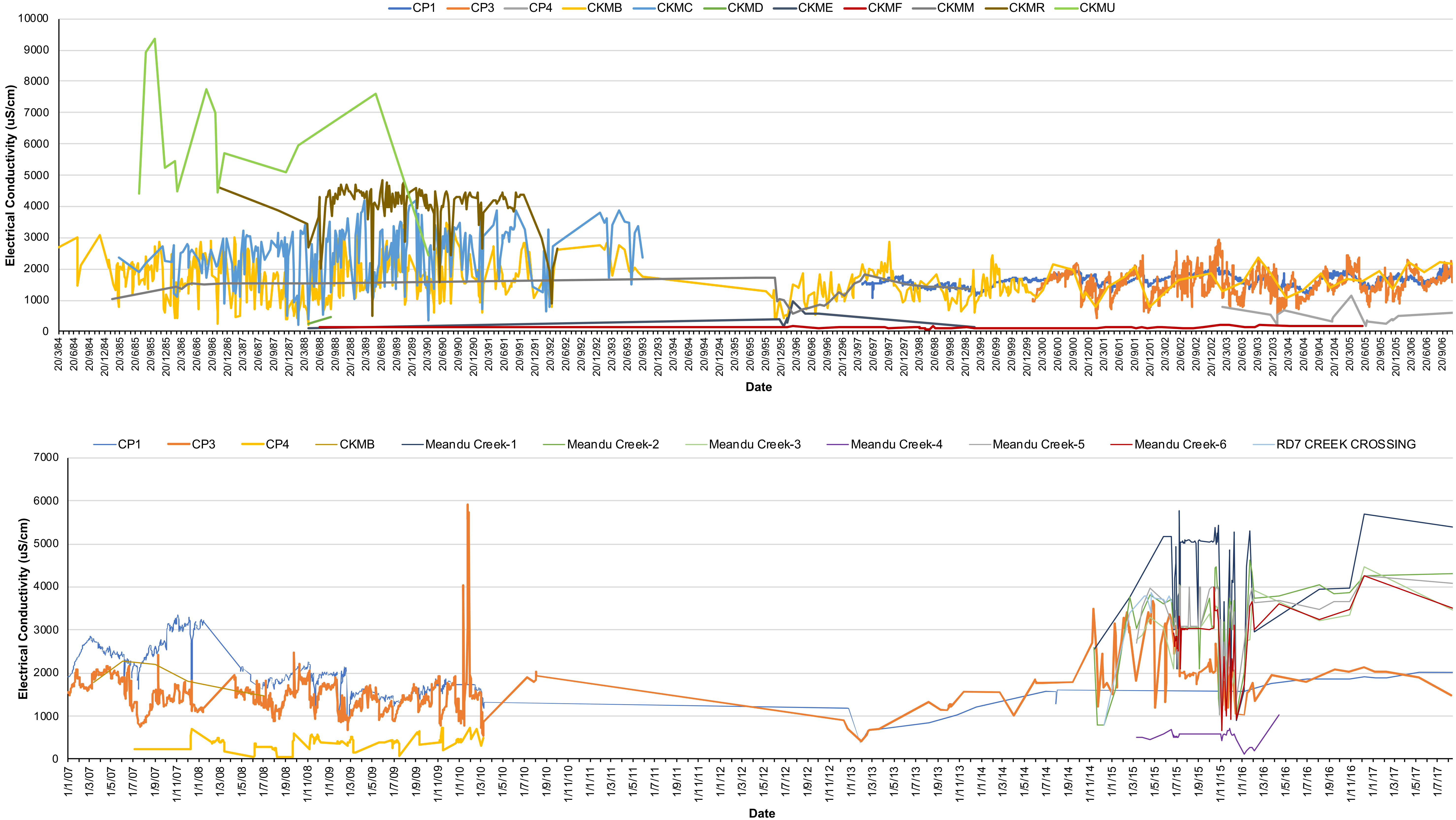
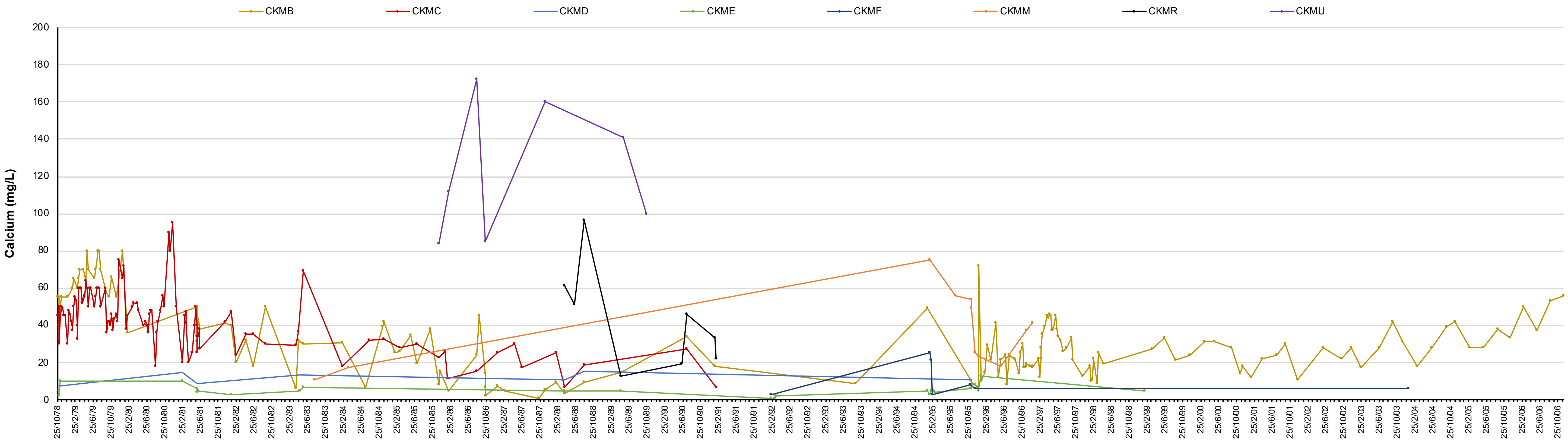


Figure 2 Electrical conductivity in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)



b)

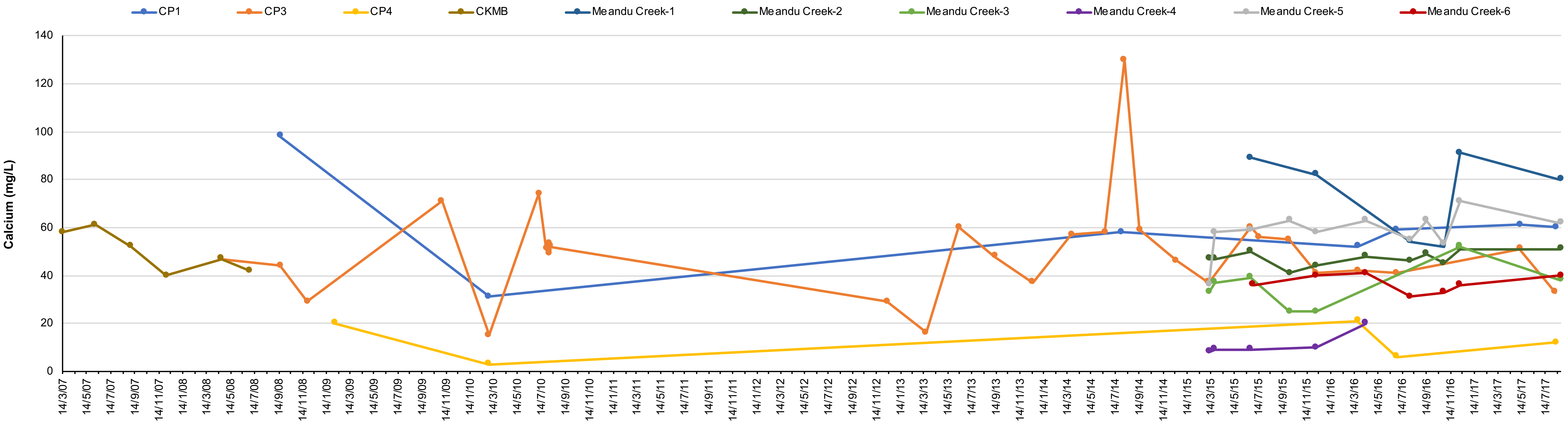


Figure 3 Calcium in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

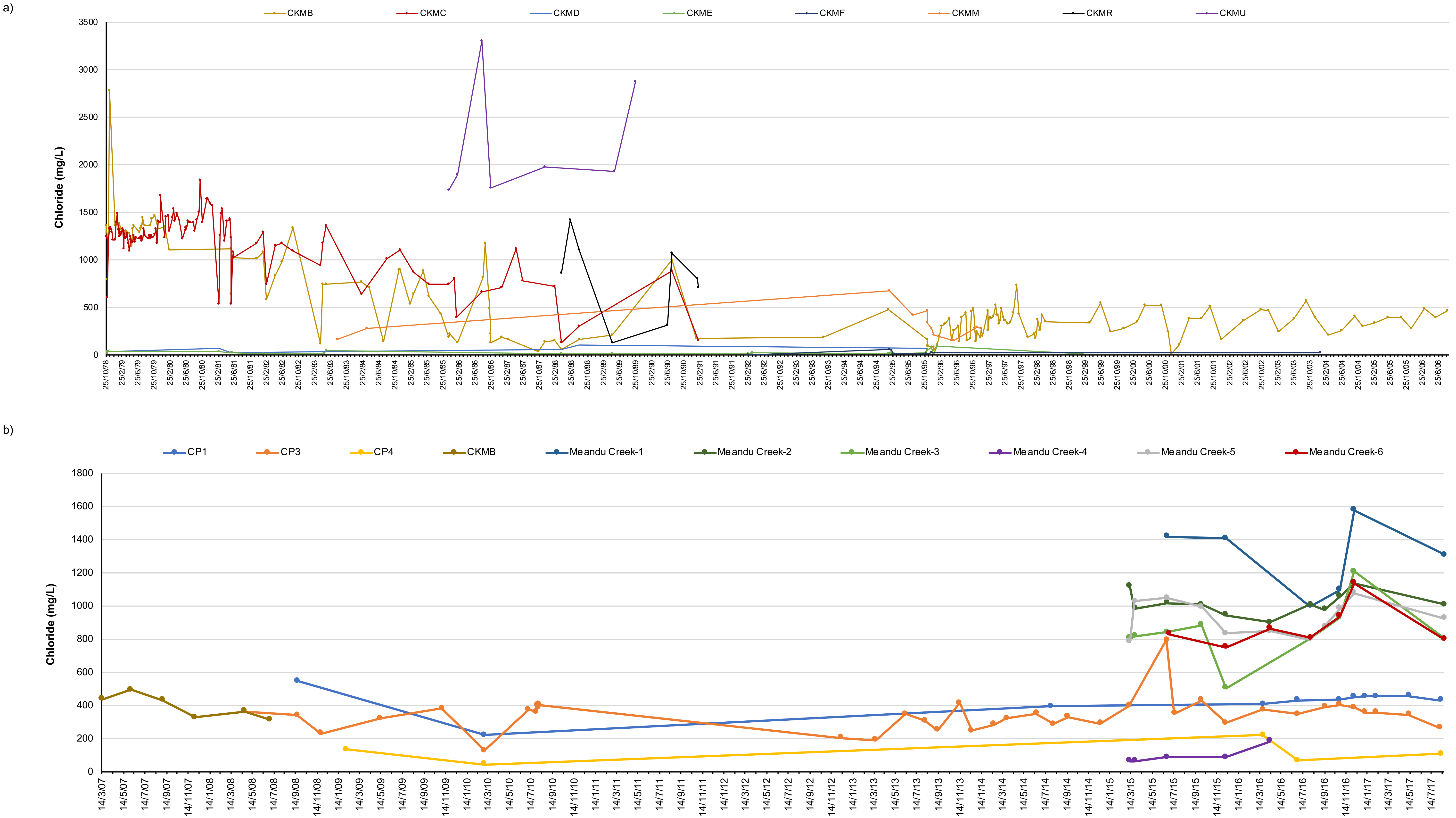


Figure 4 Chloride in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

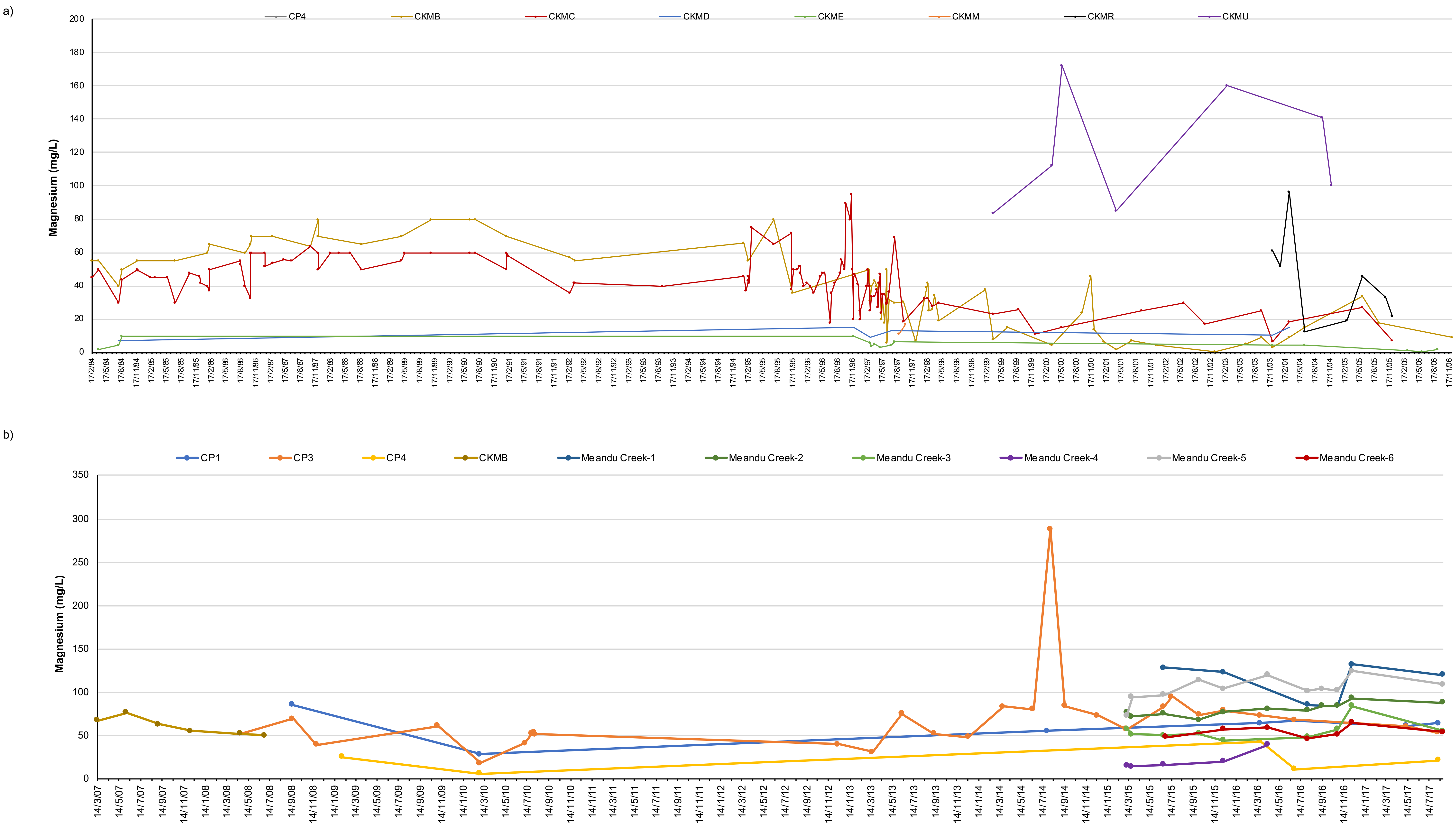
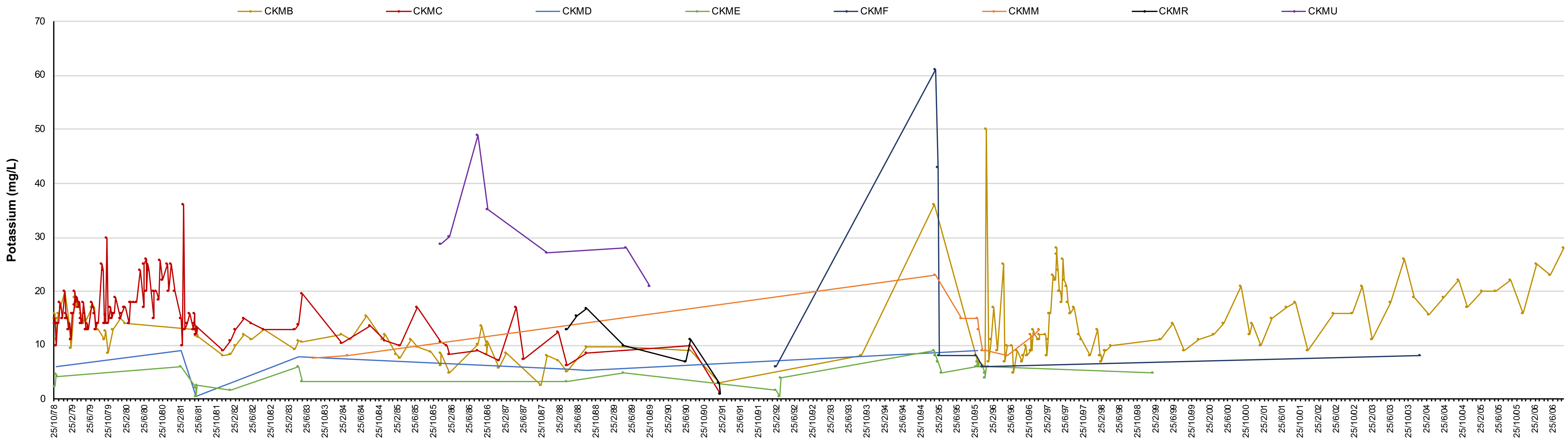


Figure 5 Magnesium in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)



b)

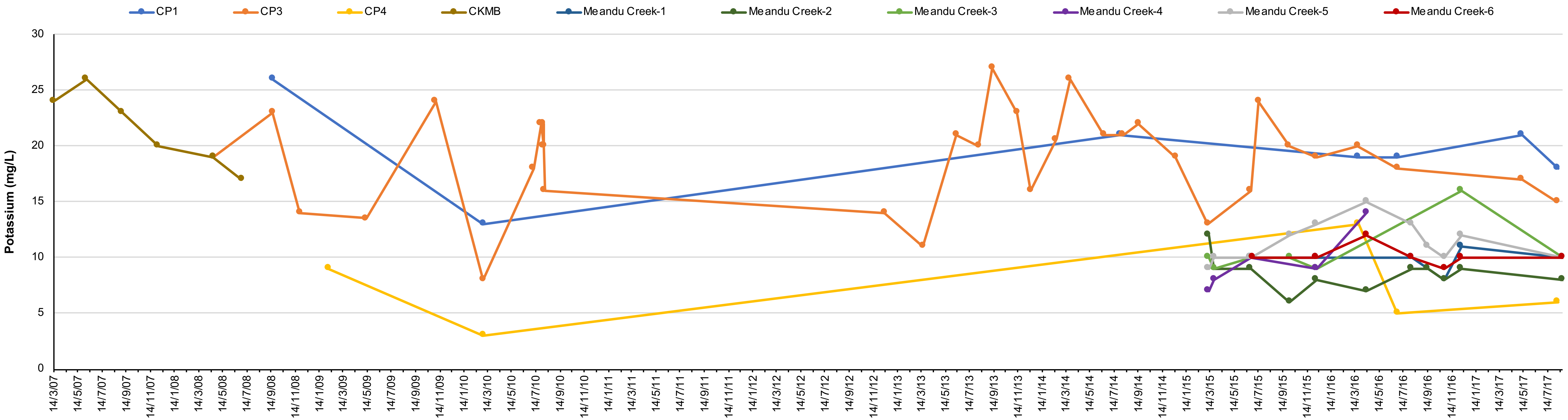
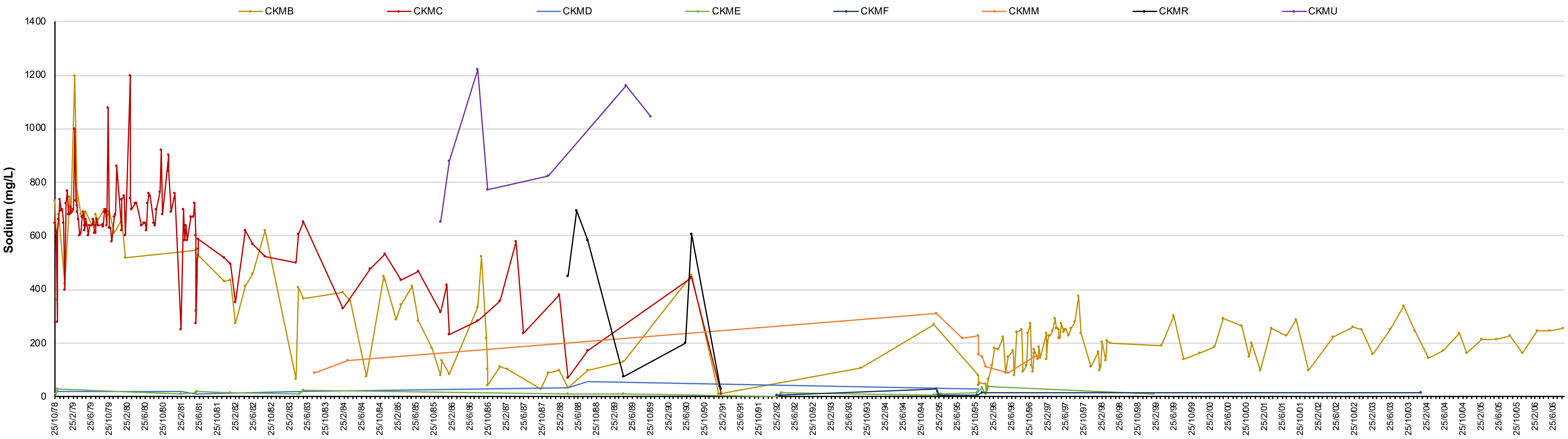


Figure 6 Potassium in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)



b)

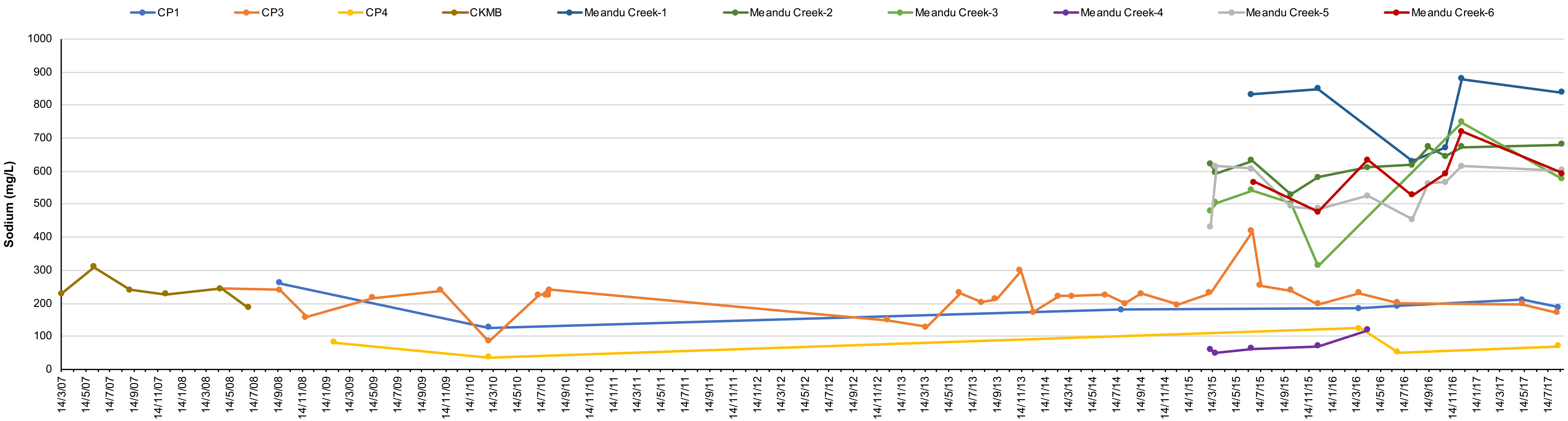


Figure 7 Sodium in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)

b)

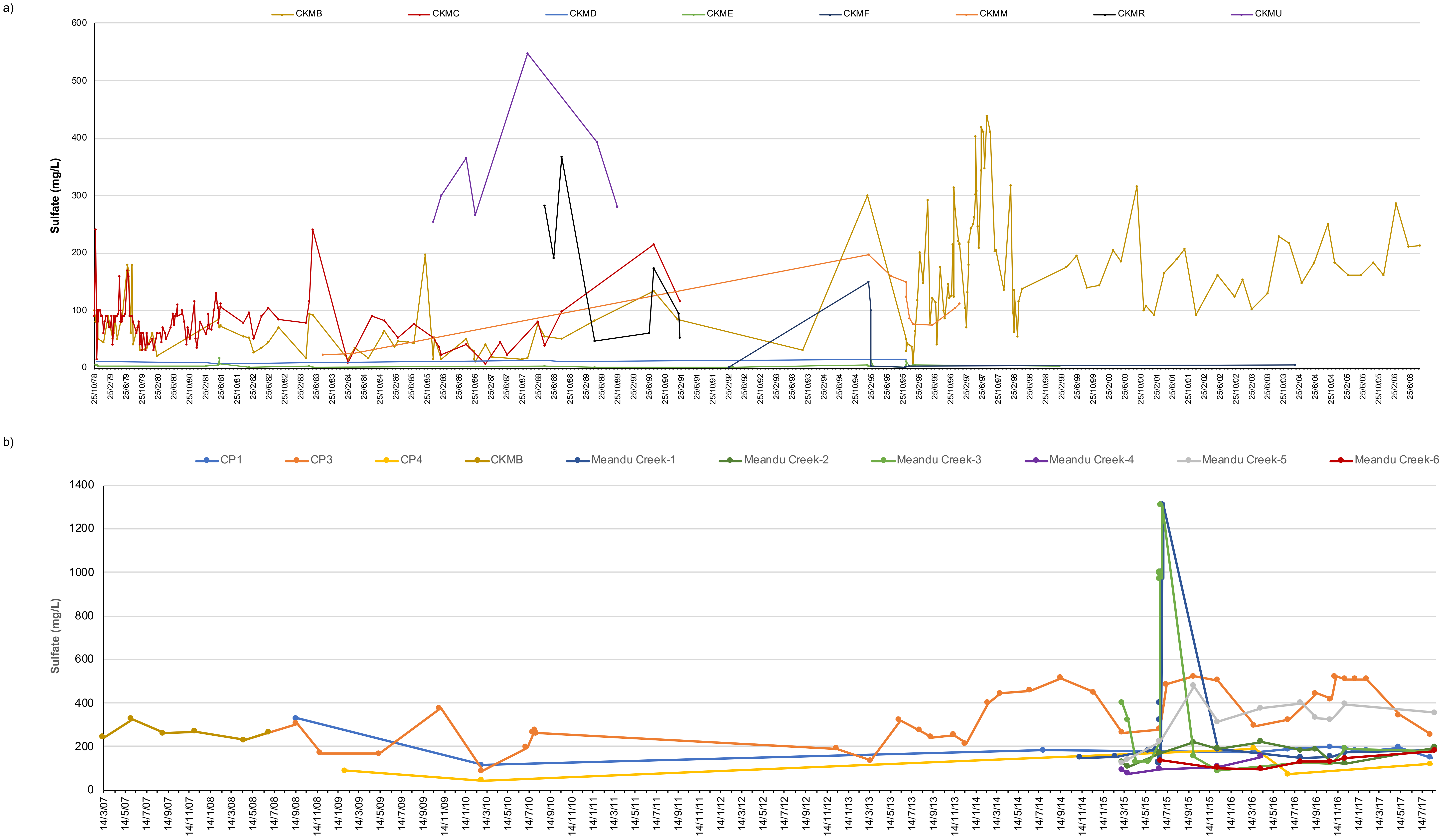


Figure 8 Sulfate in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

a)

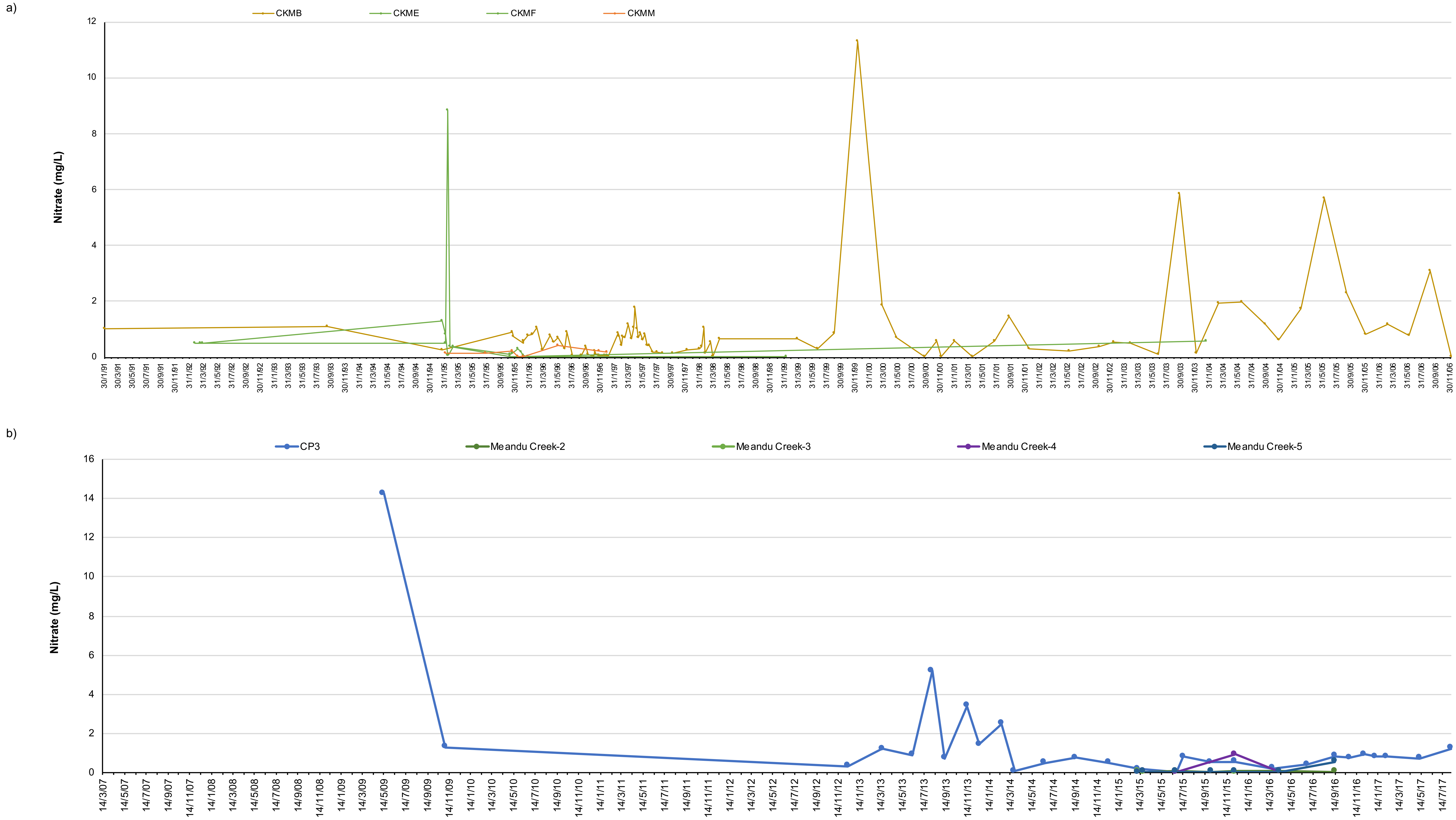


Figure 9 Nitrate in water at sites on Meandu Creek from a) 1984 to 2006 and b) 2007 to 2017

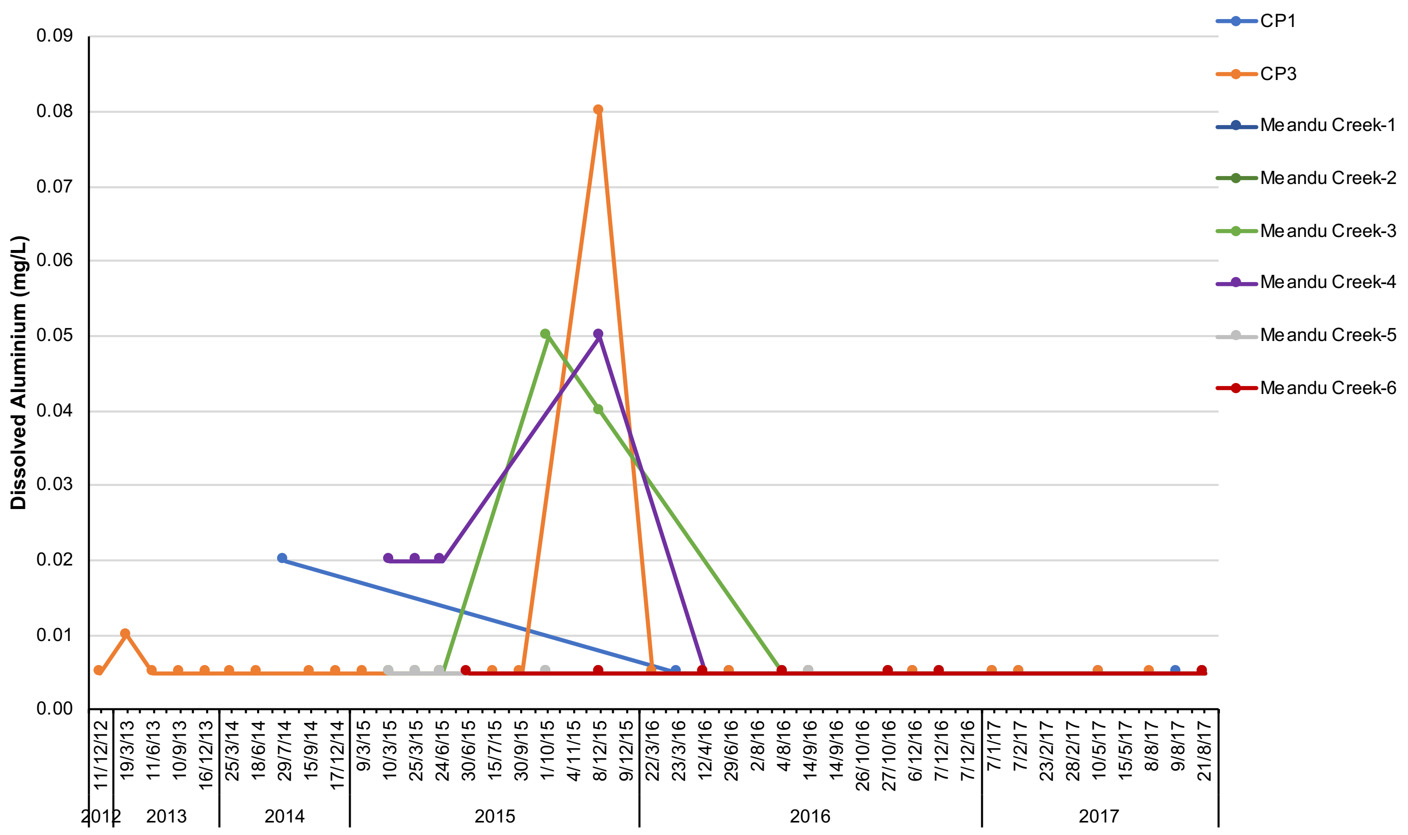


Figure 10 Dissolved aluminium concentrations in water at sites on Meandu Creek from 2015 to 2017

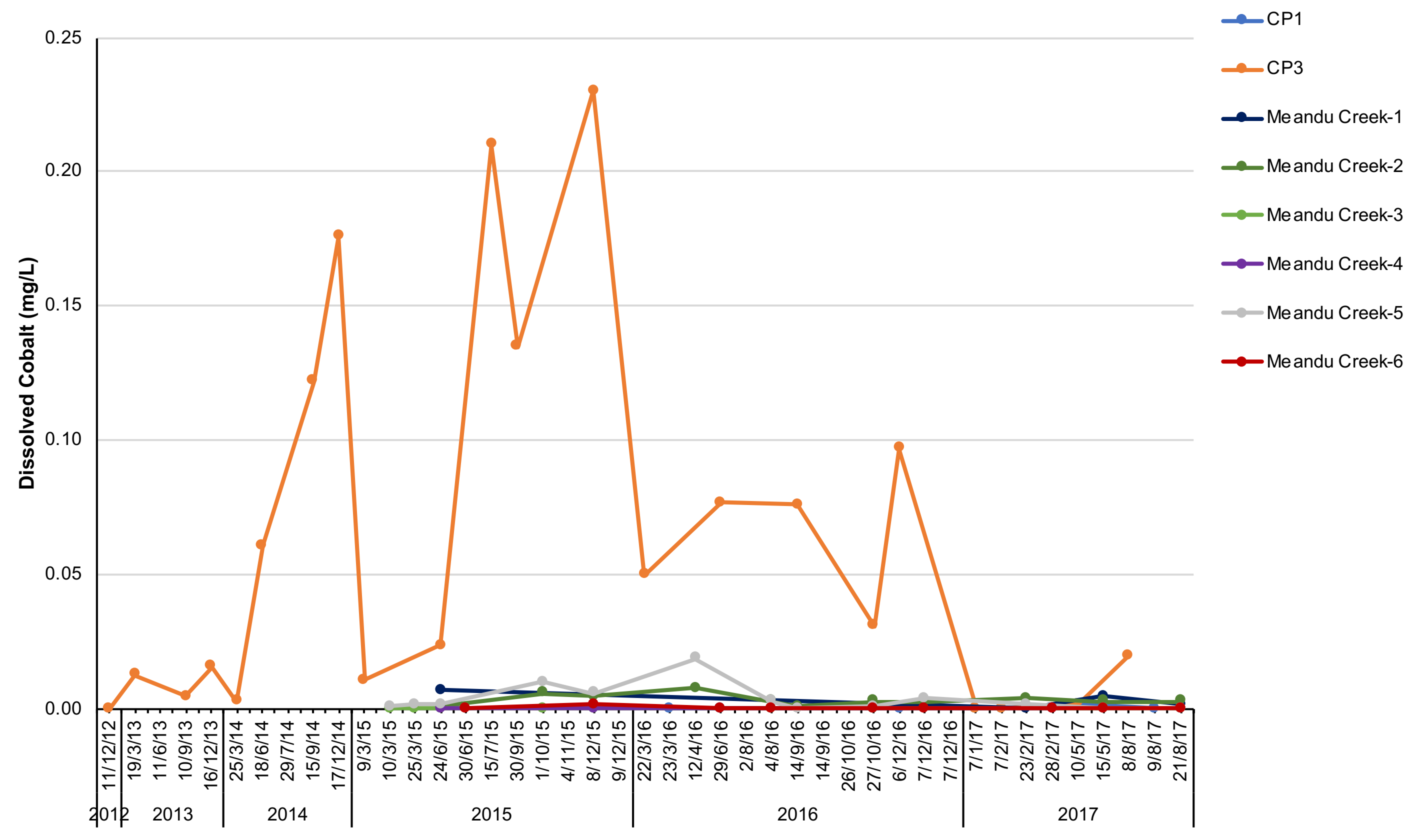


Figure 11 Dissolved cobalt concentrations in water at sites on Meandu Creek from 2015 to 2017

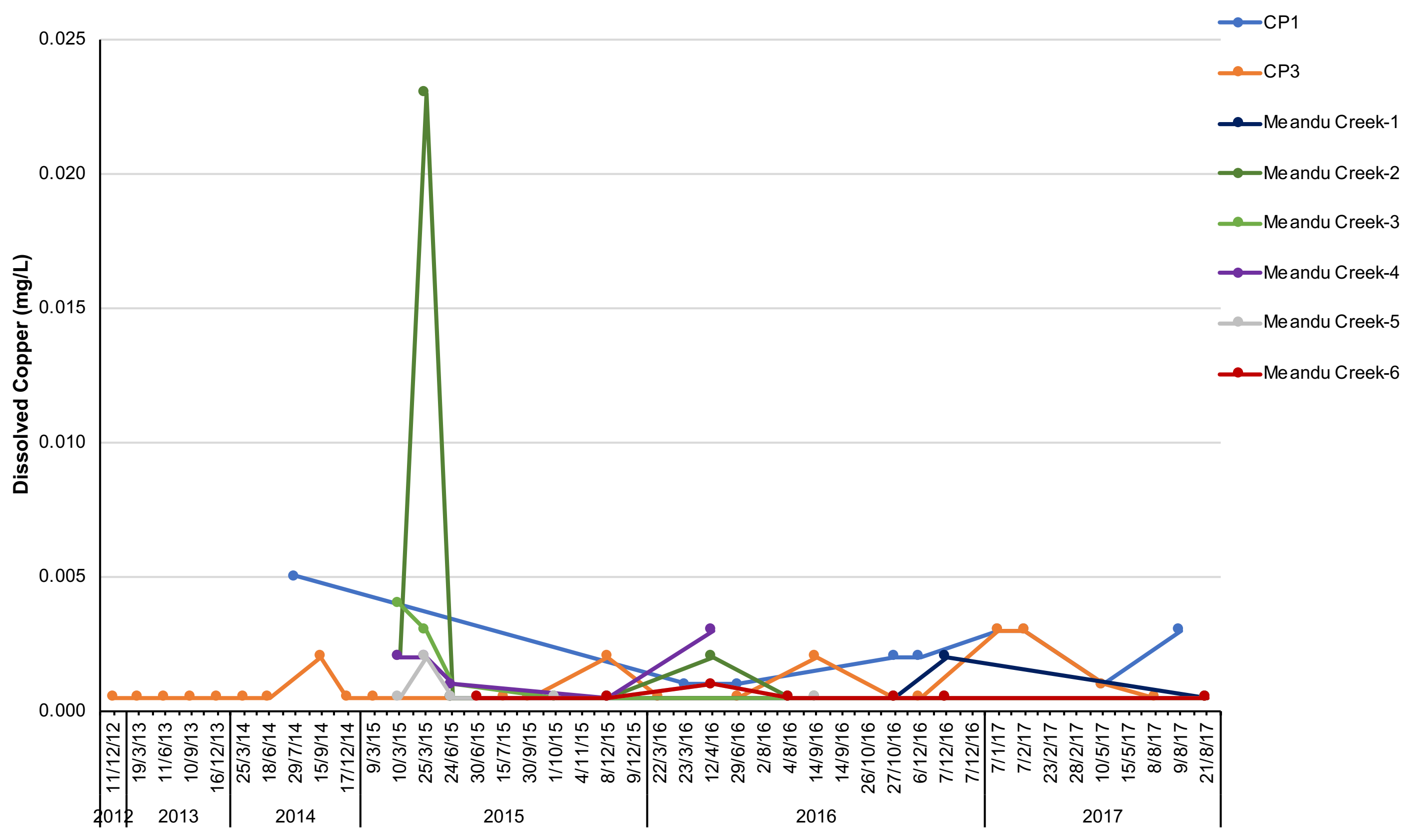


Figure 12 Dissolved copper concentrations in water at sites on Meandu Creek from 2015 to 2017

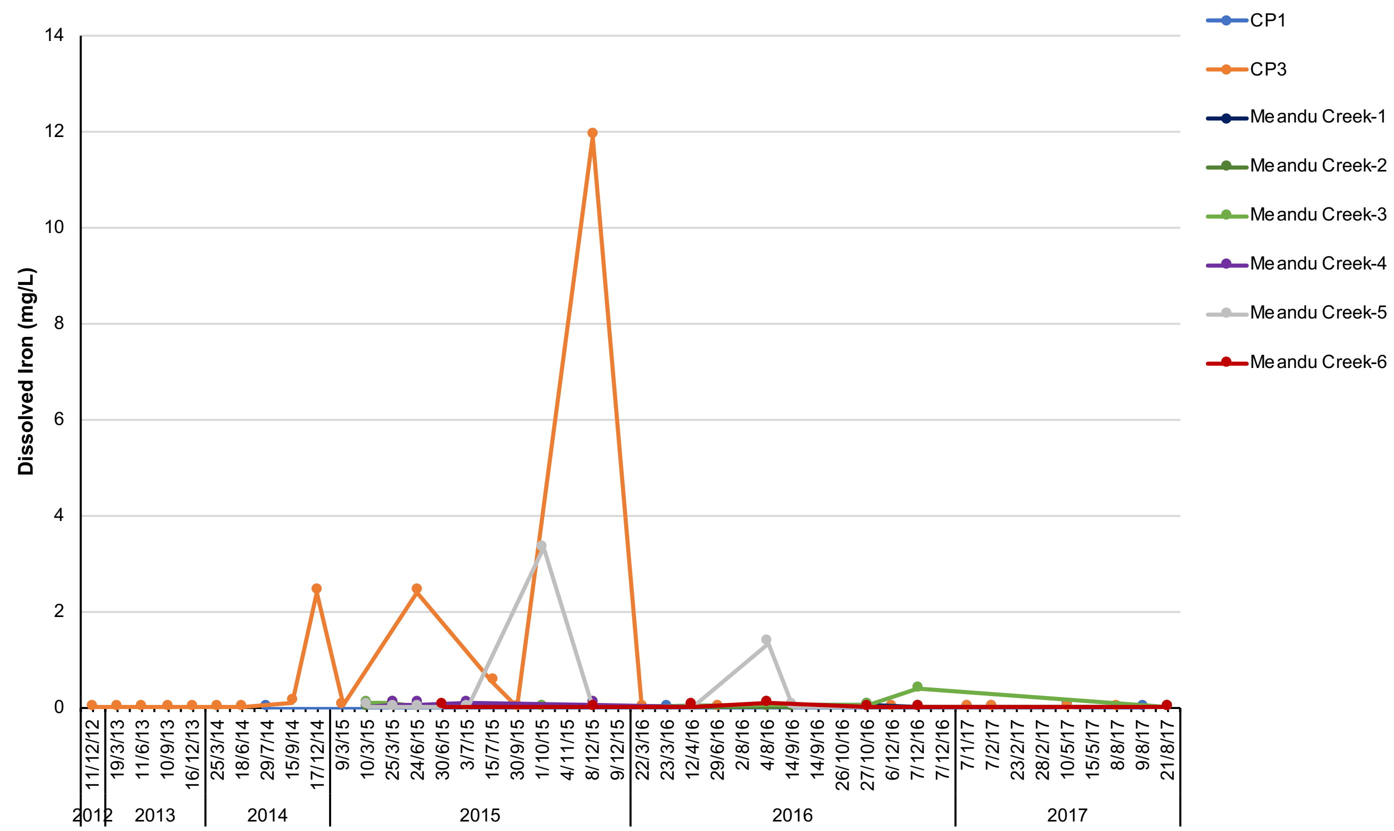


Figure 13 Dissolved iron concentrations in water at sites on Meandu Creek from 2015 to 2017

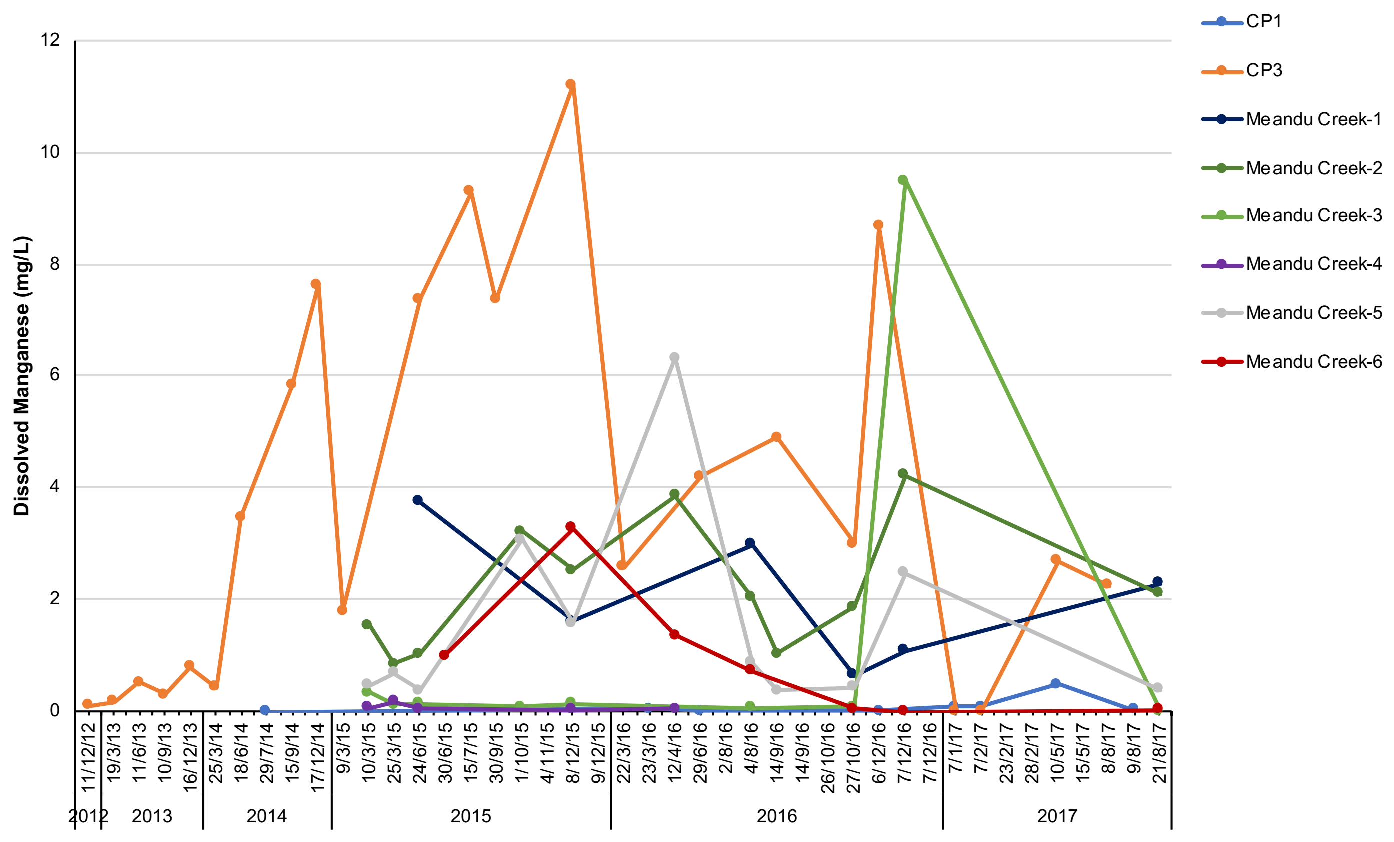


Figure 14 Dissolved manganese concentrations in water at sites on Meandu Creek from 2015 to 2017

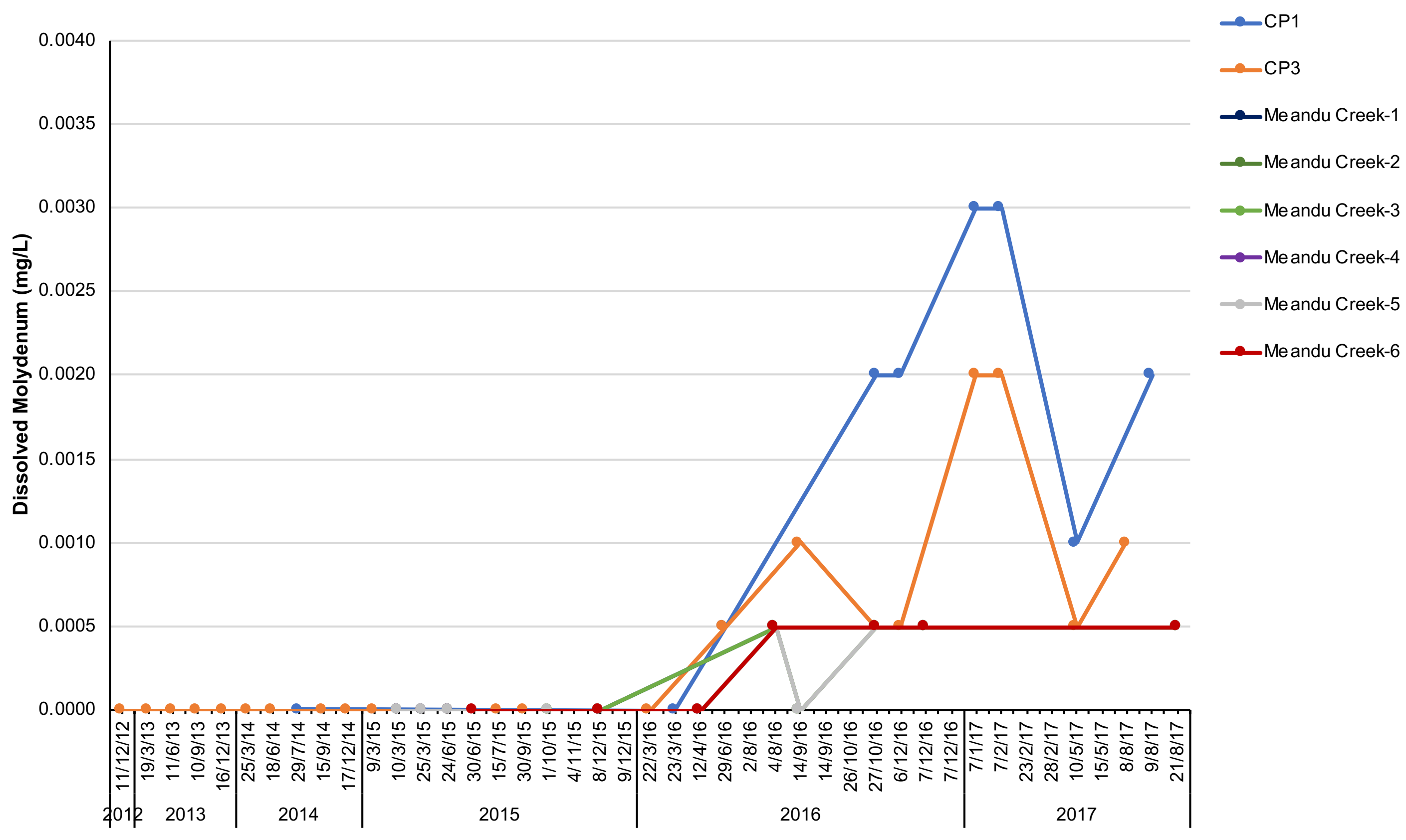


Figure 15 Dissolved molybdenum concentrations in water at sites on Meandu Creek from 2015 to 2017

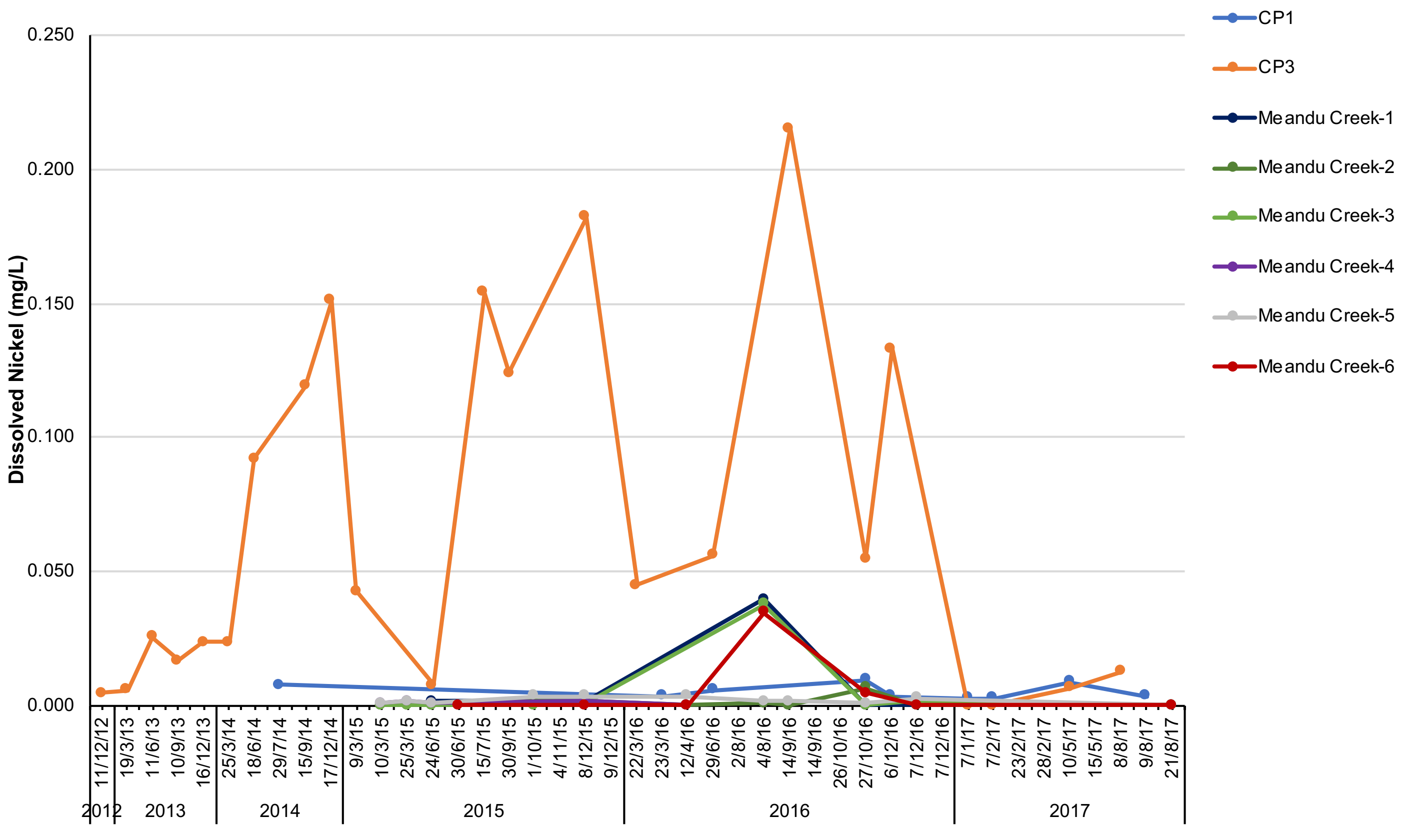


Figure 16 Dissolved nickel concentrations in water at sites on Meandu Creek from 2015 to 2017

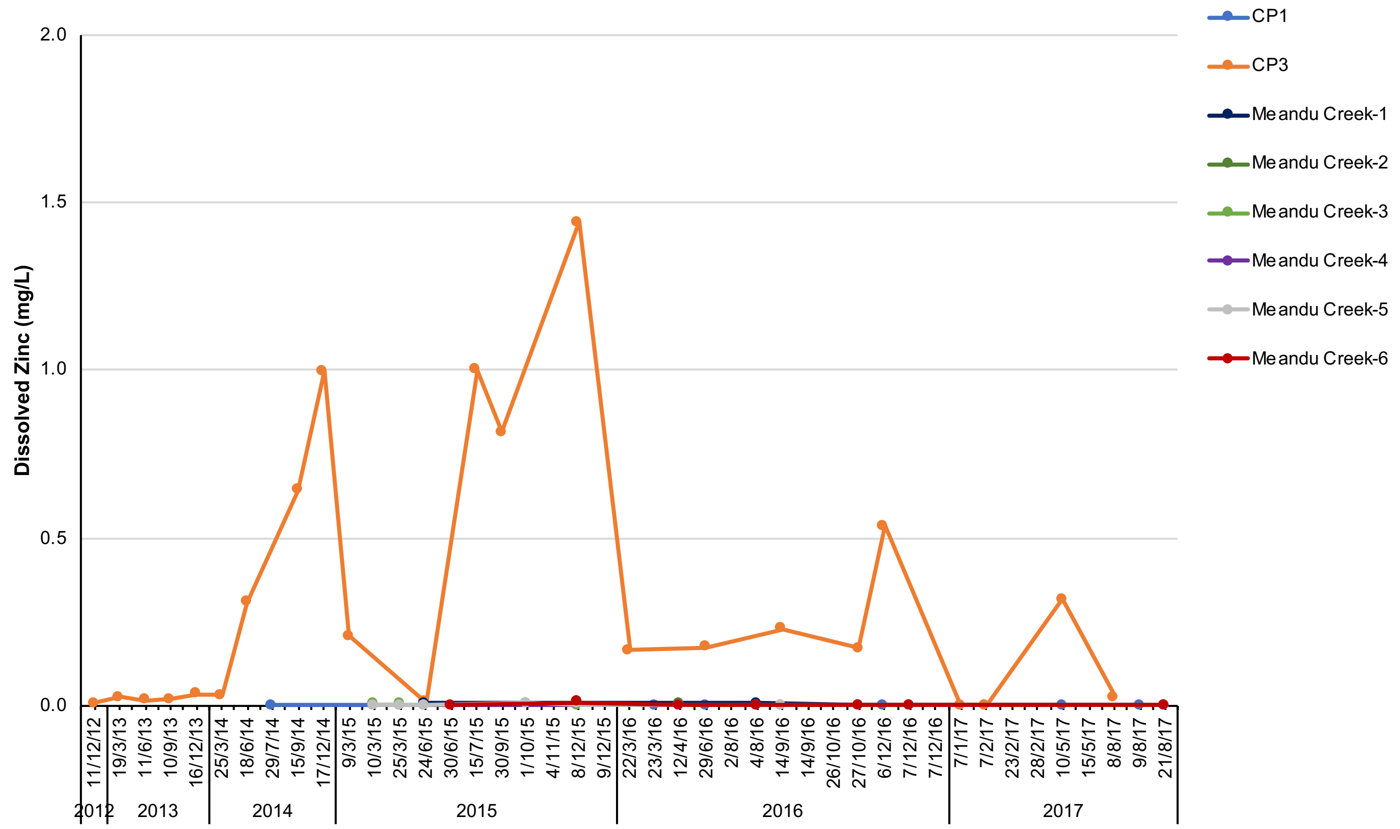


Figure 17 Dissolved zinc concentrations in water at sites on Meandu Creek from 2015 to 2017

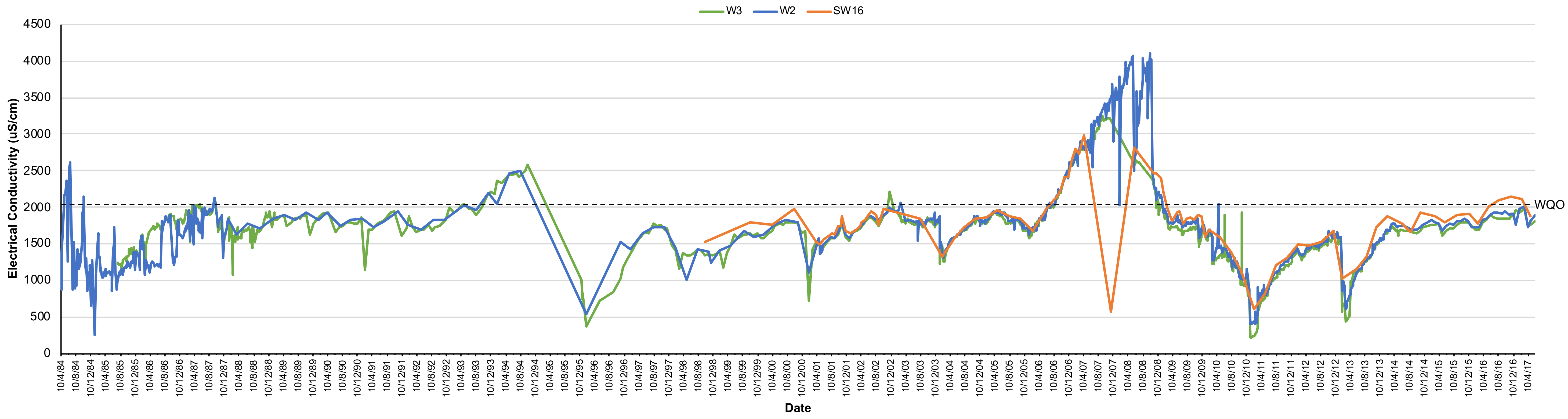


Figure 18 Electrical conductivity of water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

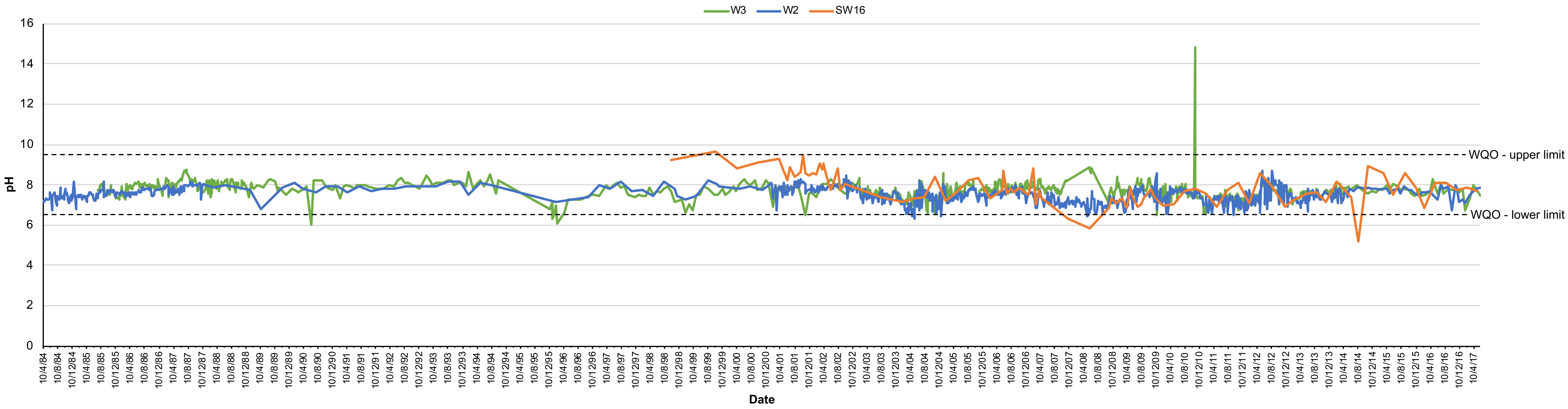


Figure 19 pH of water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

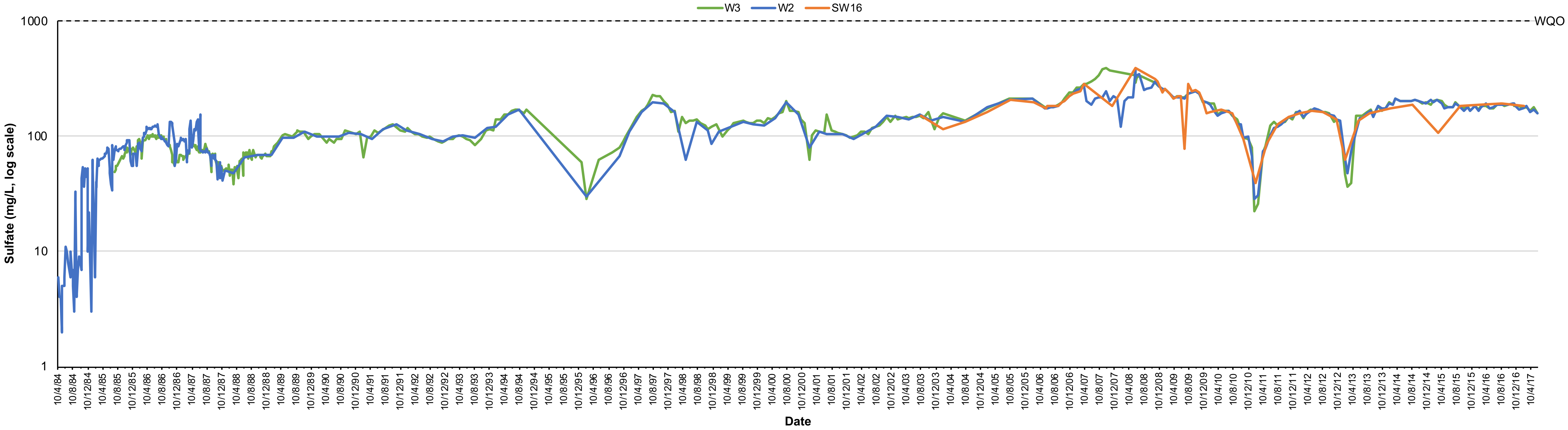


Figure 20 Sulfate of water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

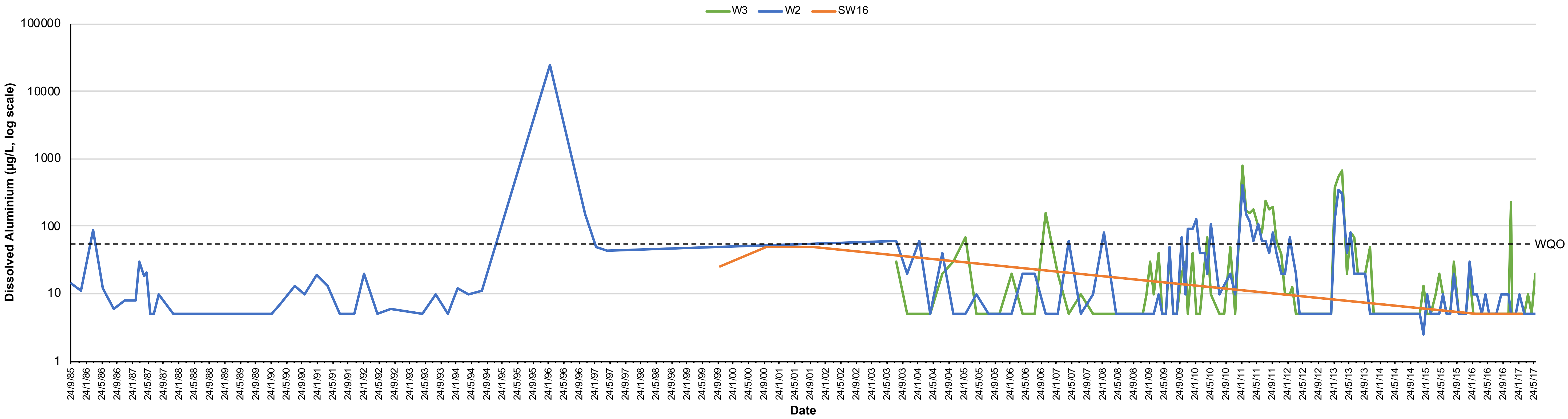


Figure 21 Dissolved aluminium concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

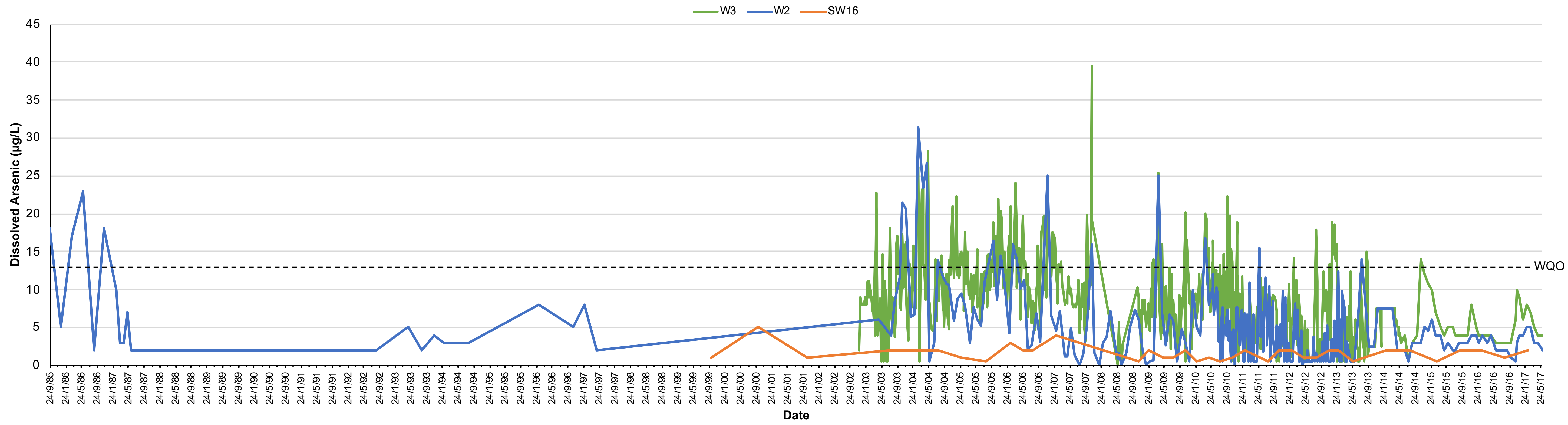


Figure 22 Dissolved arsenic concentrations in Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

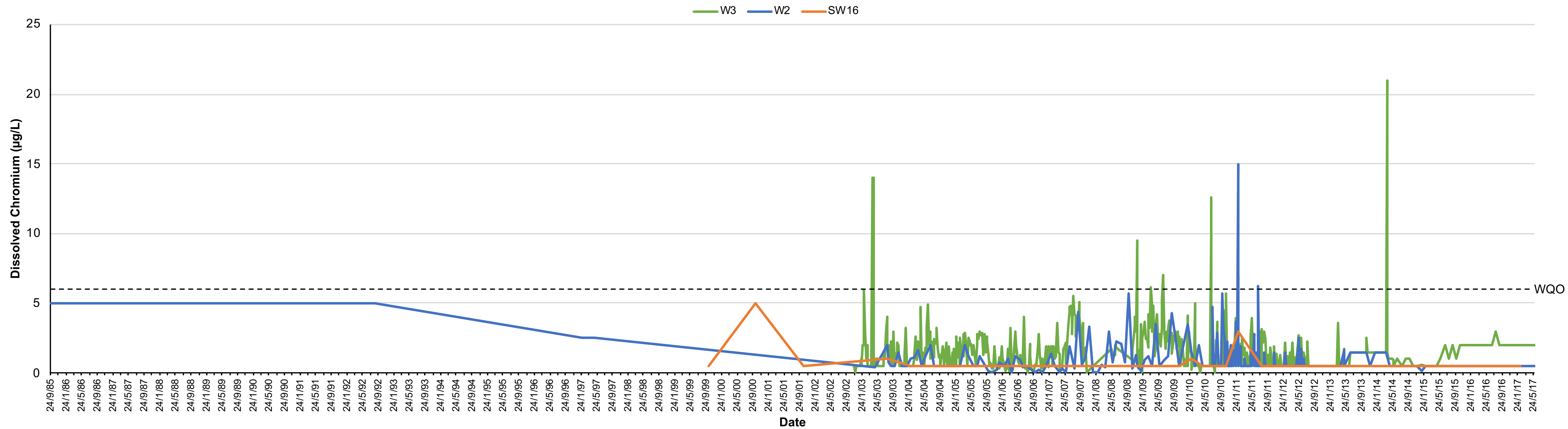


Figure 23 Dissolved chromium concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

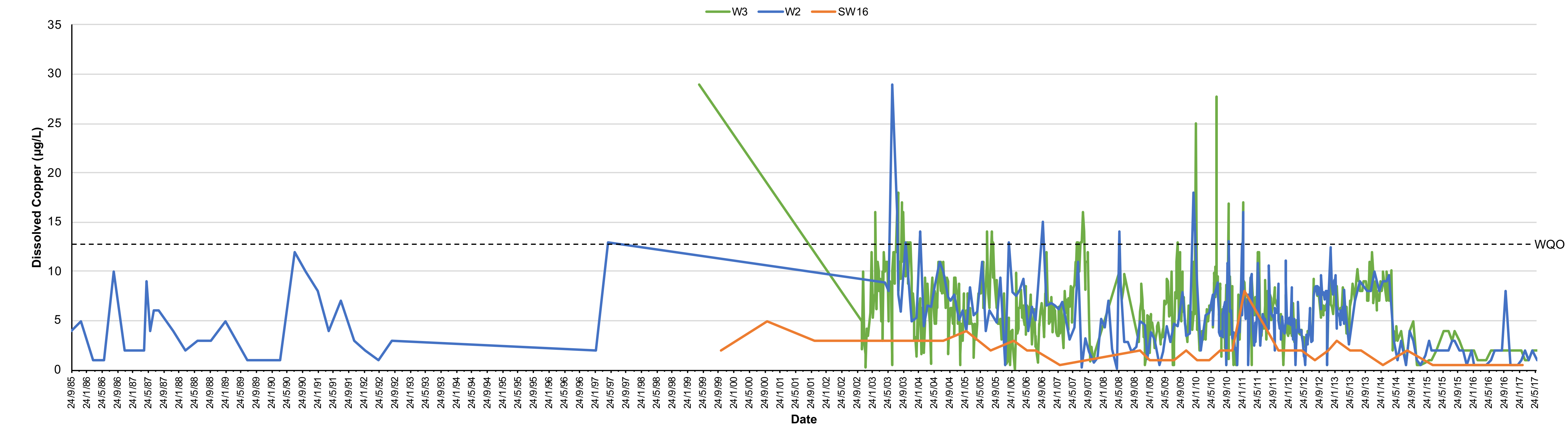


Figure 24 Dissolved copper concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

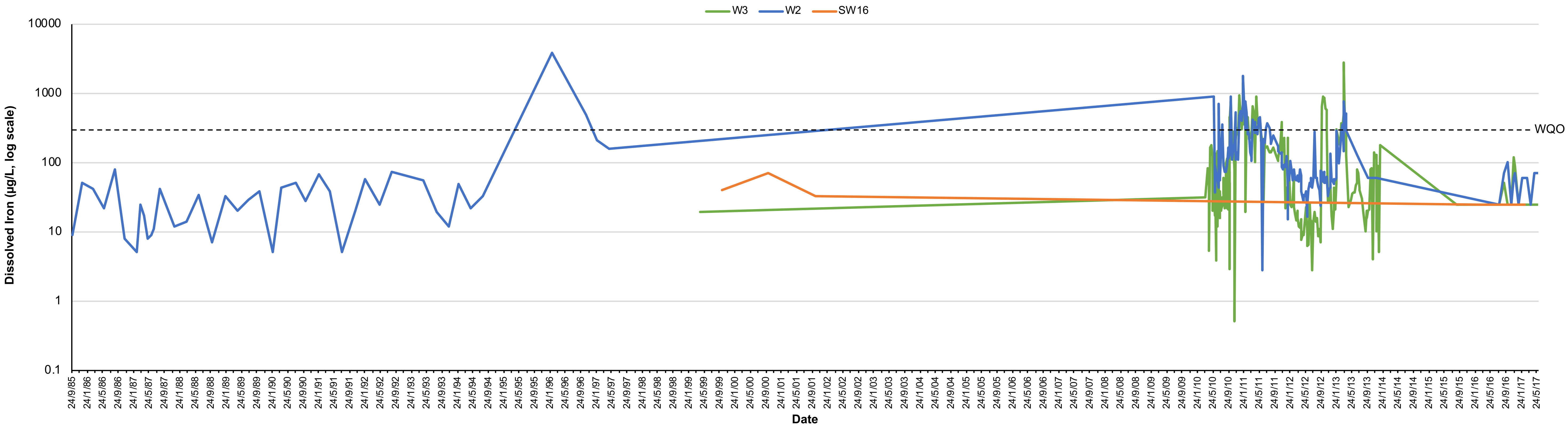


Figure 25 Dissolved iron concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

Figure 26 Dissolved boron concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

Figure 27 Dissolved manganese concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

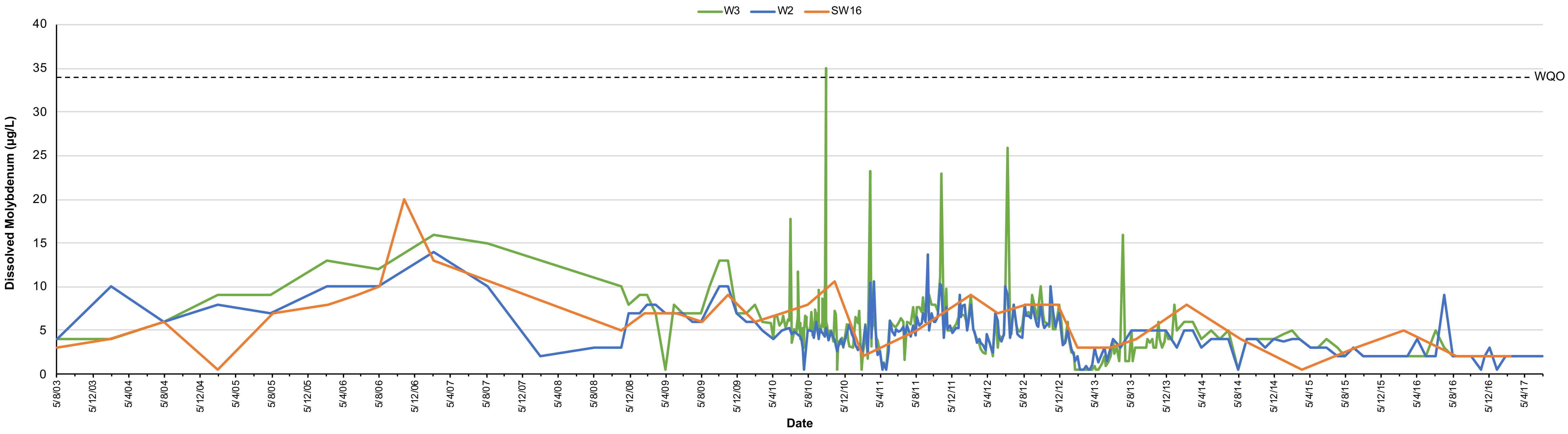


Figure 28 Dissolved molybdenum concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

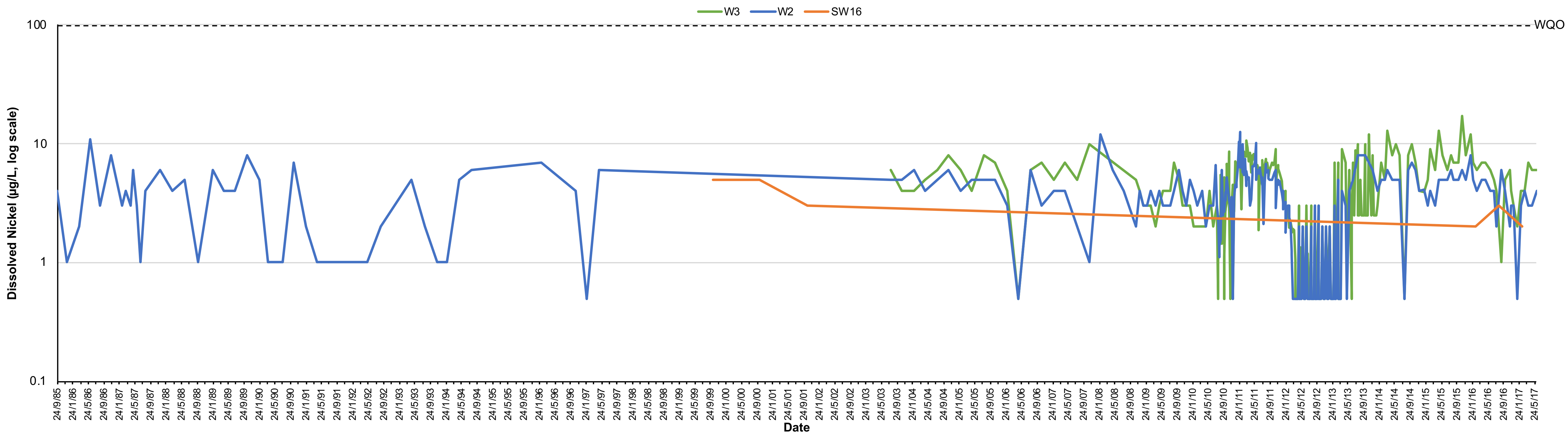


Figure 29 Dissolved nickel concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

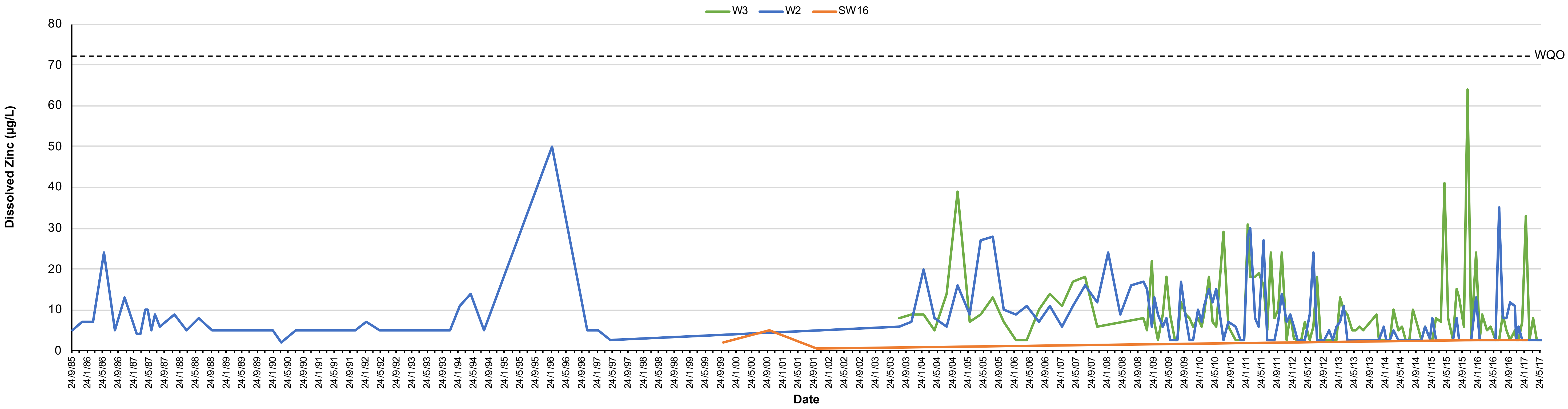


Figure 30 Dissolved zinc concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

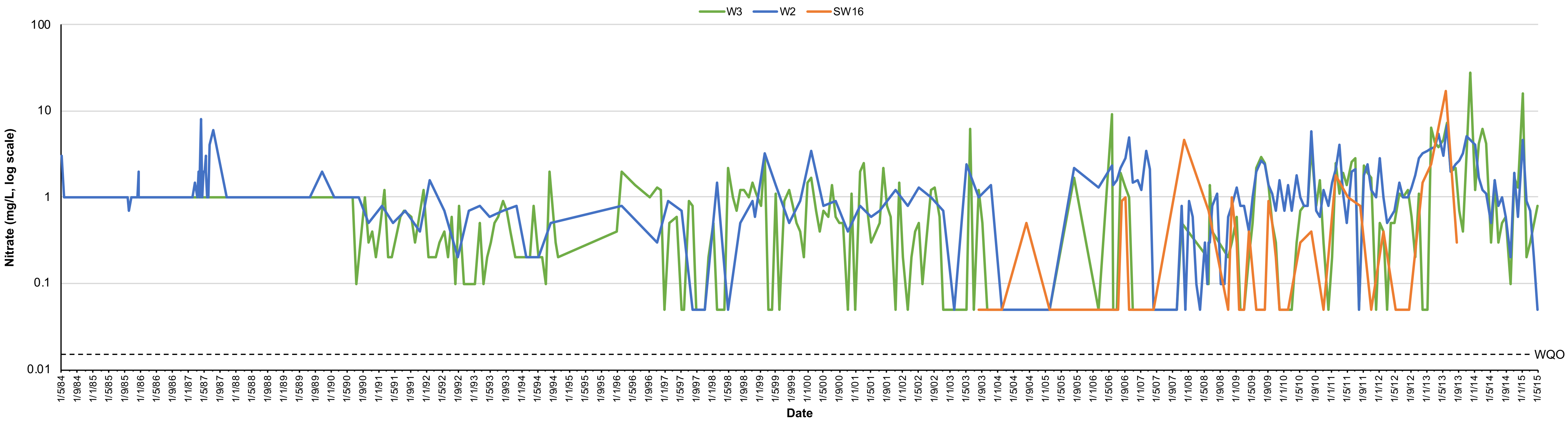


Figure 31 Dissolved nitrate concentrations in water at sites on Meandu Creek Dam (W3) and on Meandu Creek downstream of Meandu Creek Dam (W2 and SW16) from 1984–2017

APPENDIX E

RAW WATER QUALITY DATA