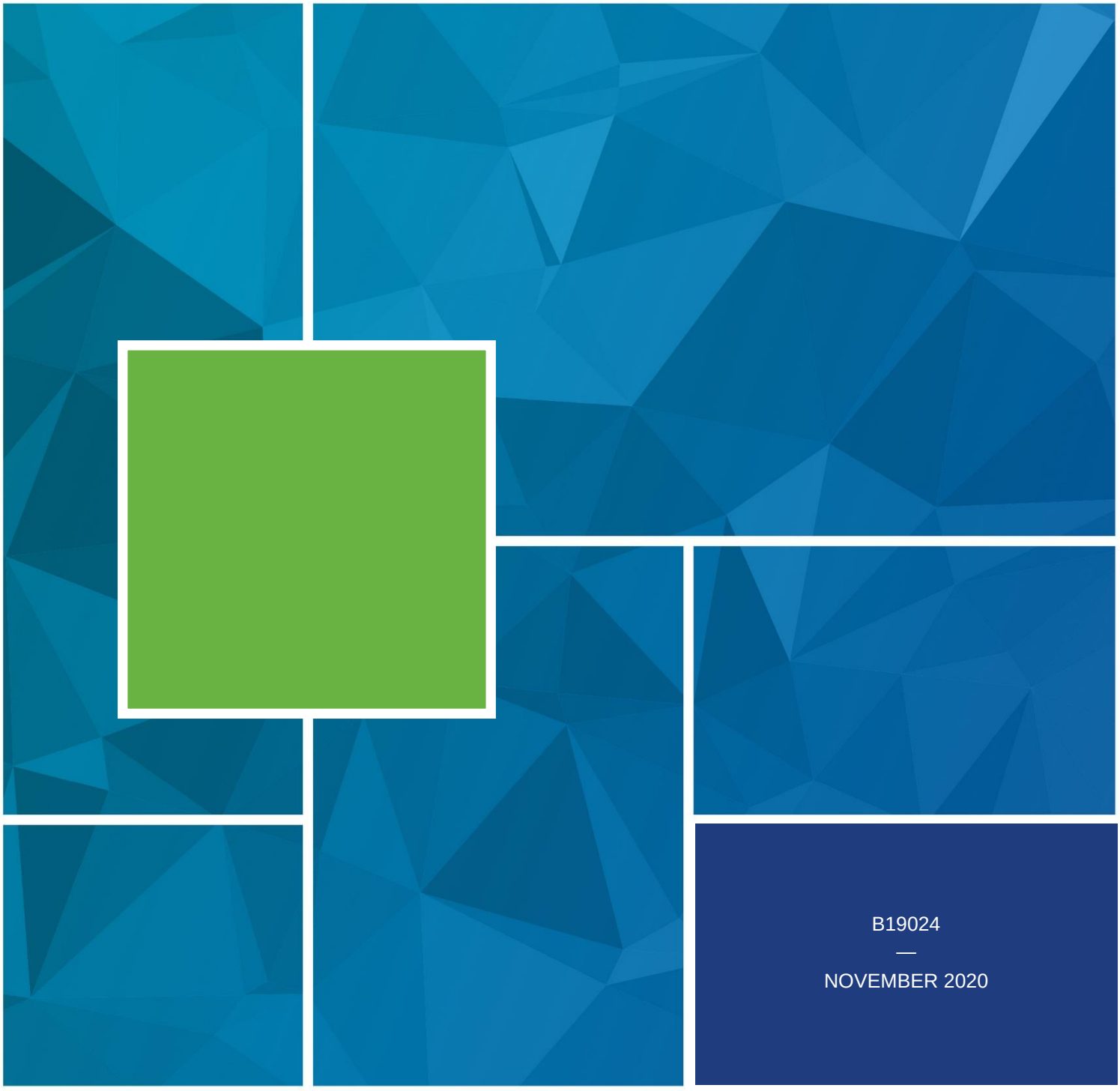
Hydrobiology

RUM JUNGLE SURFACE WATER QUALITY DATA SUMMARIES

BRISBANE | PERTH | SINGAPORE | PAPUA NEW GUINEA

PREPARED FOR NTDITT



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NOVEMBER 2020

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contents

1. INTRODUCTION AND OBJECTIVES

The Northern Territory Environment Protection Authority (NTEPA) has requested supplementary information to the draft environmental impact assessment provided by the Department of Industry, Tourism and Trade (DITT) for the rehabilitation of the former Rum Jungle mine. The aim of this report is to provide:

- A summary of current water quality data, specifying locally derived water quality objectives (LDWQOs) and trigger values in the format provided in Table 3 of the request for information document (including data collected between 2010-2020);
- A summary of trends in water quality over time as graphs.
- A summary table for each Finniss River zone (1-7).

These summaries aim to clarify and ensure that the proposed LDWQOs meet the requirements for environmental approvals and waste discharge licencing.

2. METHODS

2.1 DATA COLLATION

Surface water data were provided by DITT for 18 out of the 19 parameters requested by NTEPA for the period between 2010 and 2020. Total suspended solids were not included in the set of analyses performed as part of the historical monitoring of the Finniss River. All other parameters (electroconductivity (EC), pH, dissolved oxygen (DO), turbidity, alkalinity, sulphate (SO_4), aluminium (Al), arsenic (As), cadmium (Cd), copper (Cu), cobalt (Co), iron (Fe), magnesium (Mg), manganese (Mn), nickel (Ni), lead (Pb), zinc (Zn) and uranium (U)) were reported and included in this report. It is noted that:

- Most of the data were collected after 2013;
- DO concentrations were provided in mg/L, thus they were converted to percent saturation using the temperature measured for each sample;
- SO_4 concentrations were not available for Zone 5;
- No data were provided from Zone 8 and 9 (included in the NTEPA request for supplementary information) because DITT has not undertaken monitoring of water quality in those zones to date.

The raw data used in this report are available in Excel format.

2.2 TEMPORAL TRENDS

The provided data were plotted on graphs using the statistical program R. Temporal graphs presented in Appendix A in this report are scatter plots of the data overlayed with a smoothing generalized additive model (GAM) indicating temporal trends for the wet (from November to March) and dry (from April to October) season.

2.3 STATISTICAL SUMMARIES

All data collated were split into two seasons (dry and wet, as described above). The statistical summaries presented in the tables in Appendix B, include minimum, maximum and standard deviation based on the original dataset. For the calculation of median and percentiles, additional data processing was performed, as follows.

A preliminary assessment of the data collected over the last 10 years suggested that they were biased by accessibility of sites (e.g. no sampling was performed if the site could not be accessed due to flooding) and availability of water on the day of sampling (e.g. creek drying out in the late dry season with empty pools sometimes observed into the early wet season months). That is, the distribution of samples in the database was dictated by a routine sampling frequency and local site conditions at the time of sampling, rather than necessarily representing the presence and quality of water within the zone as a whole. This bias was observed especially at sites in the East Branch (Zones 1 to 4), and particularly in the dry season, and resulted in biased percentile calculations, by under-representation of water quality late in the dry season. In order to provide statistical summaries more closely representing real organism exposure in each zone, the data were used to derive a more balanced representation of parameter concentrations via methods developed in collaboration with the statistician Dr David Fox[1]. This was done using the Excel add-on @RISK to simulate random data as per the following stepwise process:

1. The distributions of data for each zone and each month within a zone were determined;
2. The probability of water being available for sampling on each month within a zone was estimated on a conditional ruling basis[2]. The reason for the conditional ruling approach was associated with gaps in the datasets, preventing the computation of low probability for months for which no data were available. The conditional ruling approach adopted was:
    - Mid-wet season to early dry season months (from January to May) were always wet. Therefore, each month was given equal weight in the modelled dataset;
    - For other months of the year:
        - Main Finniss zones (Zones 5, 6, 7): water is known to occur all year in the perennial main branch of the Finniss River. Therefore, each month was given equal weight in the modelled dataset;
        - East Branch zones (Zones 1, 2, 3, 4):
            - if no data were provided for a given month over the 10 years of data, the entire Zone was assumed dry in all years, therefore it was not accounted for in the dataset;
            - if some data were provided for a given month over the 10 years of data:
                - For ≥5 of the 10 years: it was assumed water was available most of the time, therefore these months weighed equally to other months
                - For <5 of the 10 years: a degressive probability was applied across the remaining months (e.g. if June/July had ≥5 years of data, August/September <5 years, October = 0 data, the probabilities were as follows for the complete dry season: 1/5 for April,

[1] Dr Fox was instrumental in the development of the standard approach for assessing physical and chemical parameters by comparing the test site median with the reference site or baseline 80th percentile under ANZECC/ARMCANZ (2000), and so he has a deep understanding of the intent of that approach and its applicability in temporary waters.
[2] Dr Fox suggested that the existing dataset could be used to estimate the probability of occurrence of water using a distribution fitting approach, but the inherent bias in dry season water sample collection meant that such a distribution fit would be unreliable unless another dataset was available to demonstrate the probability of water presence at the Zone level. However, no such datasets were identified and so the conditional ruling was developed based on knowledge from Hydrobiology's past sampling of the East Branch.

1/5 for May, 1/5 for June, 1/5 for July, 1/5*3/4 for August, 1/5*1/4 for September, 0 for October)

3. A 10,000 value simulation was performed by which values were randomly generated for each zone and season based on their respective monthly distributions and the probability of water being available; and
4. The summary statistics (median, 20th, 80th and 95th percentiles) were extracted from the simulated data for each zone and season.

In this way, the tendency for the highest concentrations of many parameters to occur late in the dry season or during the first flushes in the wet season, but for short periods of time, was accounted for by describing the probability distribution of the parameter concentrations in each month (including the tails of the distribution) and accounting for the probability that water would persist within a zone even though it was not necessarily found at the fixed sampling sites on the fixed dates of sampling. However, the more “typical” water quality characteristics of the bulk of the wet season and early dry season were also accounted for and proportionally represented in the simulation.

3. RESULTS

3.1 SURFACE WATER QUALITY TEMPORAL TRENDS

Temporal trends for each parameter are represented graphically in Appendix A. They are displayed per season and per zone.

3.2 DATA SUMMARIES

Data summaries for each Finniss River zone for which surface water data were collected between 2010-2020 (i.e. Zone 1 to 7) are presented in Appendix B.

4. DISCUSSION

The development of the LDWQOs pre-dated the release of the ANZG (2018), but their development was entirely consistent with the Water Quality Management Framework (WQMF) of ANZG (2018), and specifically the guidance provided for use of the framework for a remediation project (https://www.waterquality.gov.au/anz-guidelines/framework/remediation-study).

Hydrobiology (2013) summarised available knowledge at the time regarding ecosystem condition (Step 1 of the WQMF), and in consultation with key stakeholders, particularly the traditional owner groups, identified the applicable community values (=environmental values) for each zone and levels of protection for each zone. Note that there was acknowledged to be some need for pragmatism in the allocation of levels of protection. Despite the expertise used and the expense of the 1986 rehabilitation of the mine, water quality in the East Branch in 2012/2013 was much poorer than the then ANZECC/ARMCANZ (2000) default guideline values for several parameters, and it was acknowledged that designing a rehabilitation to achieve the default level of protection for slightly to moderately disturbed systems of 95% of species would be prohibitively difficult and costly. Instead, in keeping with the intent of the Guidelines for highly disturbed systems, lesser levels of protection were agreed to that still amounted to very substantial improvement.

The levels of protection that were agreed to with the stakeholders was <80% species protection for Zone 2 (in practice, a value of 70% was used), 80% protection for Zone 3 and 90% protection for Zone 4, with 95% protection applied to all other zones. These agreements on community values and levels of protection were consistent with Step 2 of the WQMF.

Hydrobiology (2013) then selected a number of parameters known to be relevant (Step 3 of the WQMF) and applied the agreed levels of protection to identify appropriate water quality guideline values for each parameter for each zone (Step 4 of the WQMF) using the ANZECC/ARMANZ (2000)

default guideline values for each level of protection. For 70% protection that meant using the database and software provided with ANZECC/ARMCANZ (2000) to calculate the guideline values for that level of protection. These guideline values were taken back to the stakeholders, and agreed to, making them the first iteration of water quality objectives for the rehabilitation (Step 5 of the WQMF).

Subsequently, Hydrobiology (2016a, 2016b) conducted sampling of the aquatic biota of zones 1 to 7, and using this information and water quality monitoring conducted by DITT, Hydrobiology (2016c) undertook an impact assessment (Step 6 of the WQMF) and refined the water quality objectives by using the ecosystem condition data to derive site specific guideline values (Step 7 of the WQMF and consistent with the preference under ANZG (2018) for development of site specific Guideline Values. See https://www.waterquality.gov.au/anz-guidelines/guideline-values).

These values were taken back to the stakeholders and agreed to (that is, consistent with the decision at Step 7 to refine the water quality objectives, by returning to Steps 3 and 4 with the information gained at Step 6, and resulting in agreed refined water quality objectives at Step5). These refined Guideline Values then became the next, and latest iteration of the LDWQOs.

This summary, then highlights that the development of the LDWQOs was:

i) Consistent with the recommendations for use of the WQMF under ANZG (2018); and

ii) Intended to feed into design of the rehabilitation such that substantial improvement of the aquatic ecosystems of the East Branch could be achieved to the level agreed to with the stakeholders.

Under this application of the WQMF, design and implementation of the rehabilitation constitutes Step 8 of the WQMF – *Consider alternative management strategies*.

It is clear from the data summaries provided herein that achieving the LDWQOs for each zone would constitute a very substantial improvement of water quality compared with the water quality observed over the last decade of monitoring.

Note that under ANZG (2018), is it recommended that for toxicants the value to be compared with the water quality objective is the 95th percentile of the test data, not the 80th percentile (see https://www.waterquality.gov.au/anz-guidelines/monitoring/data-analysis/derivation-assessment), the latter being applicable to other types of physical and chemical parameters. Therefore, the 95th percentile has been added to the data summaries requested by the NTEPA in Appendix B.

Comparison of the applicable percentiles against the LDWQOs clearly shows how substantial the improvement aims of the rehabilitation are.

5. REFERENCES

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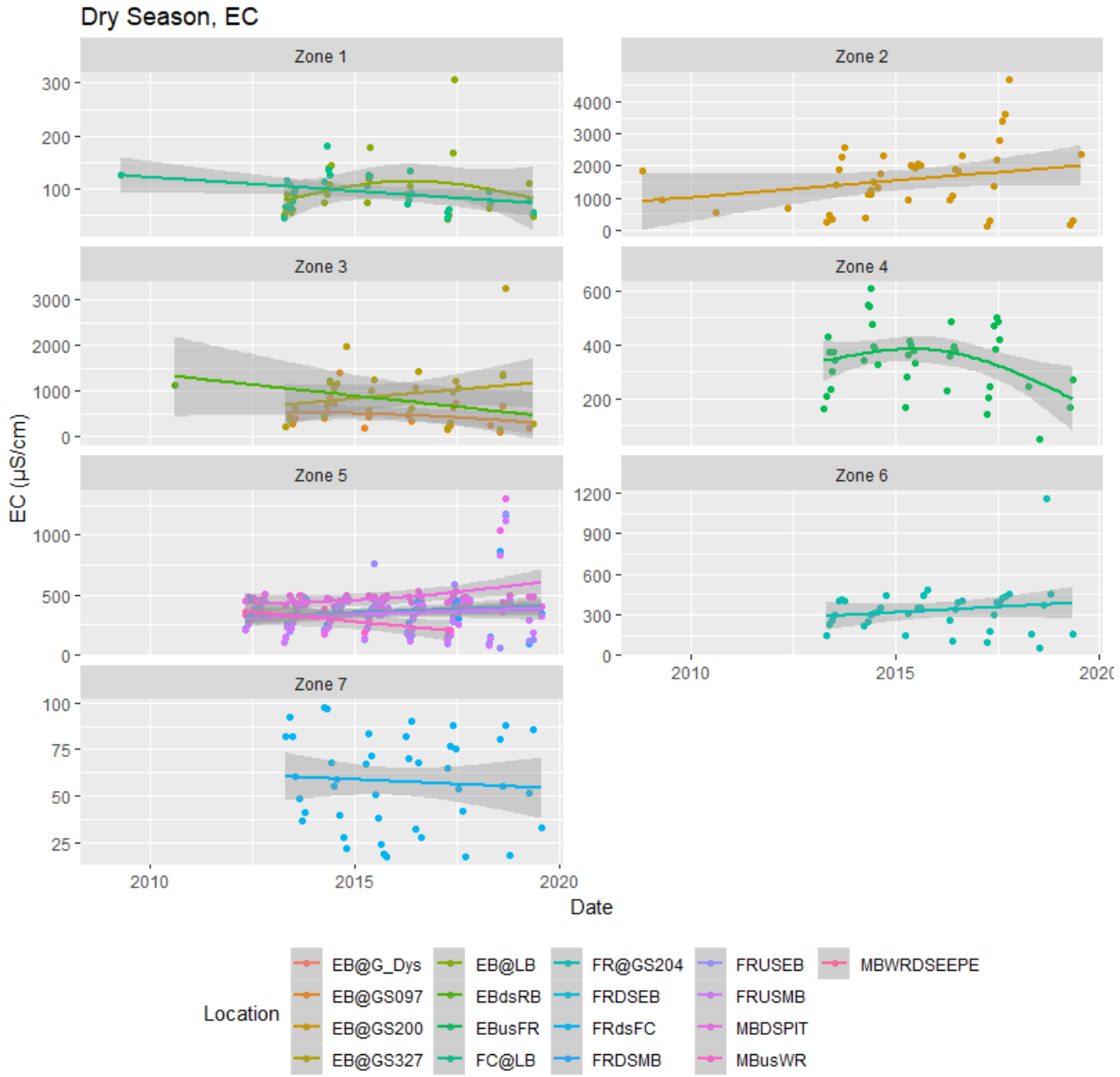
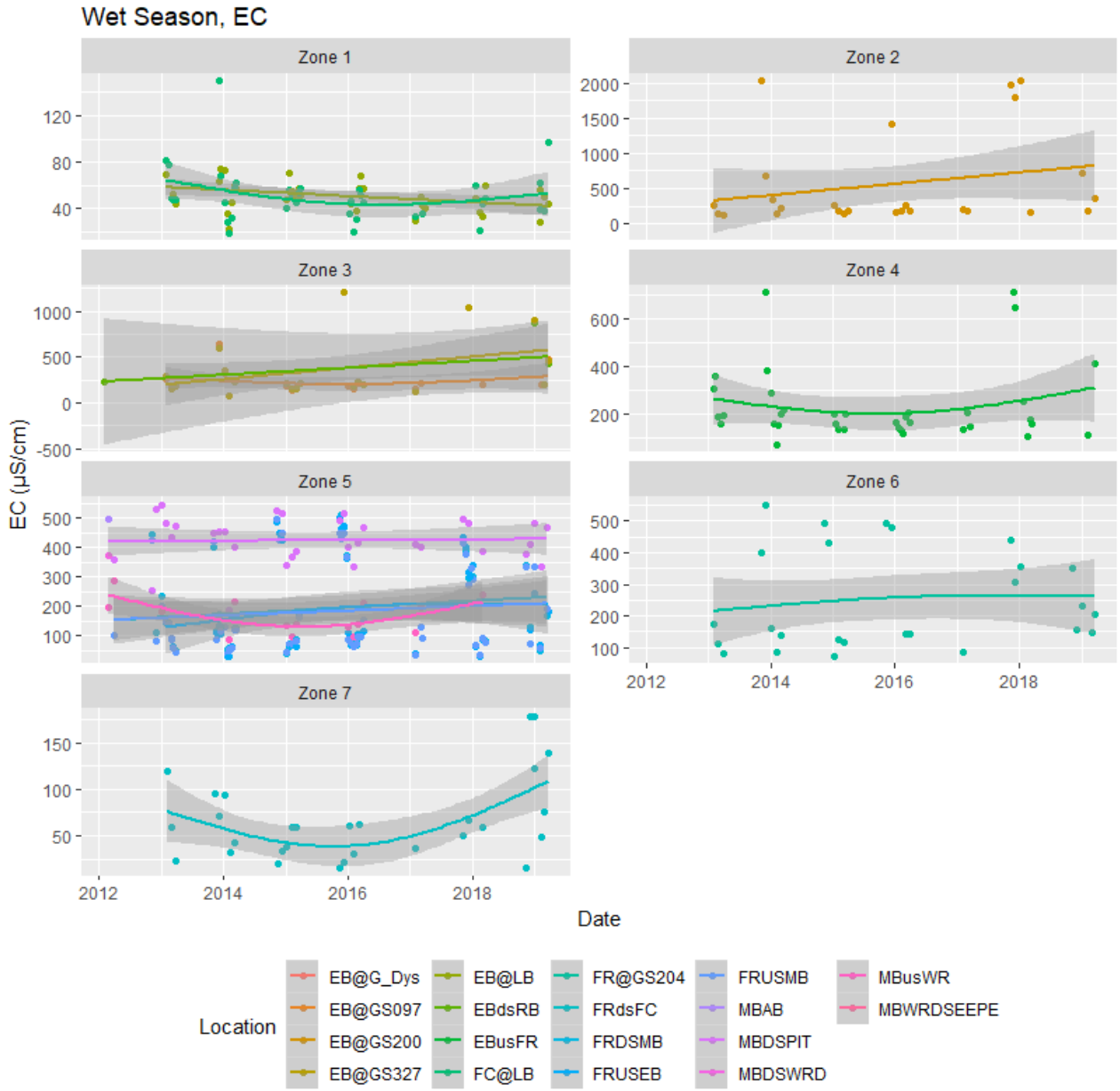
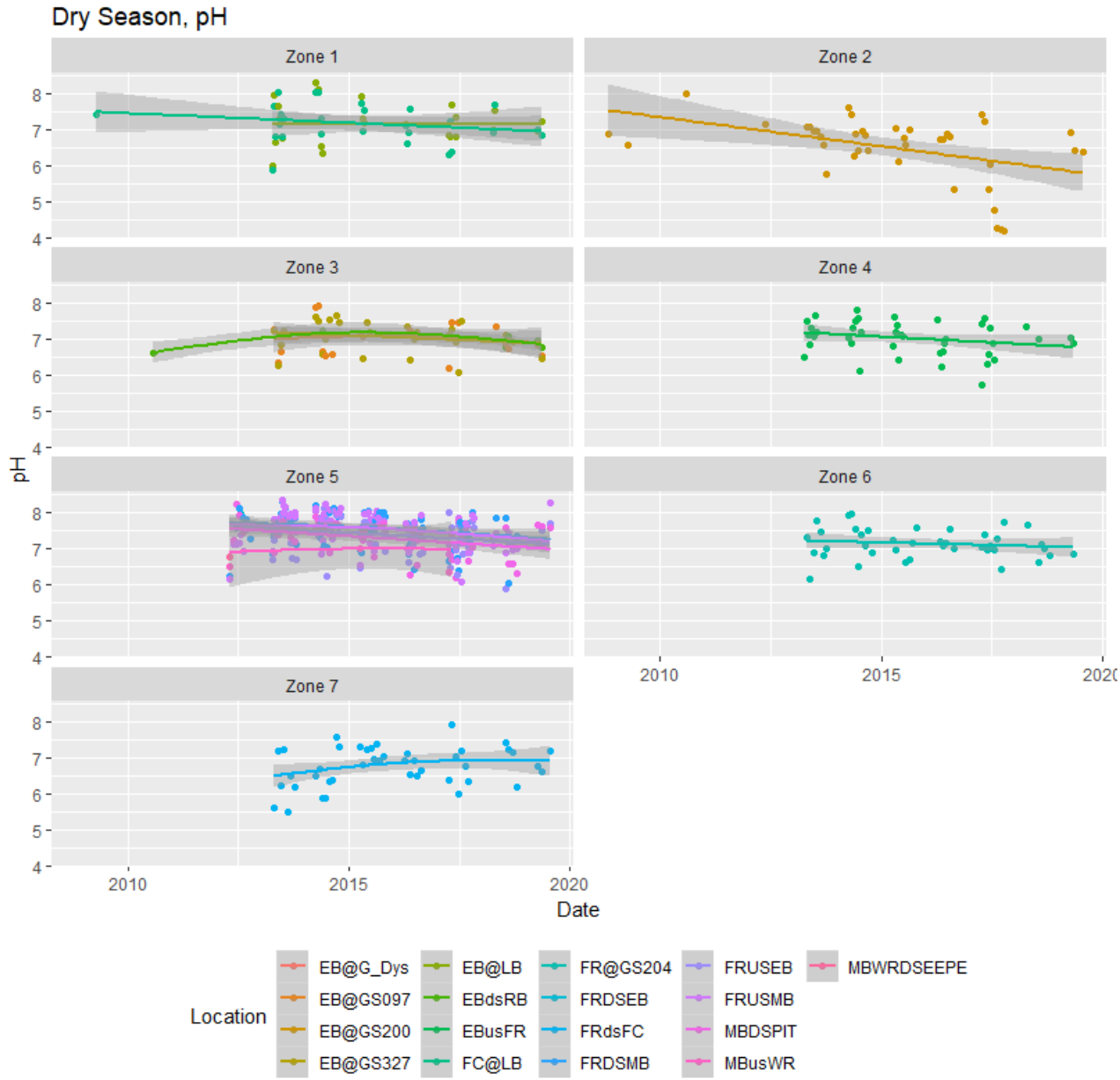
APPENDIX A. TEMPORAL TREND GRAPHS

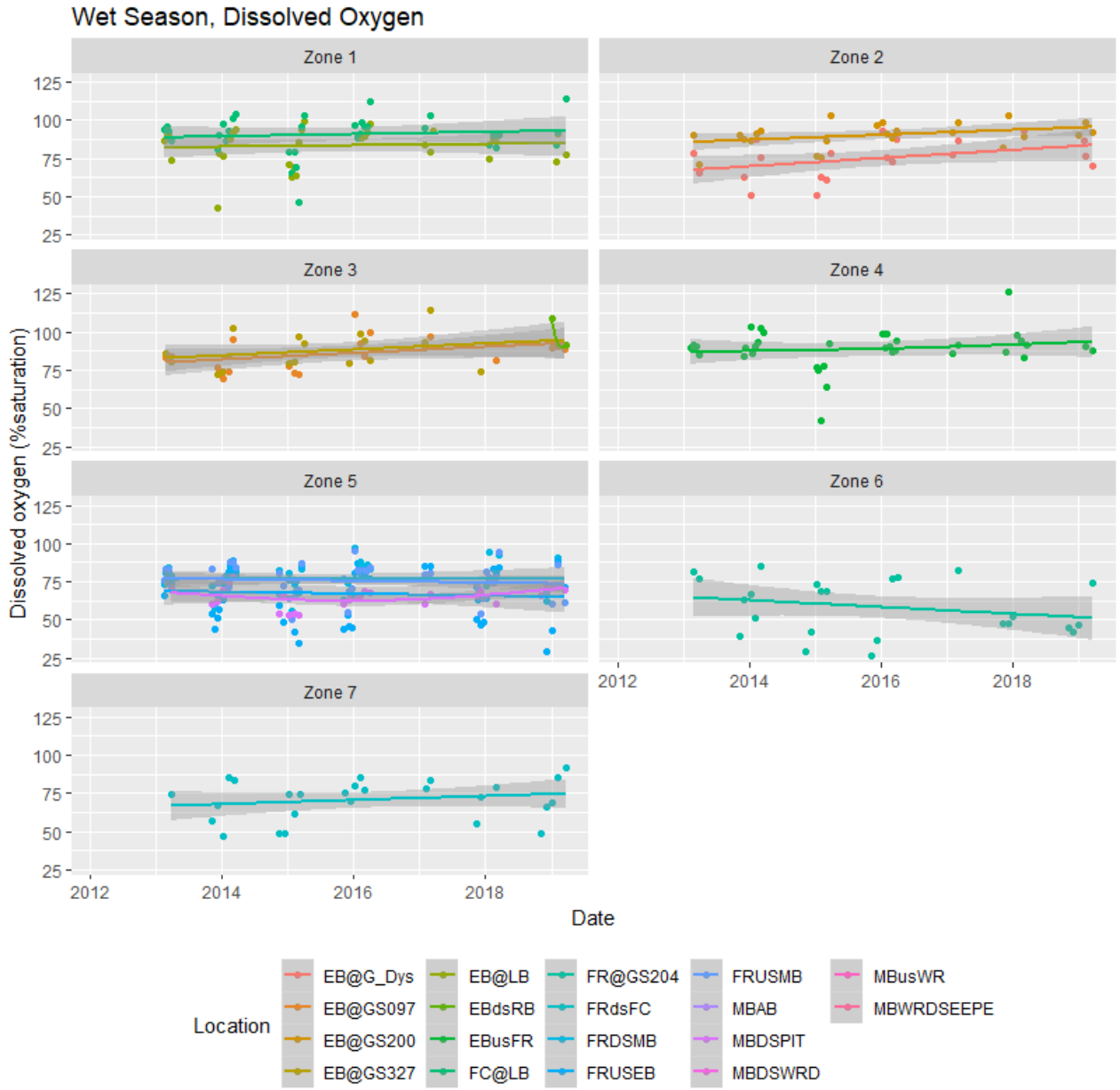

Dry Season, EC
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
EC (µS/cm)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

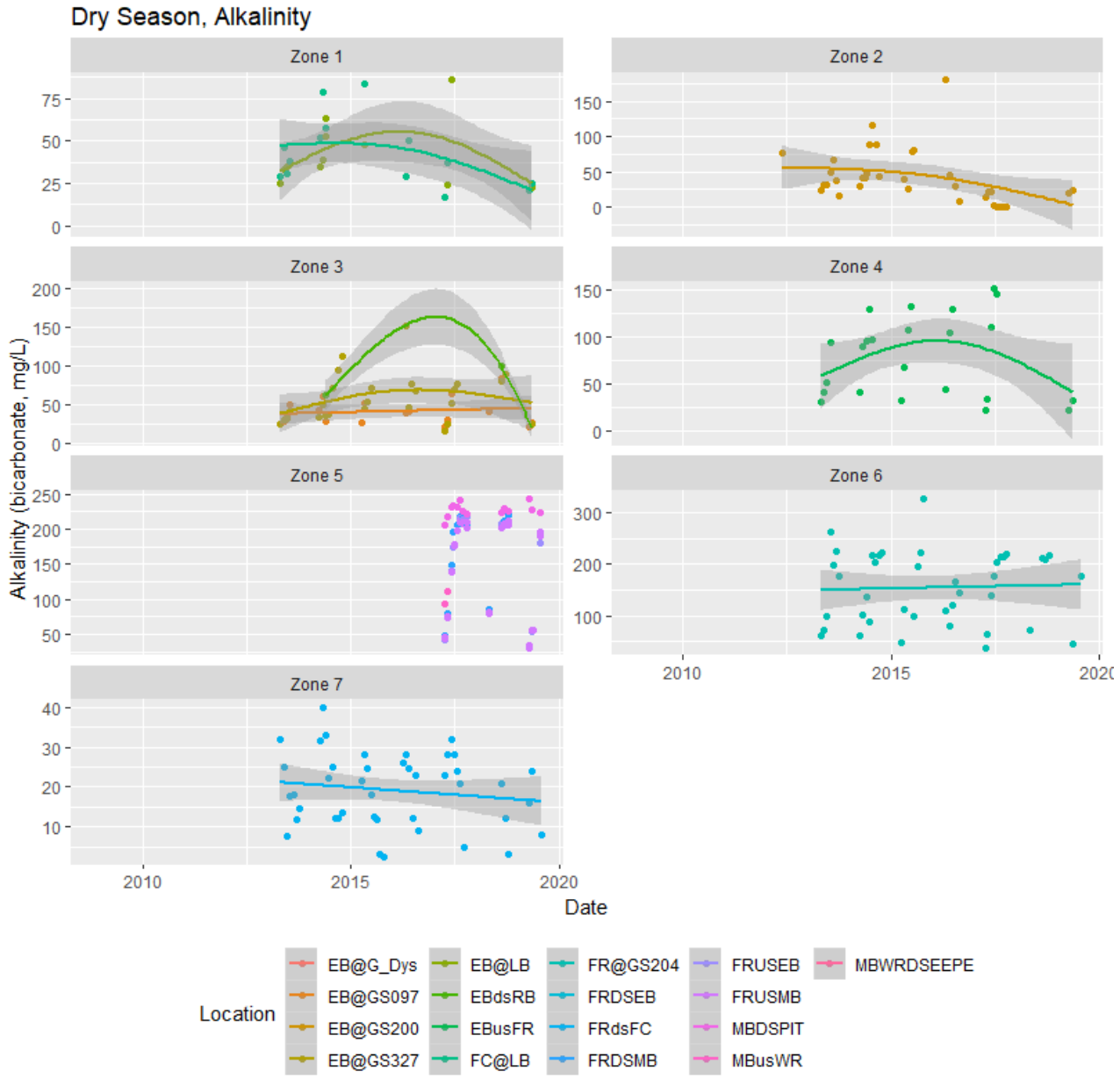

Wet Season, EC
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
EC (µS/cm)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

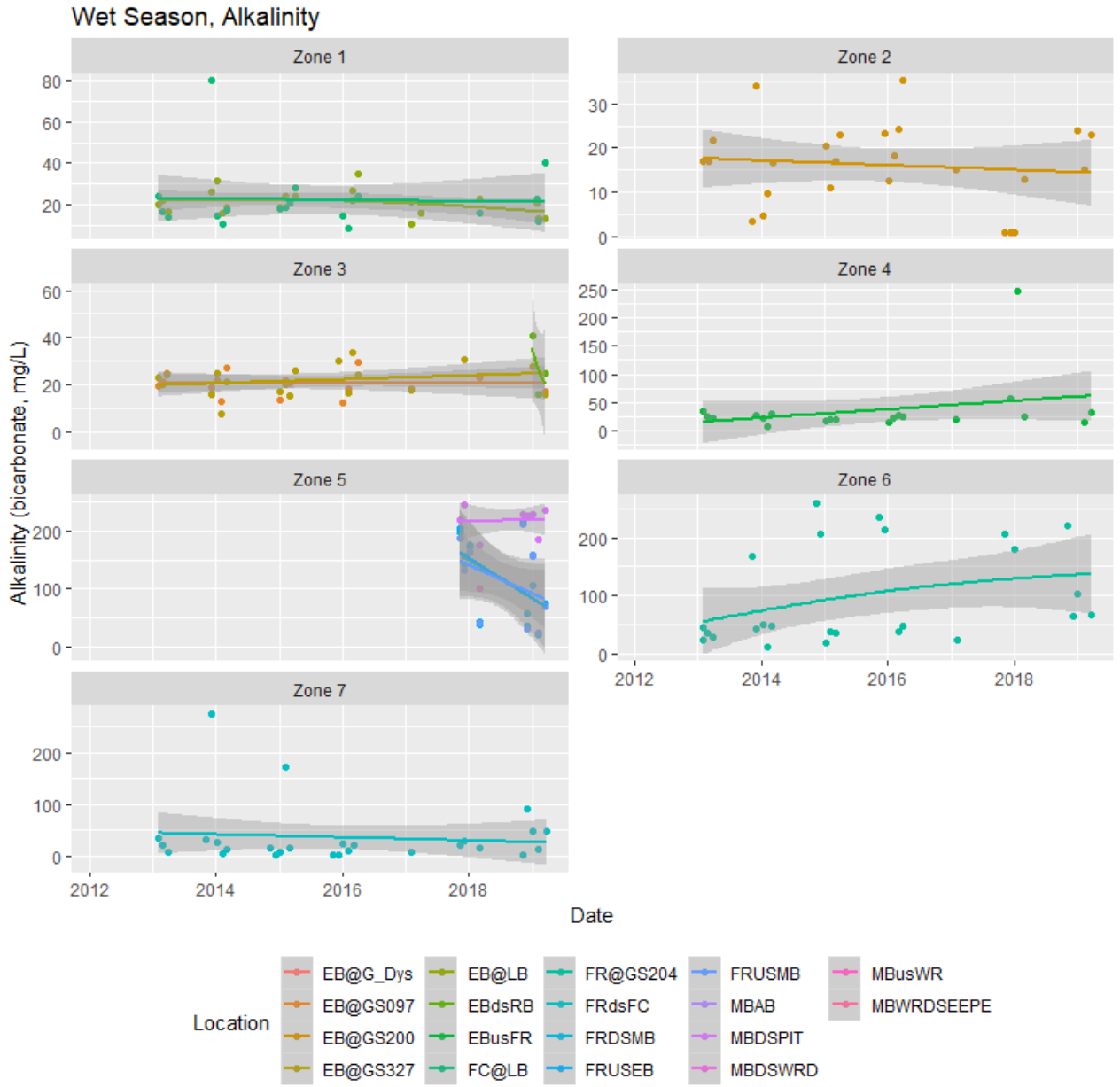

Dry Season, pH
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
pH
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

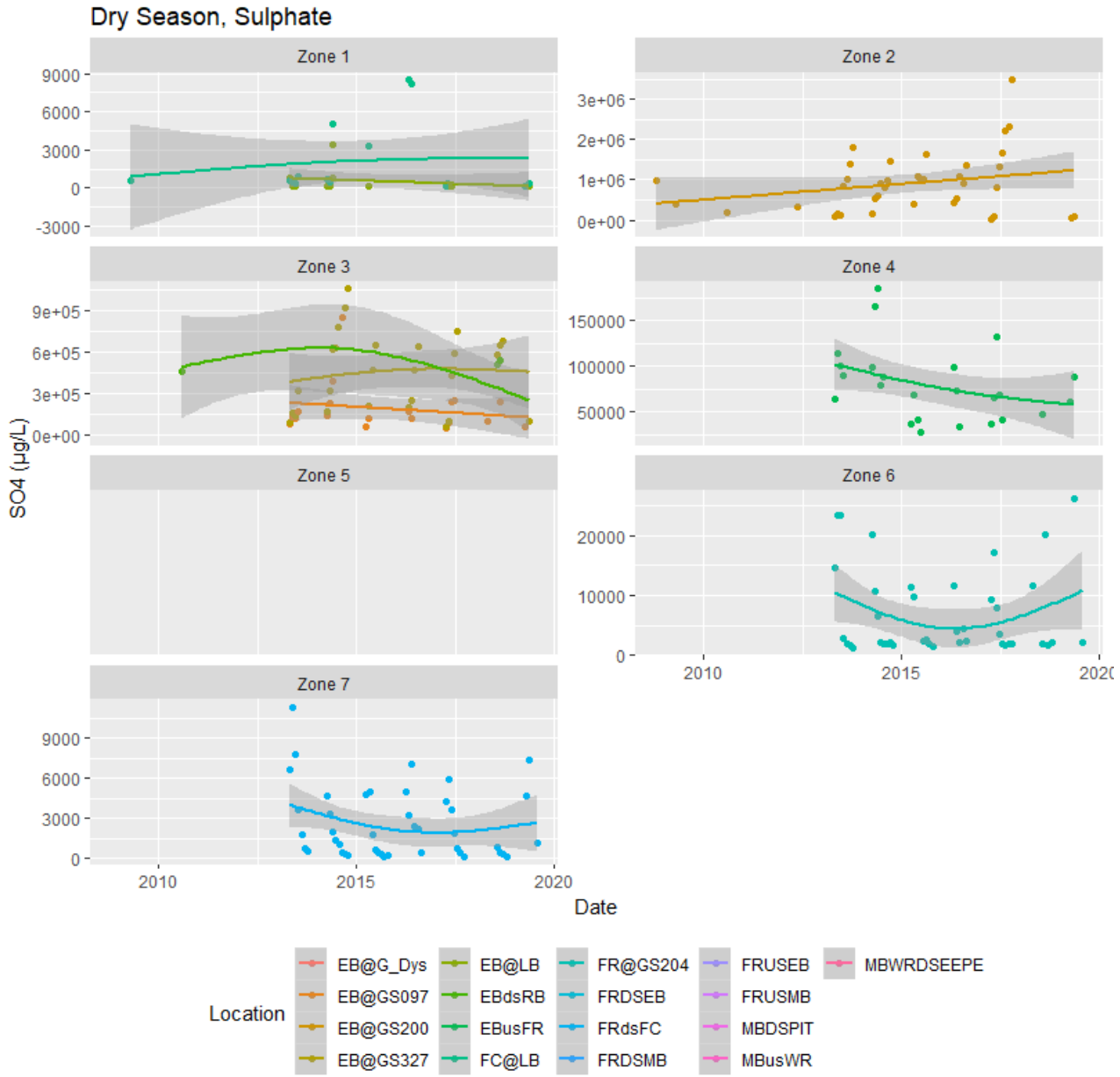

Wet Season, pH
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
pH
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

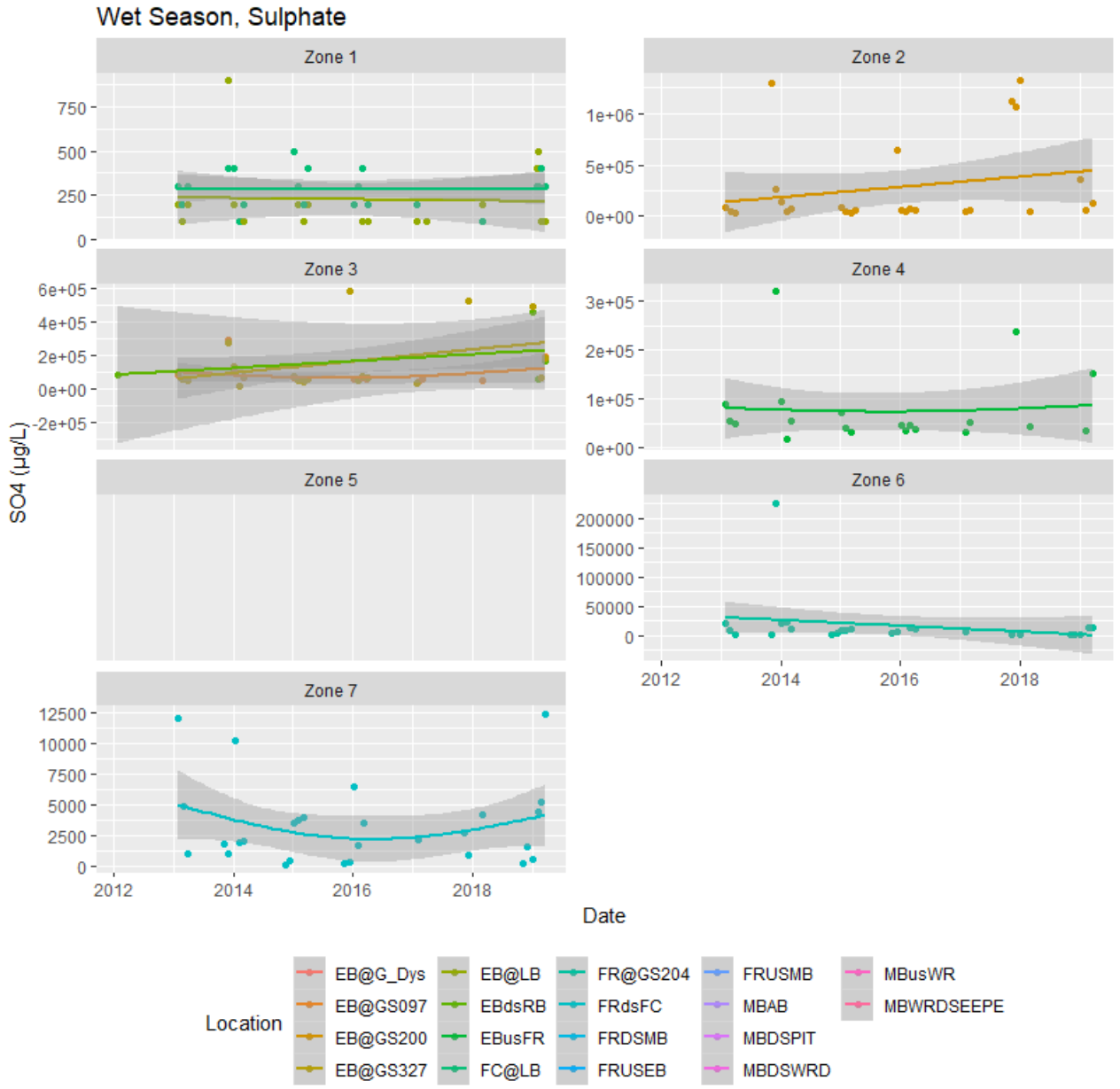

Dry Season, Dissolved Oxygen
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Dissolved oxygen (%saturation)
100
75
50
25
2010
2015
2020
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

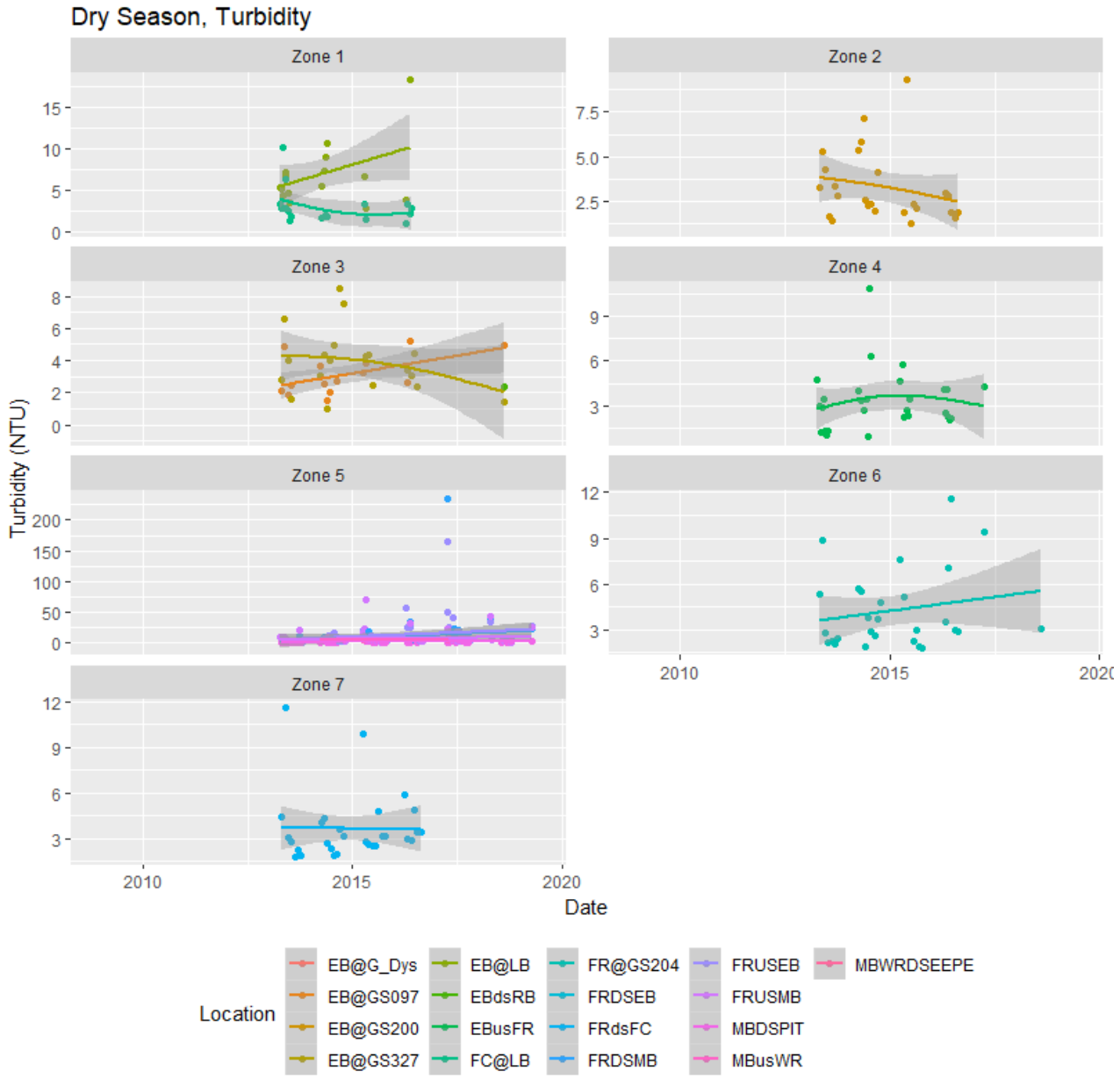

Wet Season, Dissolved Oxygen
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Dissolved oxygen (%saturation)
125
100
75
50
25
2012
2014
2016
2018
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

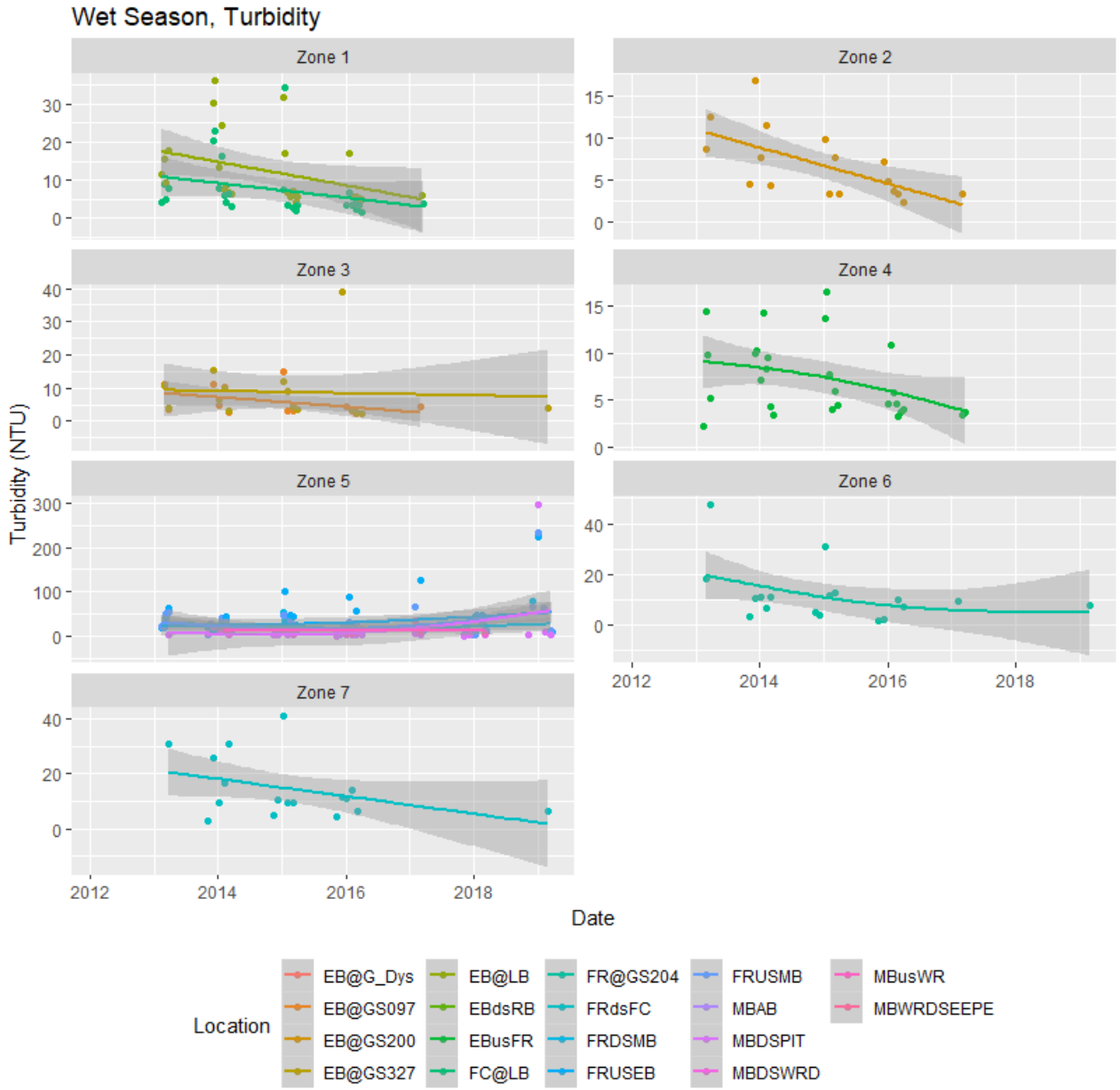

Dry Season, Alkalinity
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Alkalinity (bicarbonate, mg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

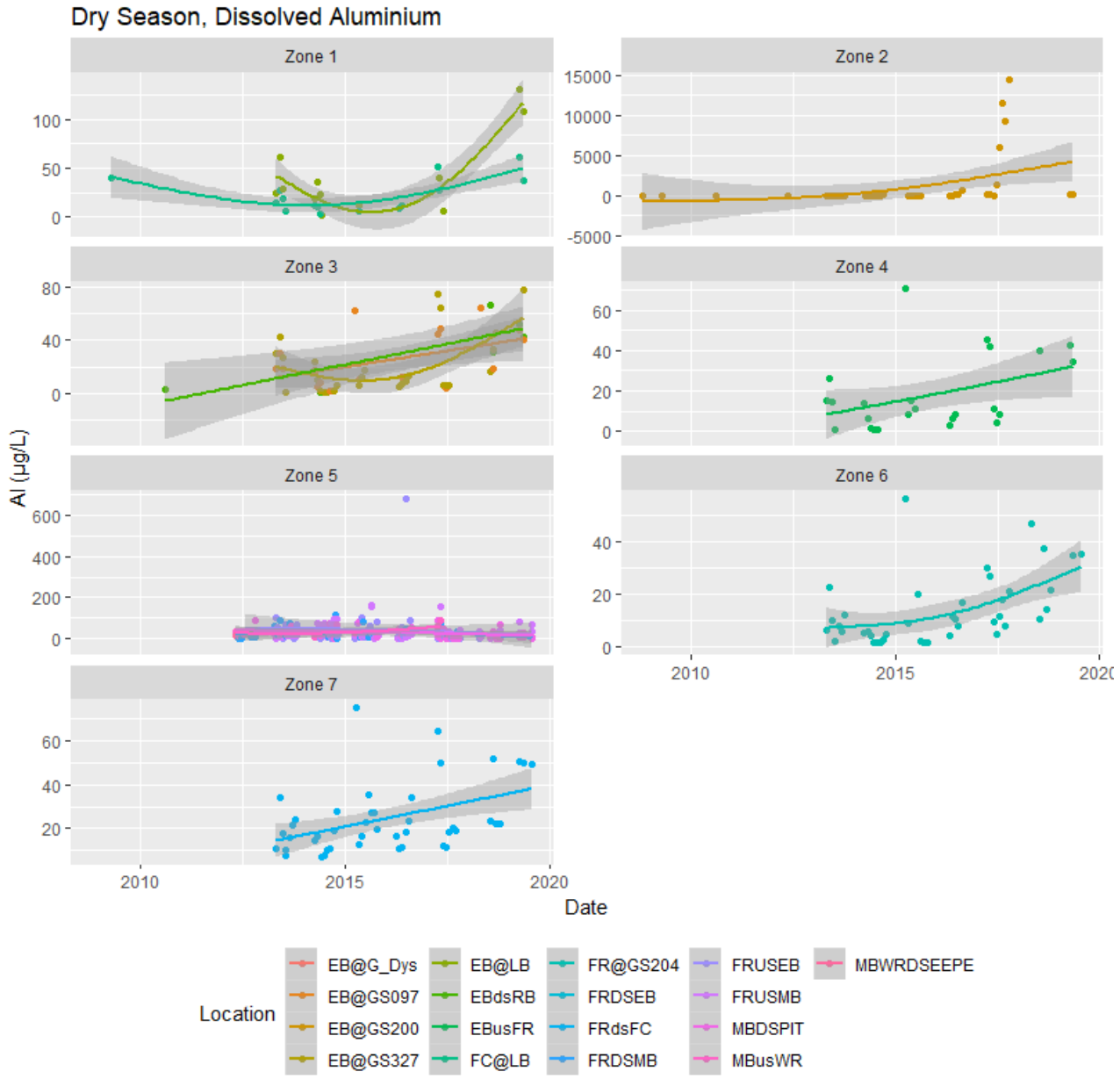

Wet Season, Alkalinity
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Alkalinity (bicarbonate, mg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

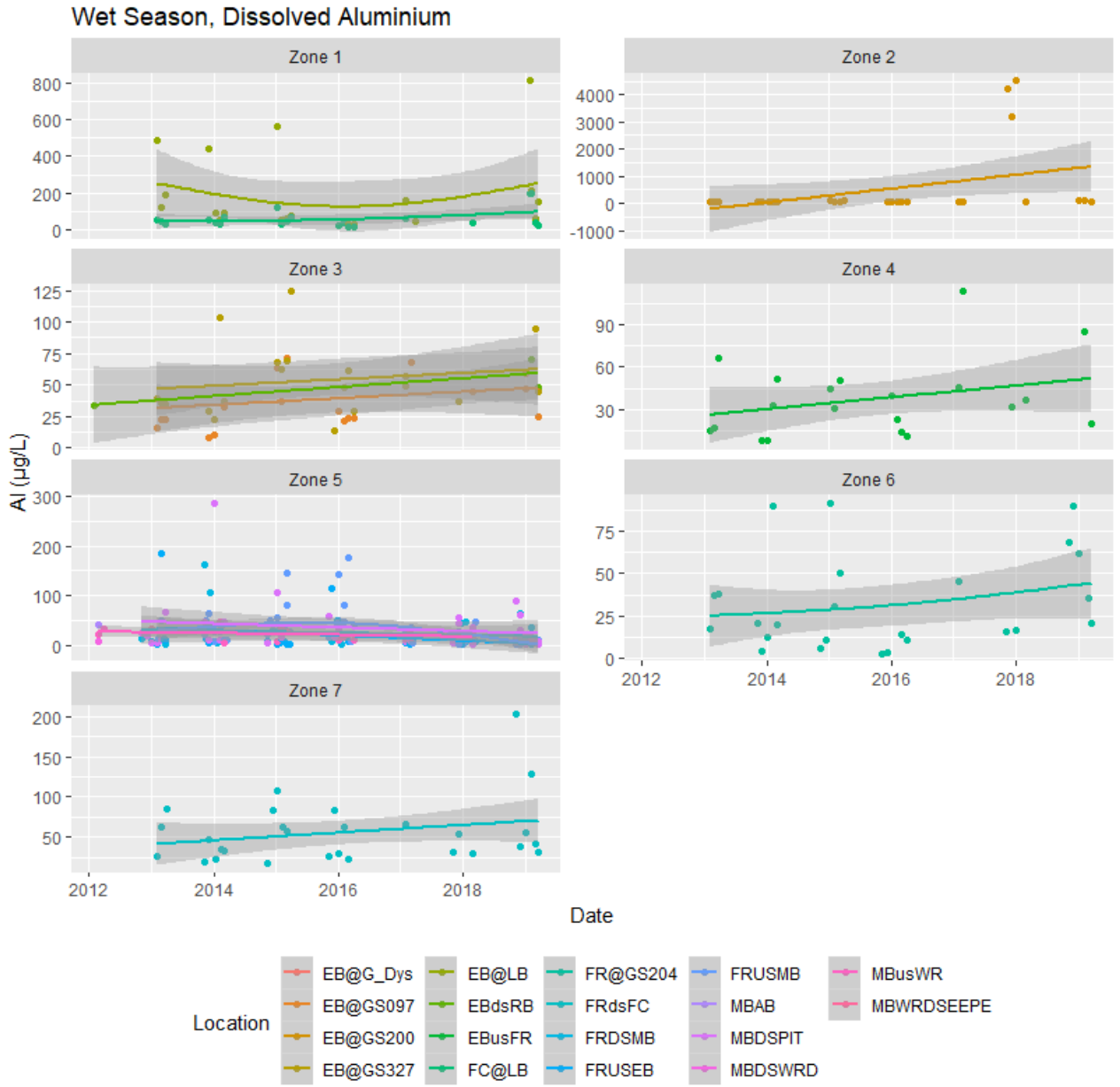

Dry Season, Sulphate
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
SO4 (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Sulphate
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
SO4 (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE


Dry Season, Turbidity
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Turbidity (NTU)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Turbidity
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Turbidity (NTU)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE


Dry Season, Dissolved Aluminium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Al (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Aluminium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Al (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
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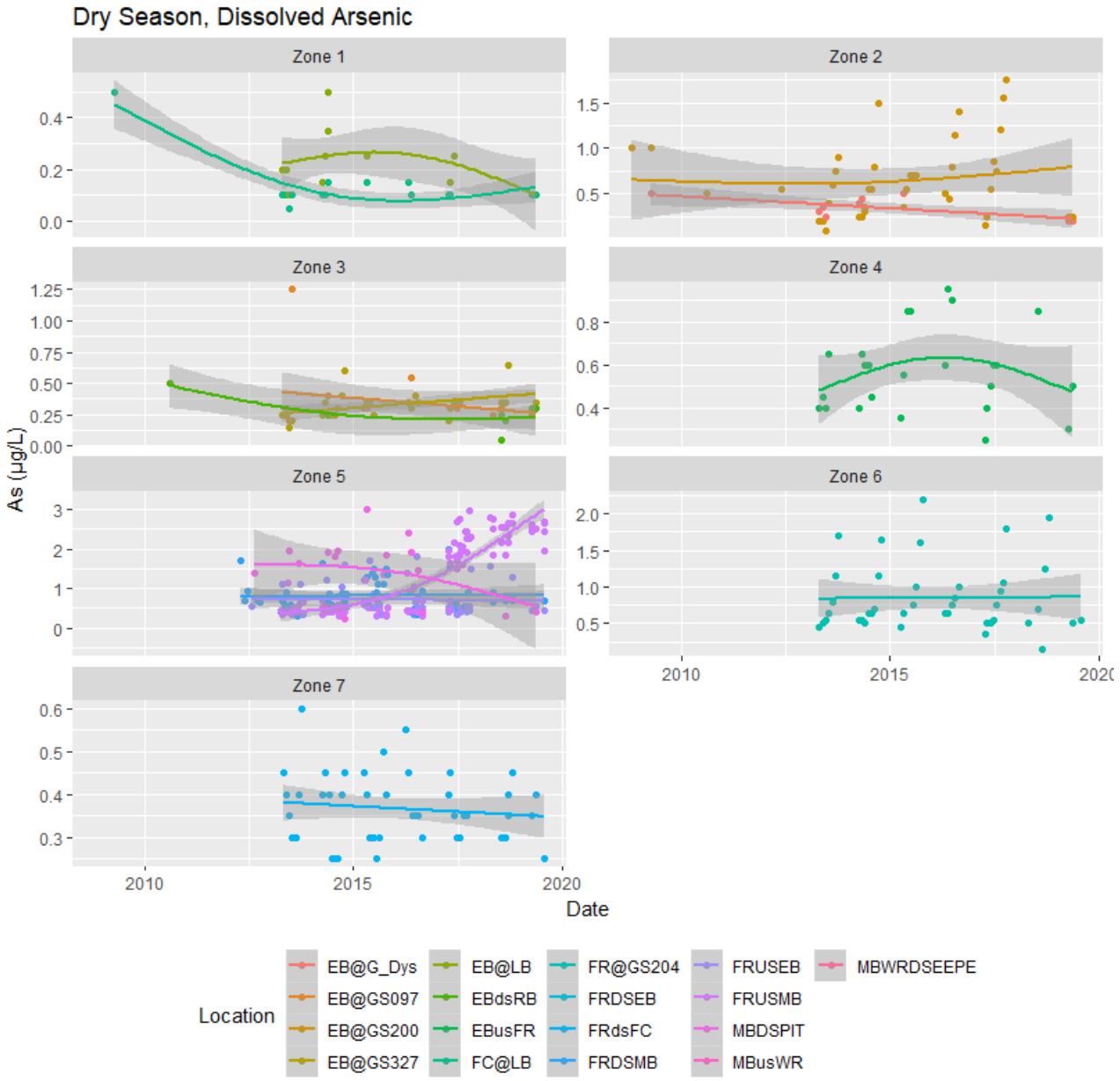
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE


Dry Season, Dissolved Arsenic
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
As (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
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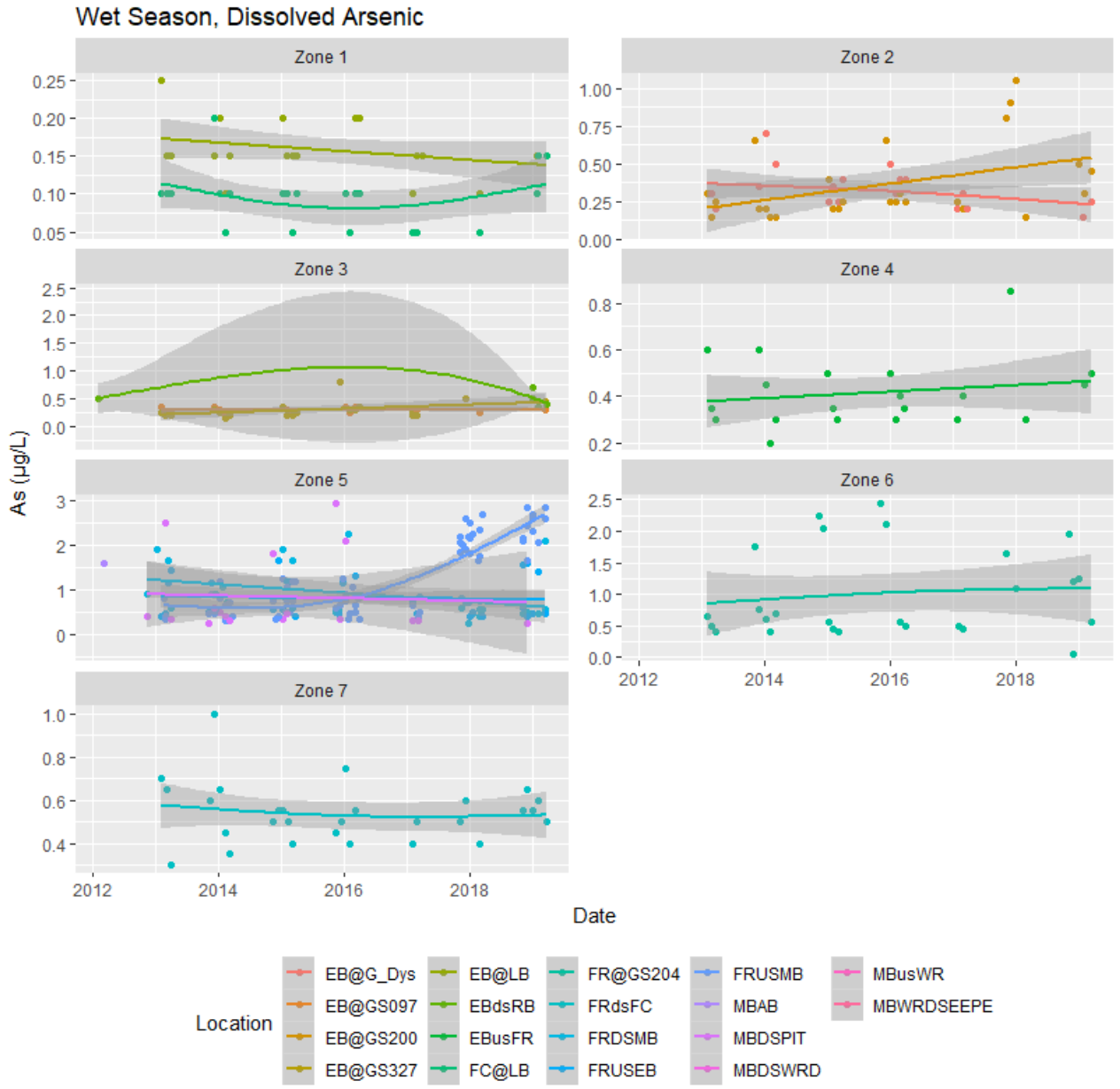
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Arsenic
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
As (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
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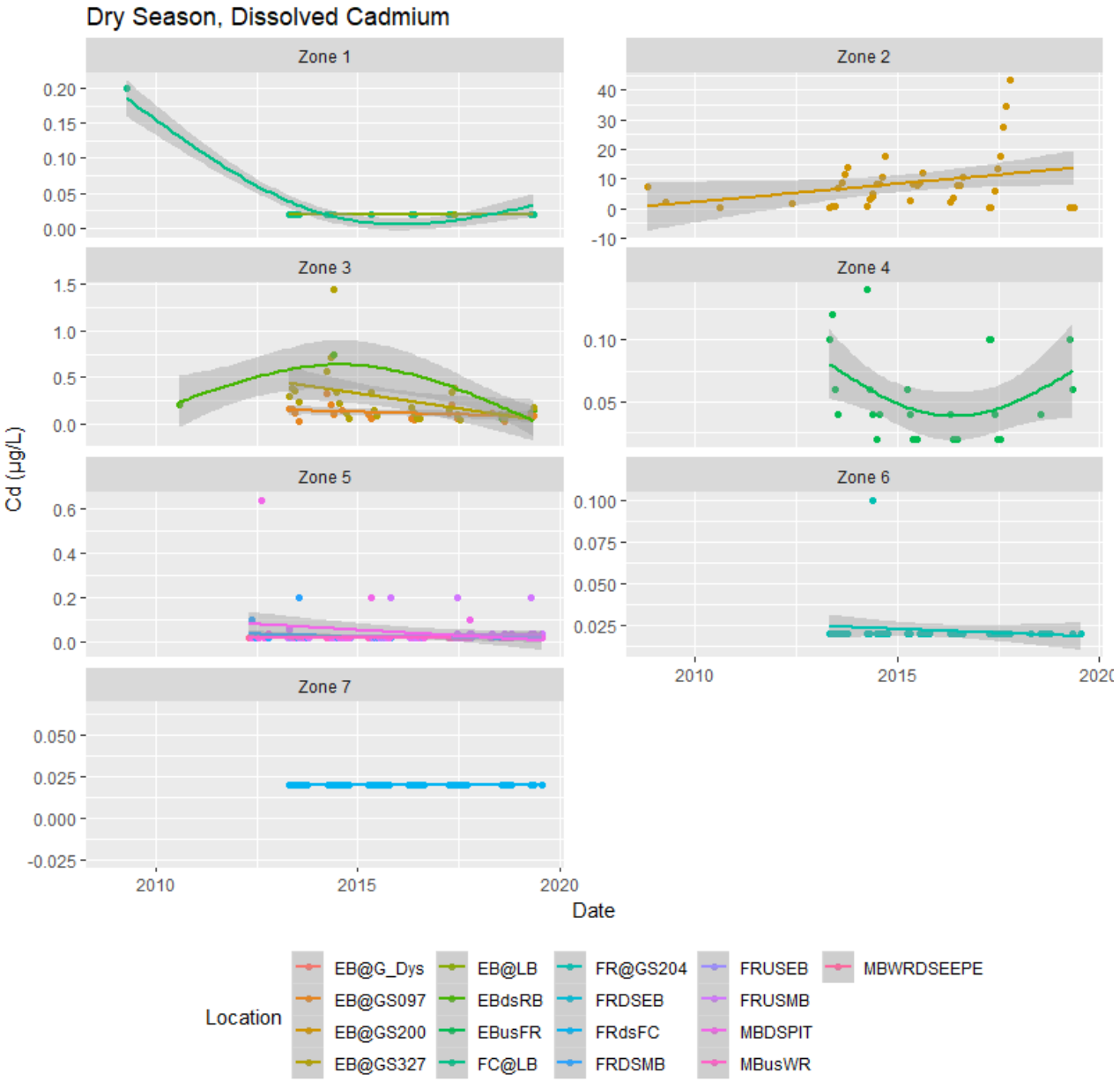
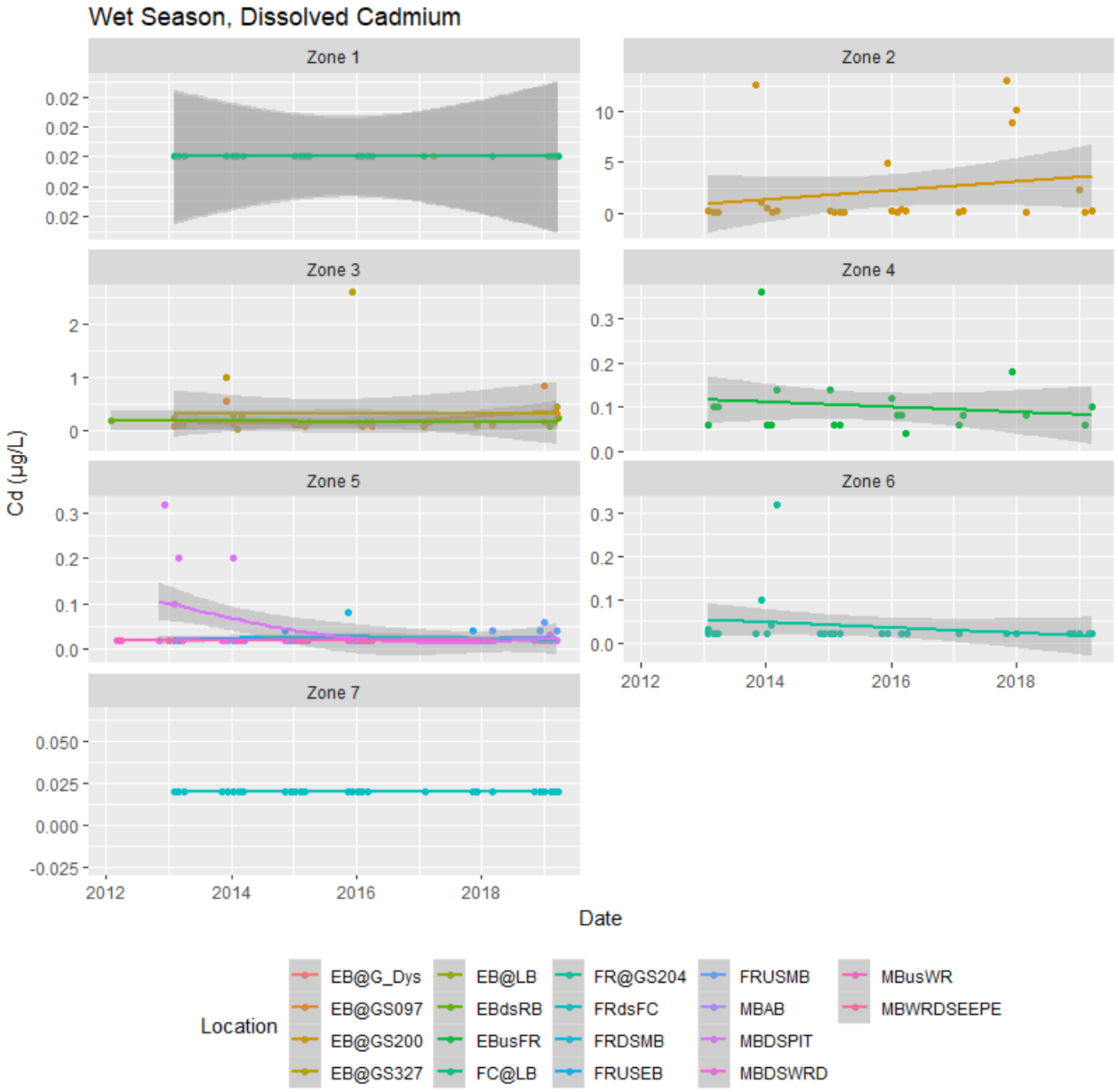
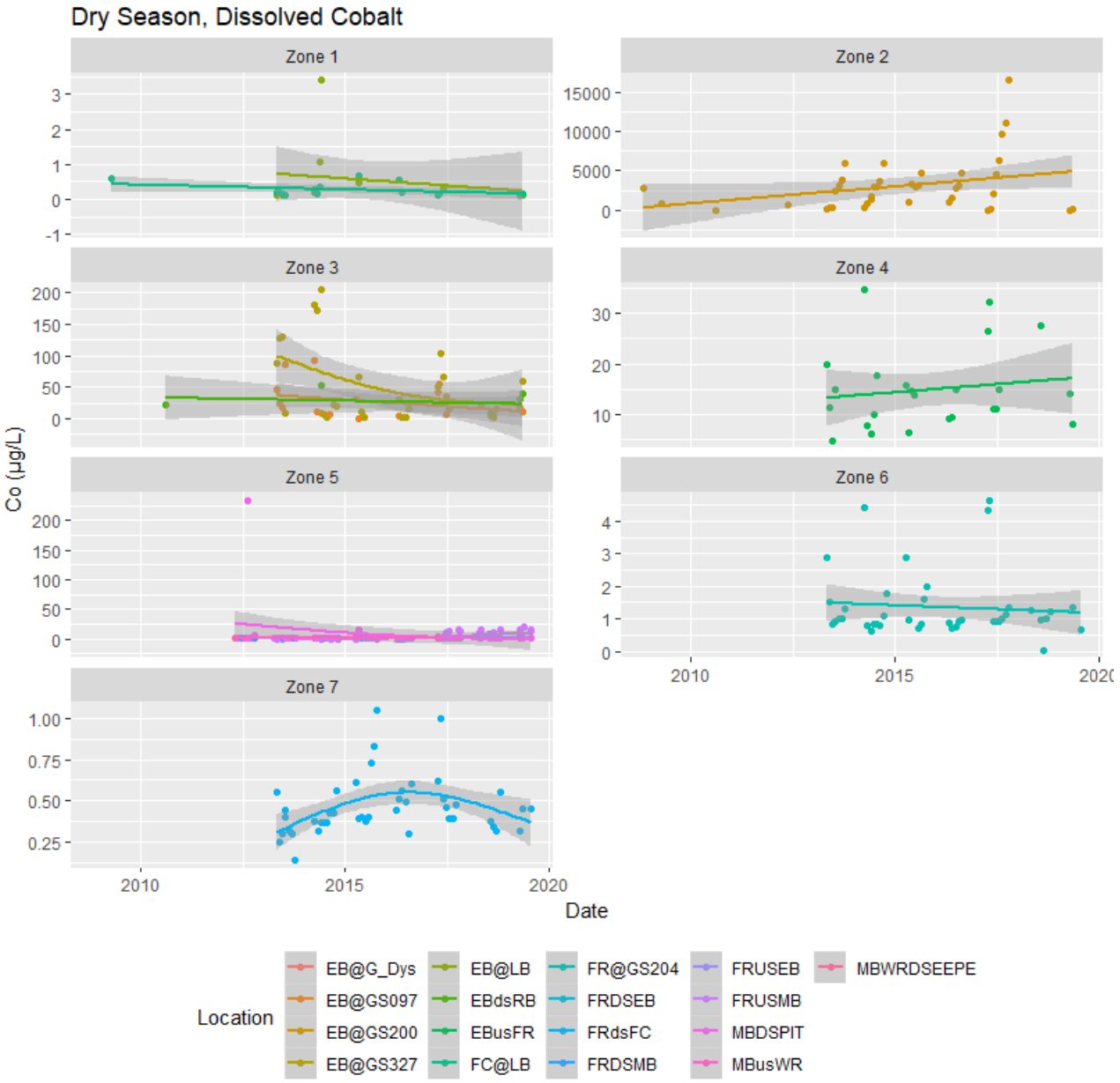
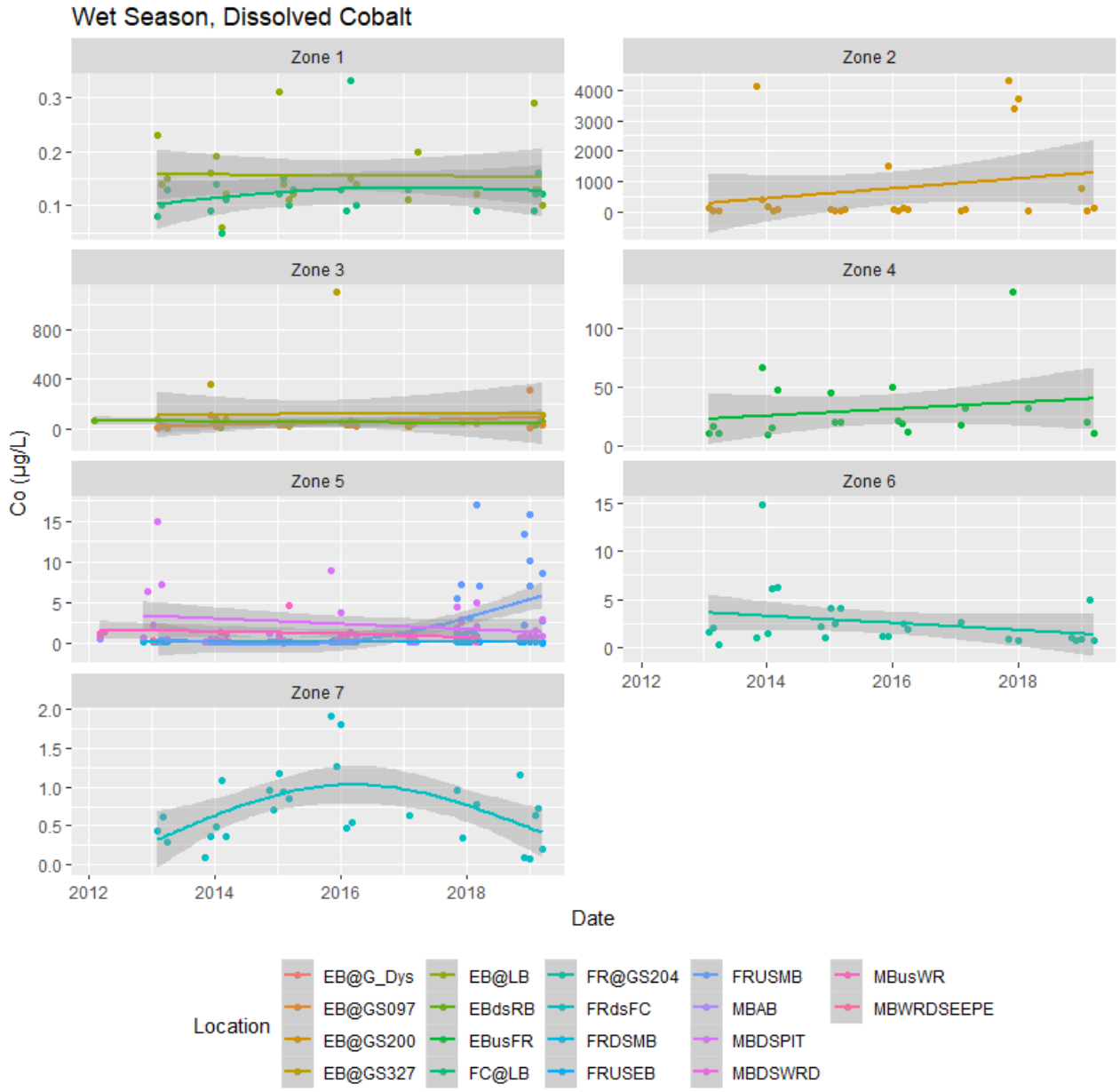
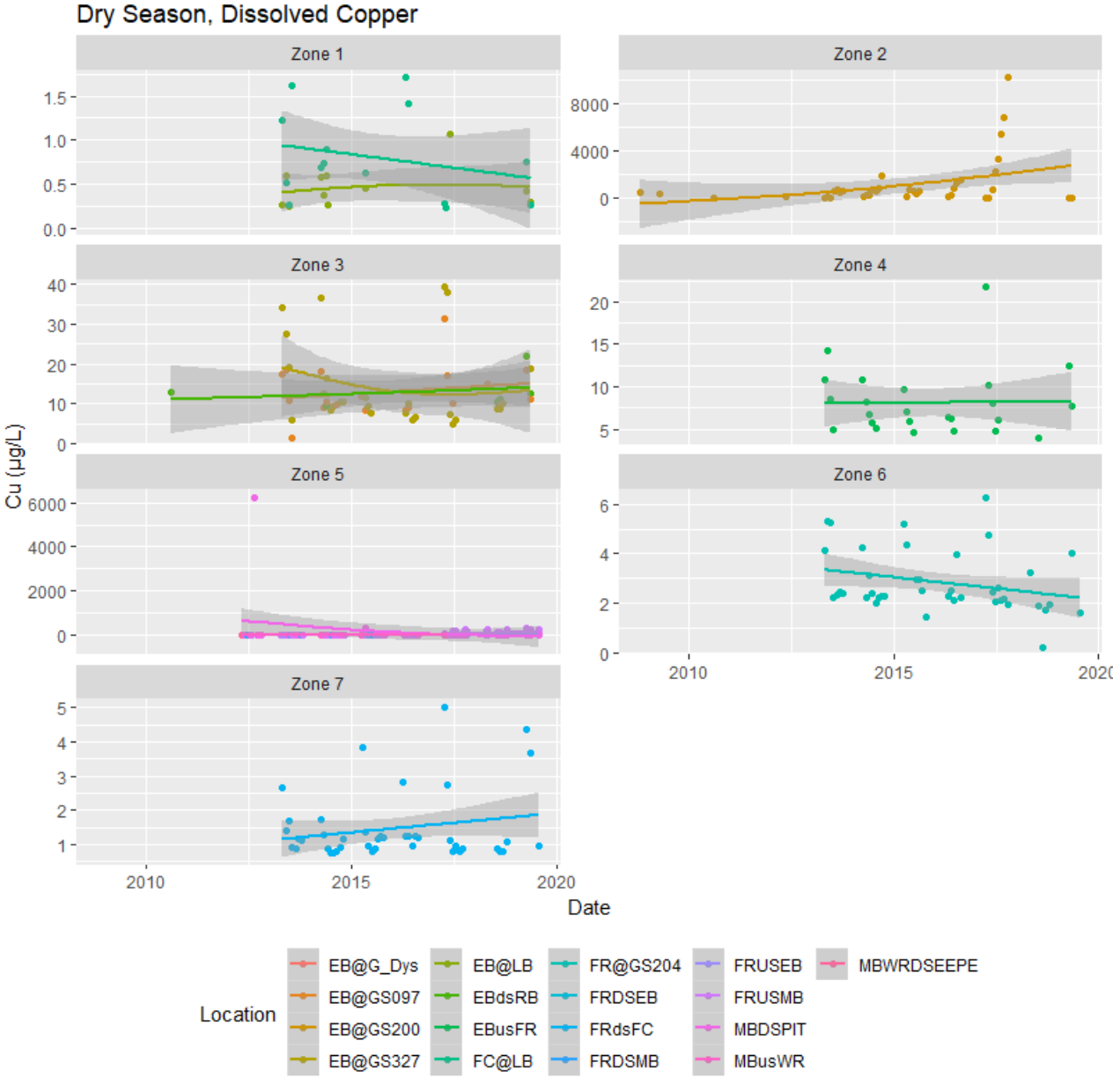
MBusWR
MBWRDSEEPE

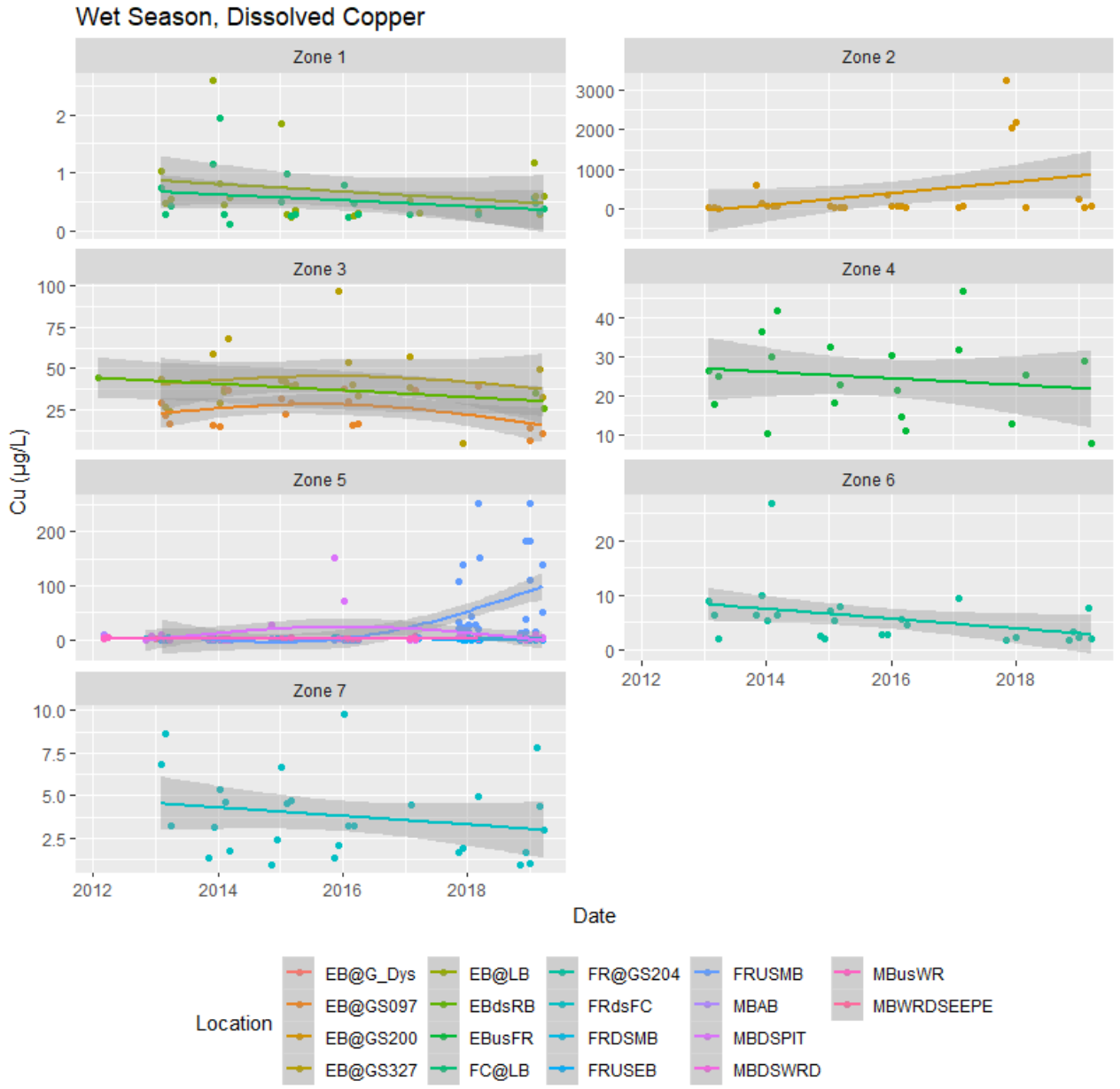

Dry Season, Dissolved Cadmium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Cd (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Cadmium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Cd (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

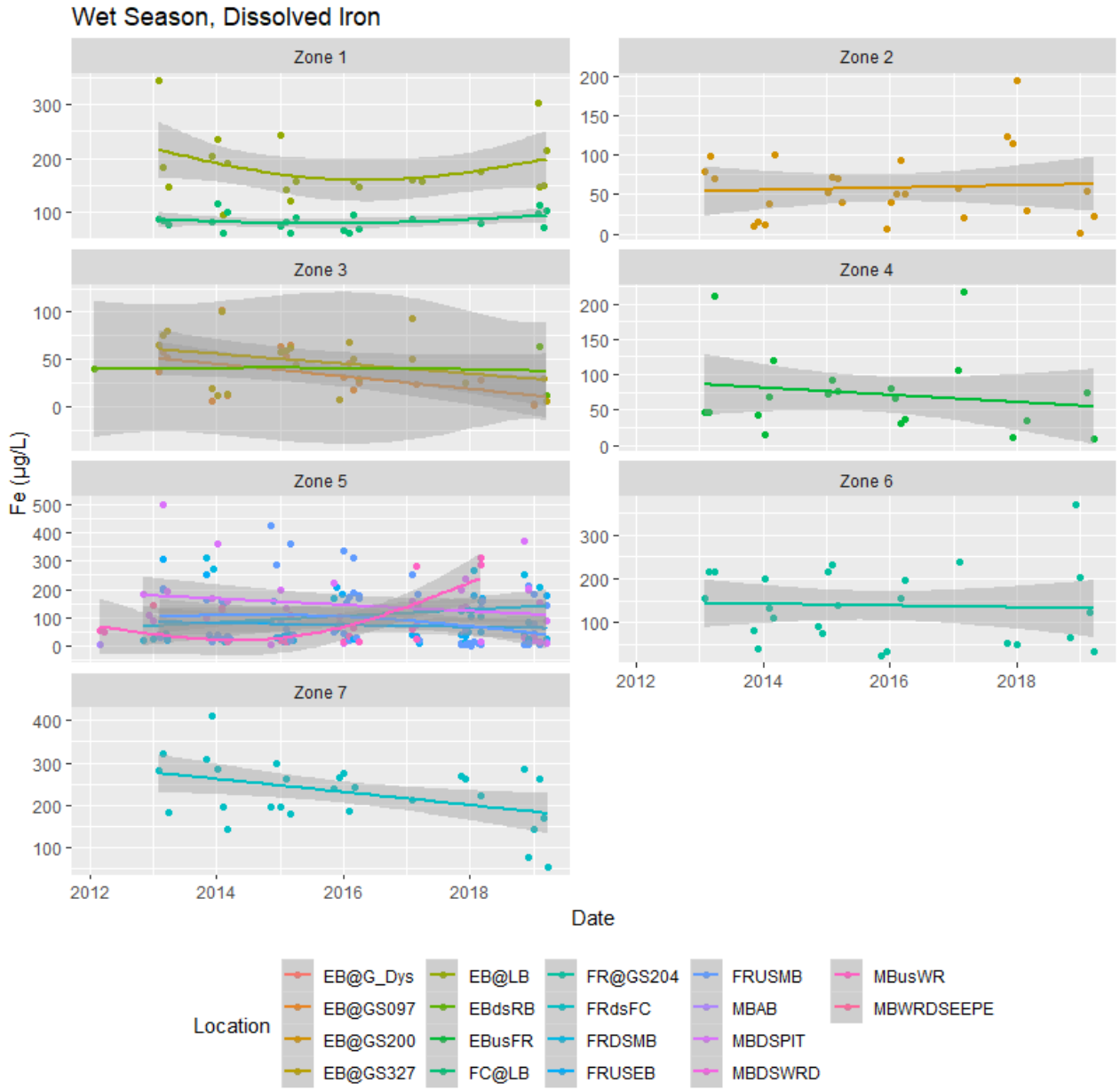

Dry Season, Dissolved Cobalt
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Co (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

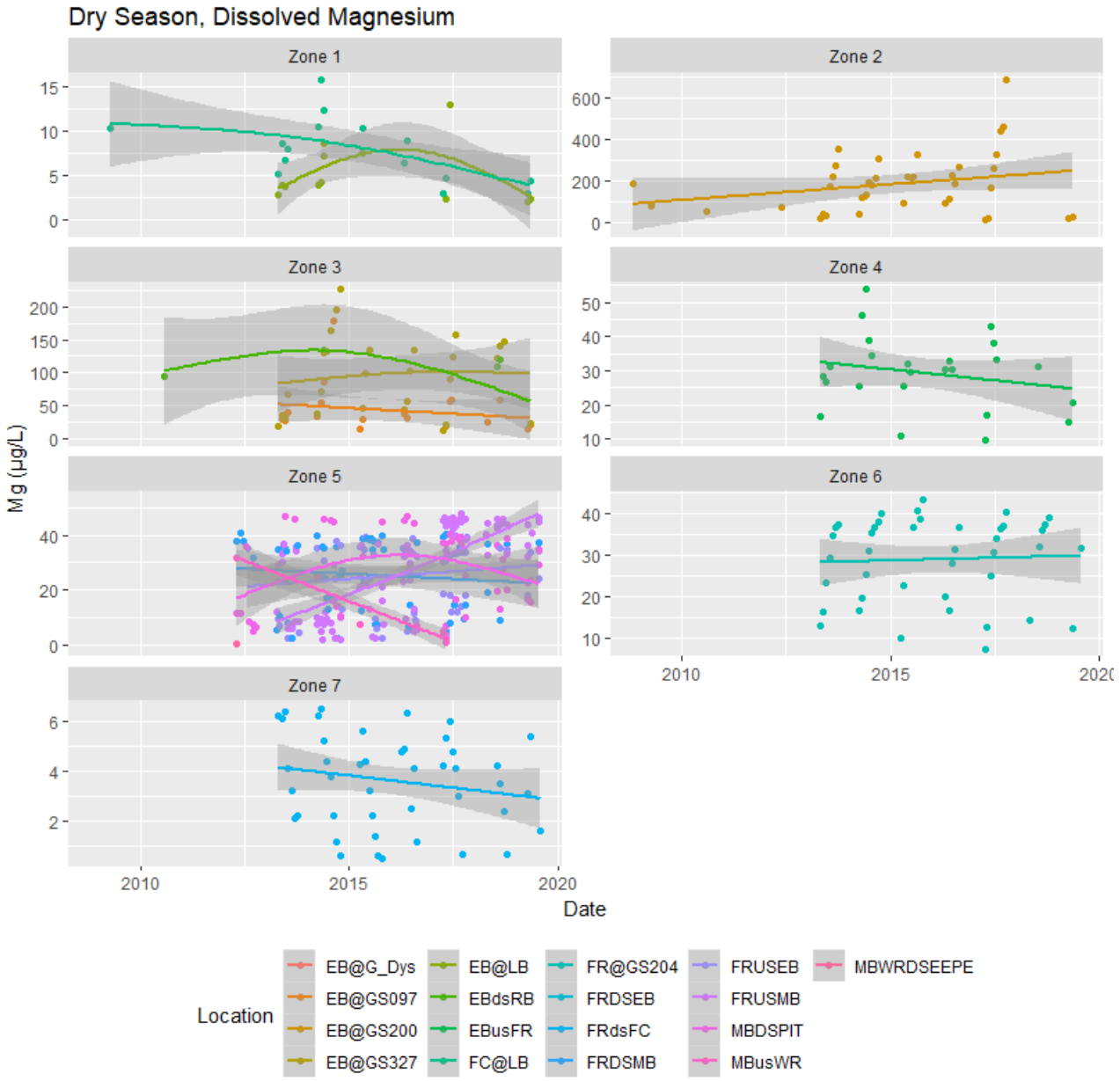

Wet Season, Dissolved Cobalt
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Co (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

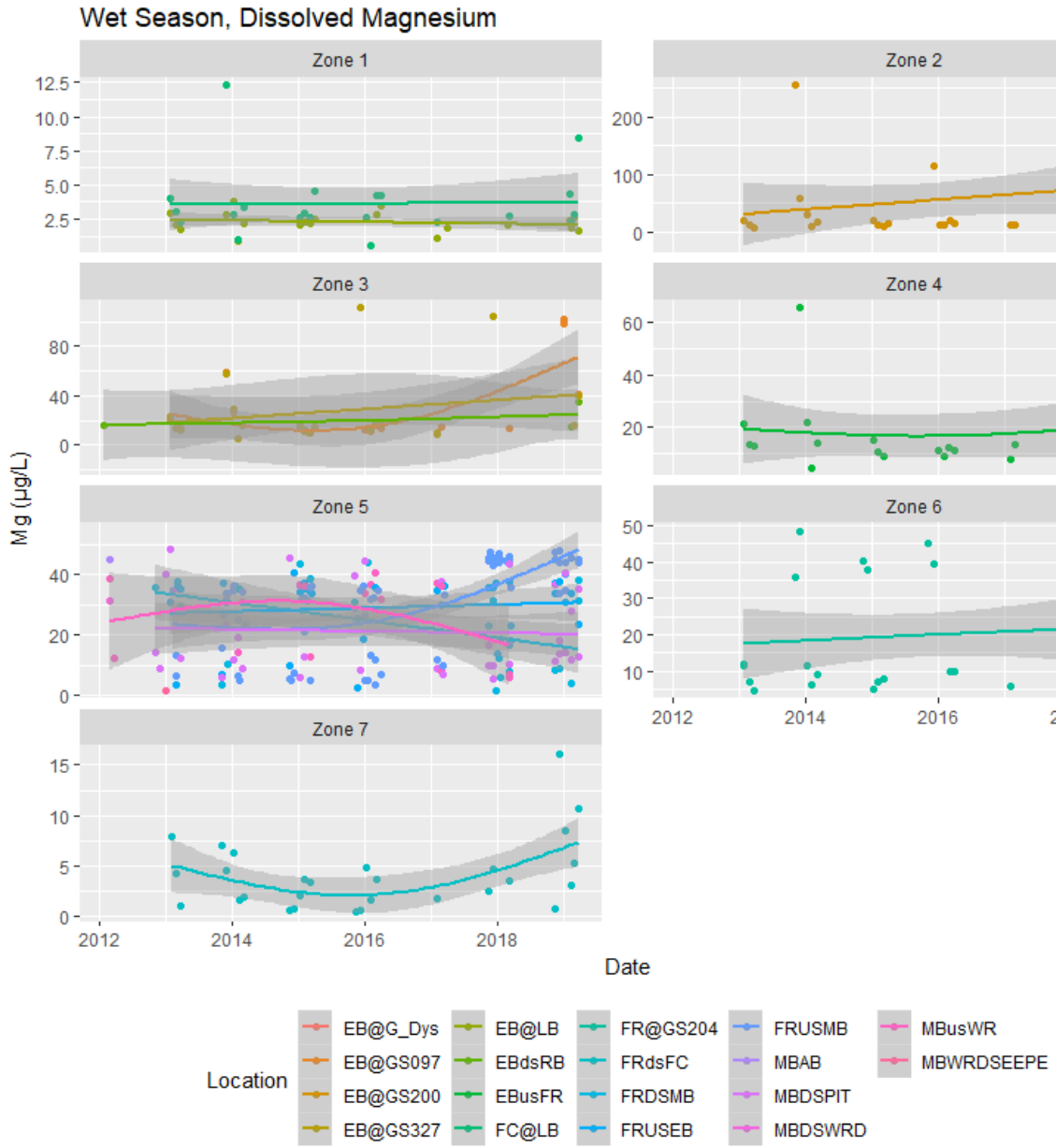

Dry Season, Dissolved Copper
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Cu (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

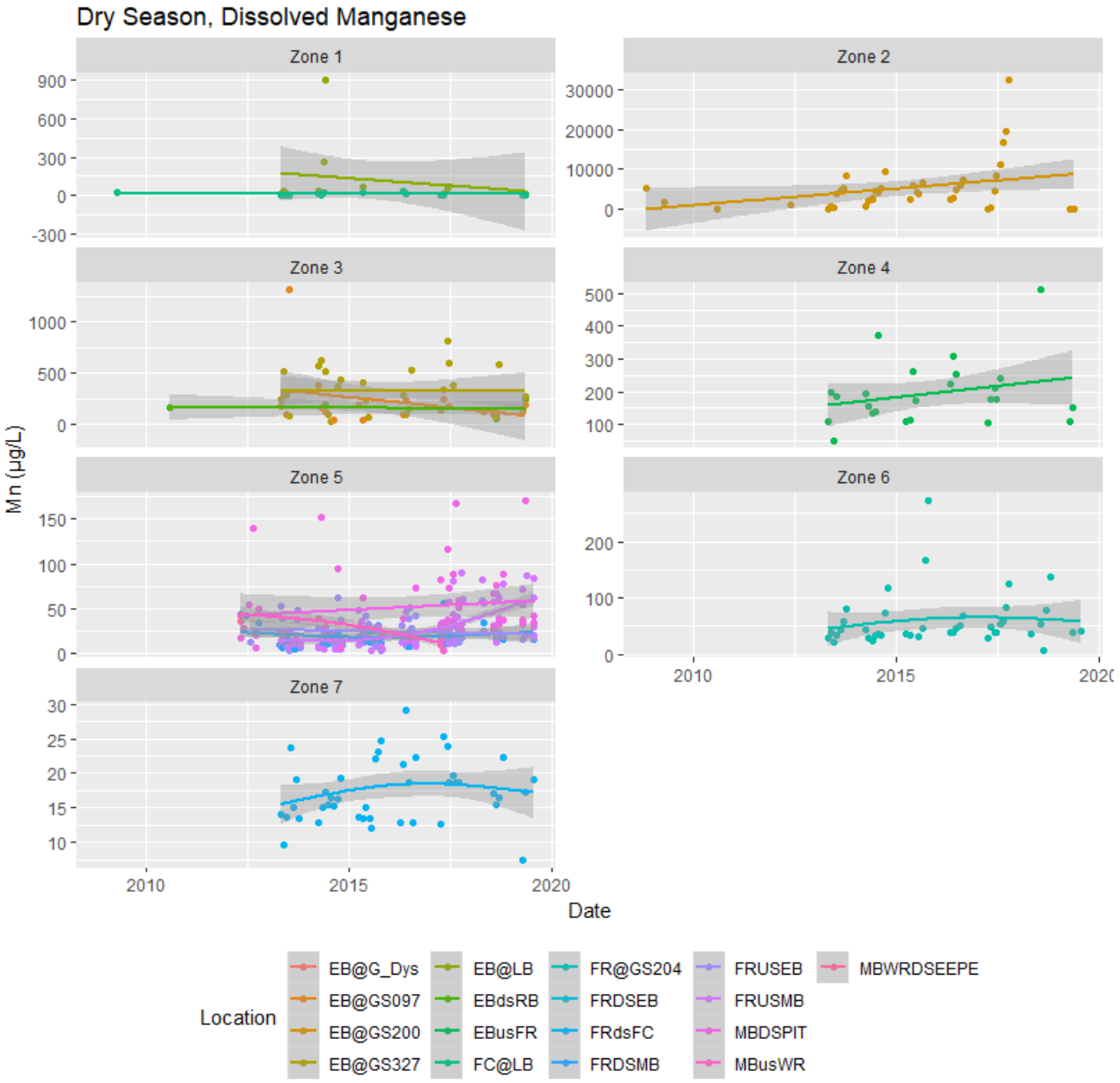

Wet Season, Dissolved Copper
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Cu (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

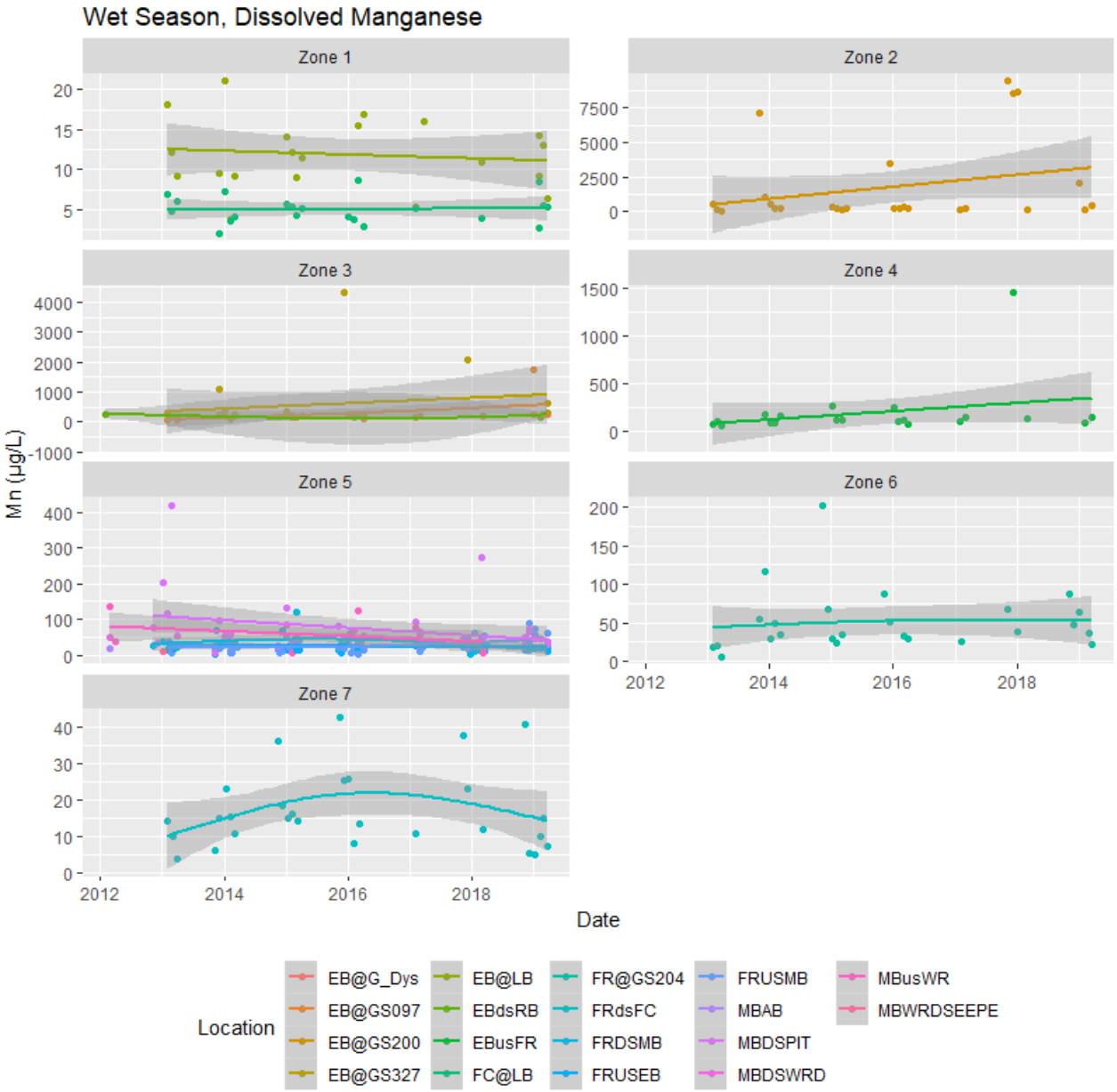

Dry Season, Dissolved Iron
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Fe (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

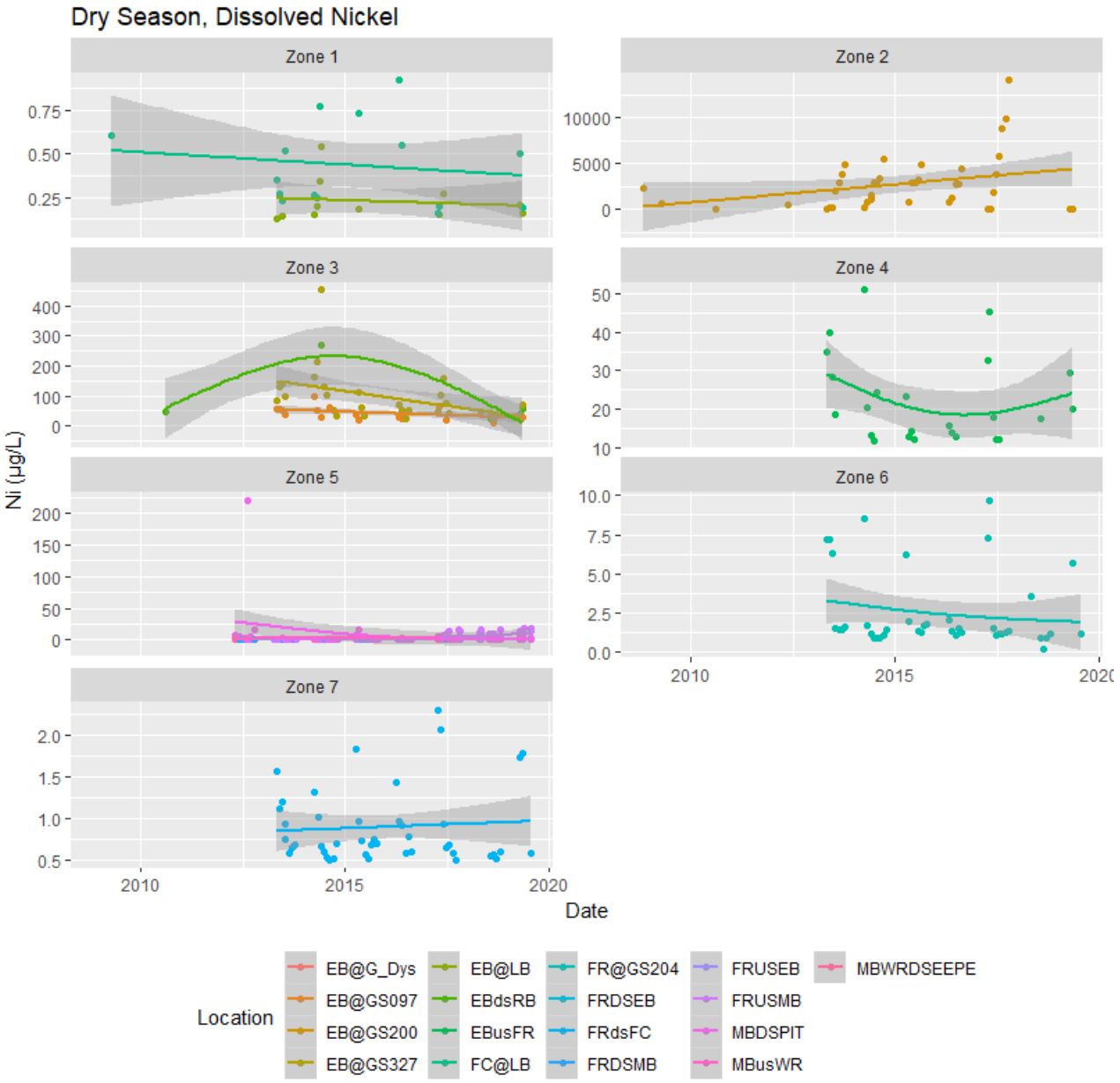

Wet Season, Dissolved Iron
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Fe (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

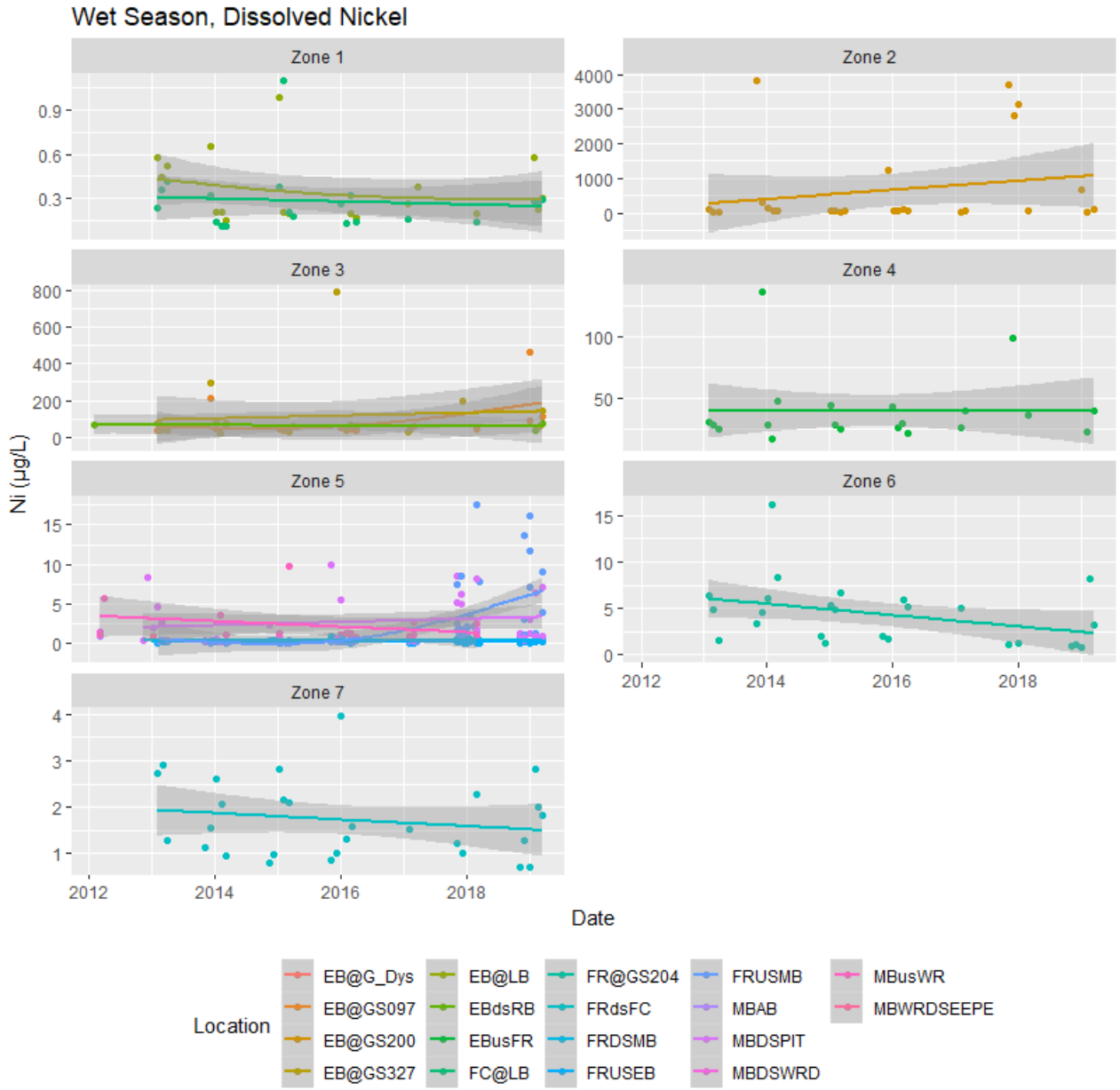

Dry Season, Dissolved Magnesium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Mg (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

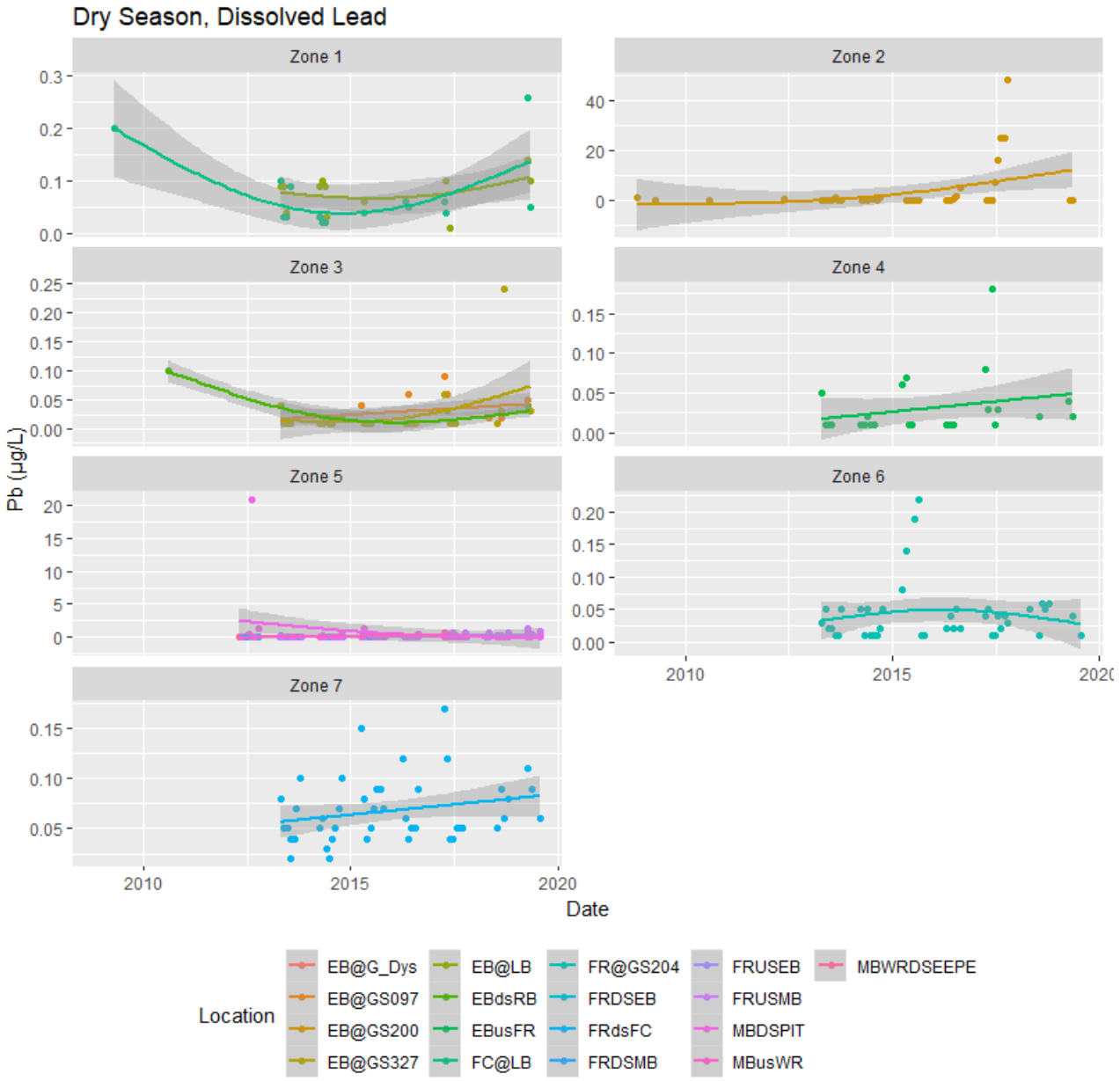

Wet Season, Dissolved Magnesium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Mg (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

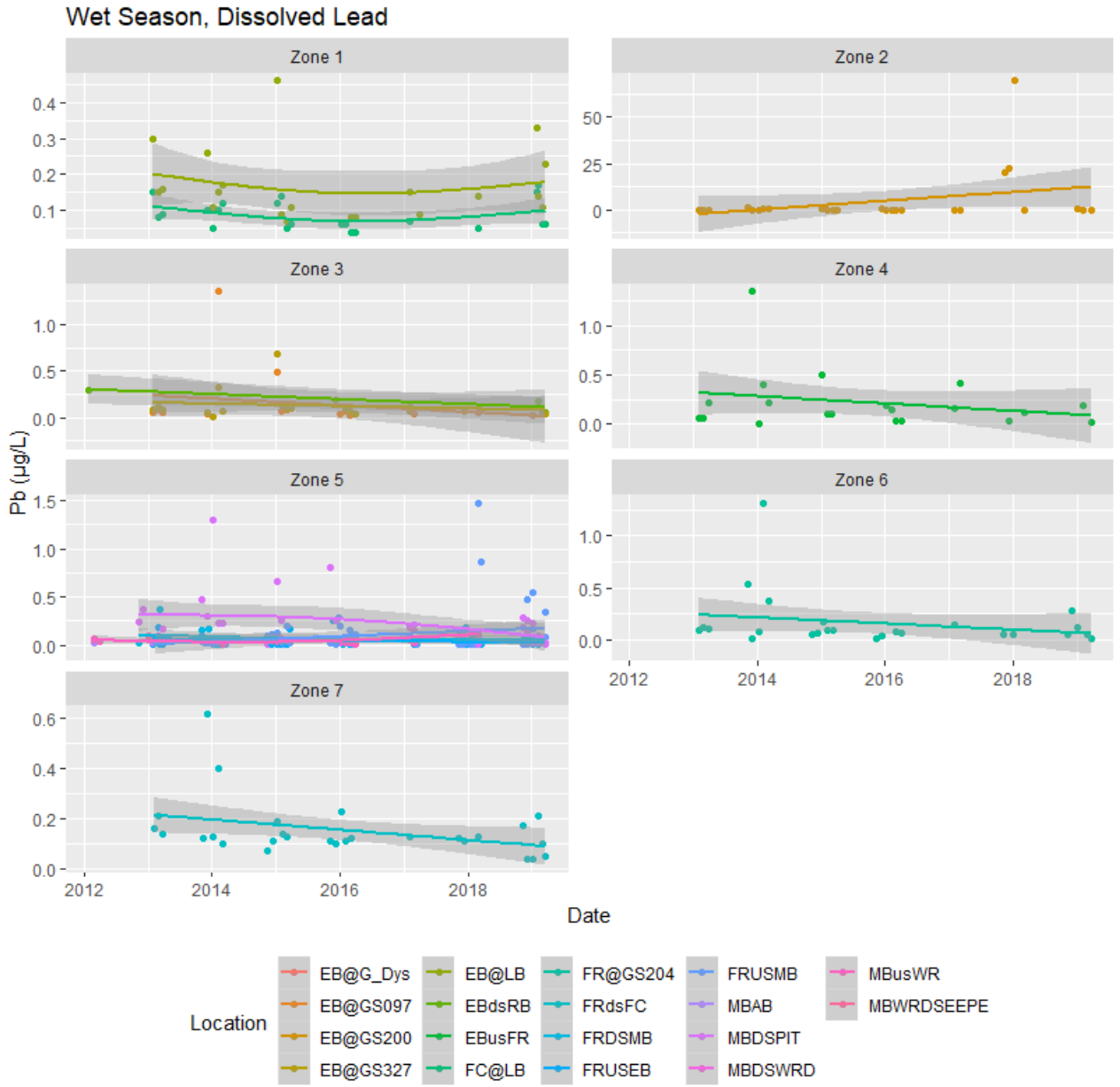

Dry Season, Dissolved Manganese
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Mn (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

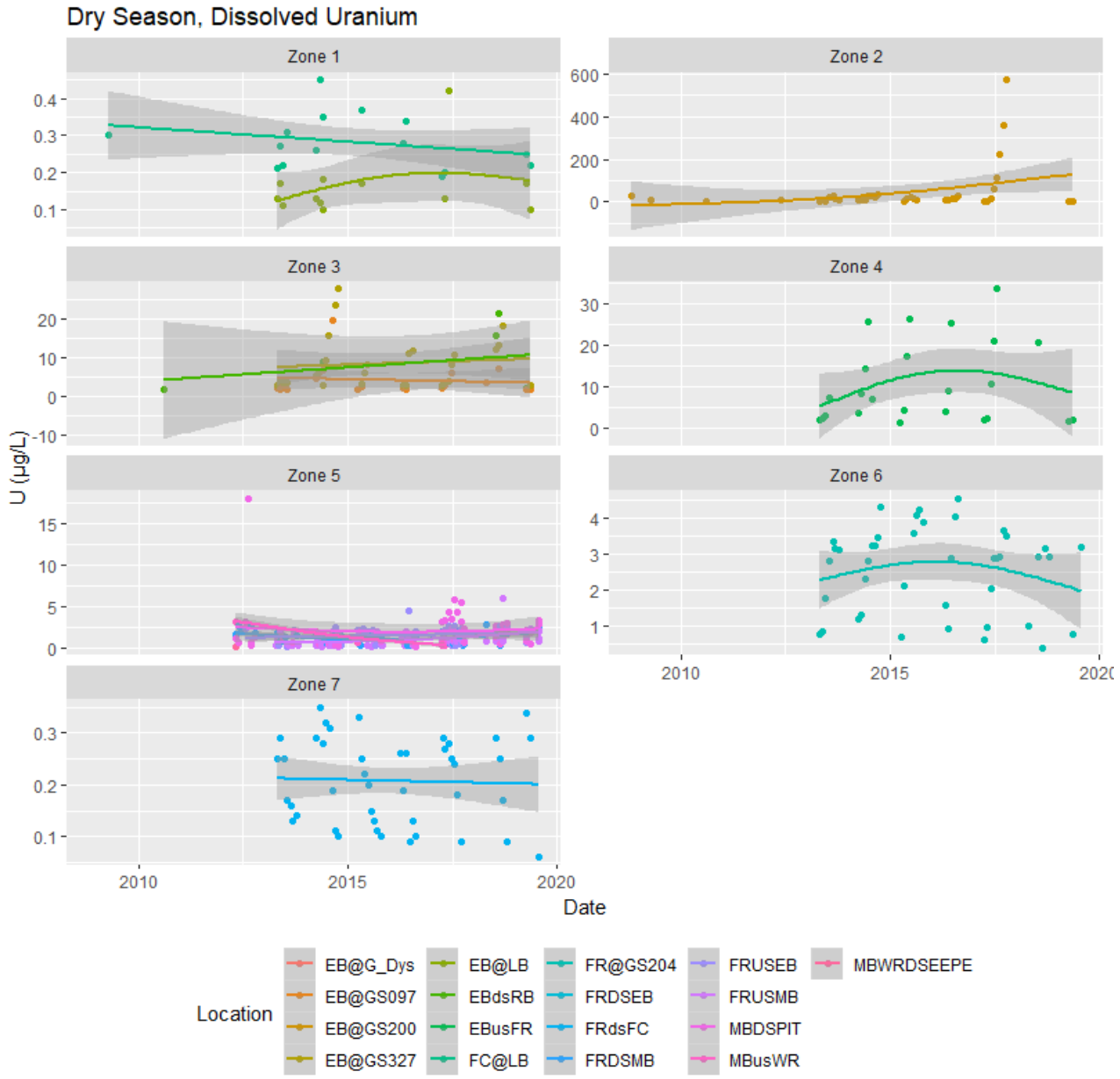

Wet Season, Dissolved Manganese
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Mn (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

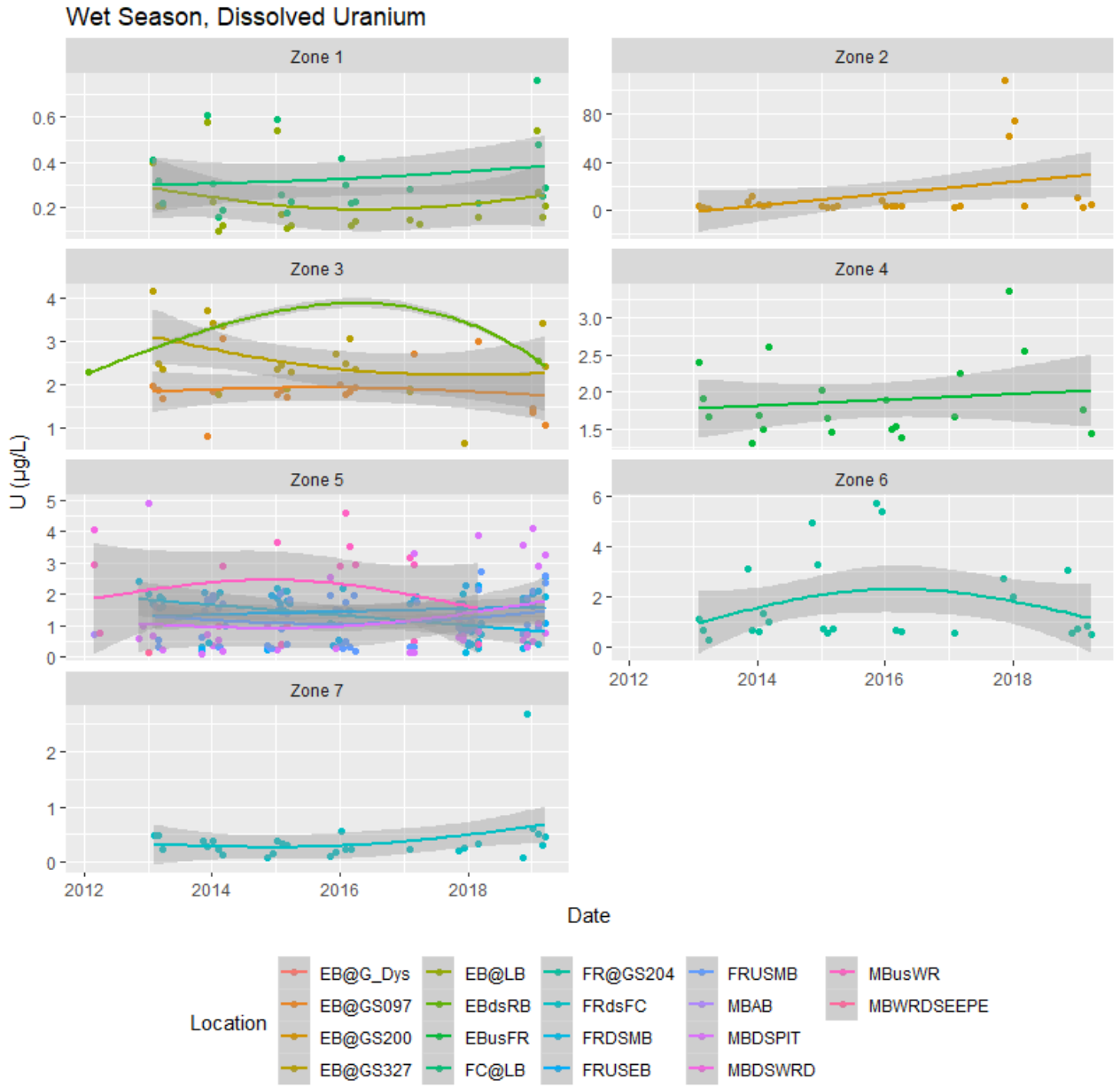

Dry Season, Dissolved Nickel
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Ni (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE

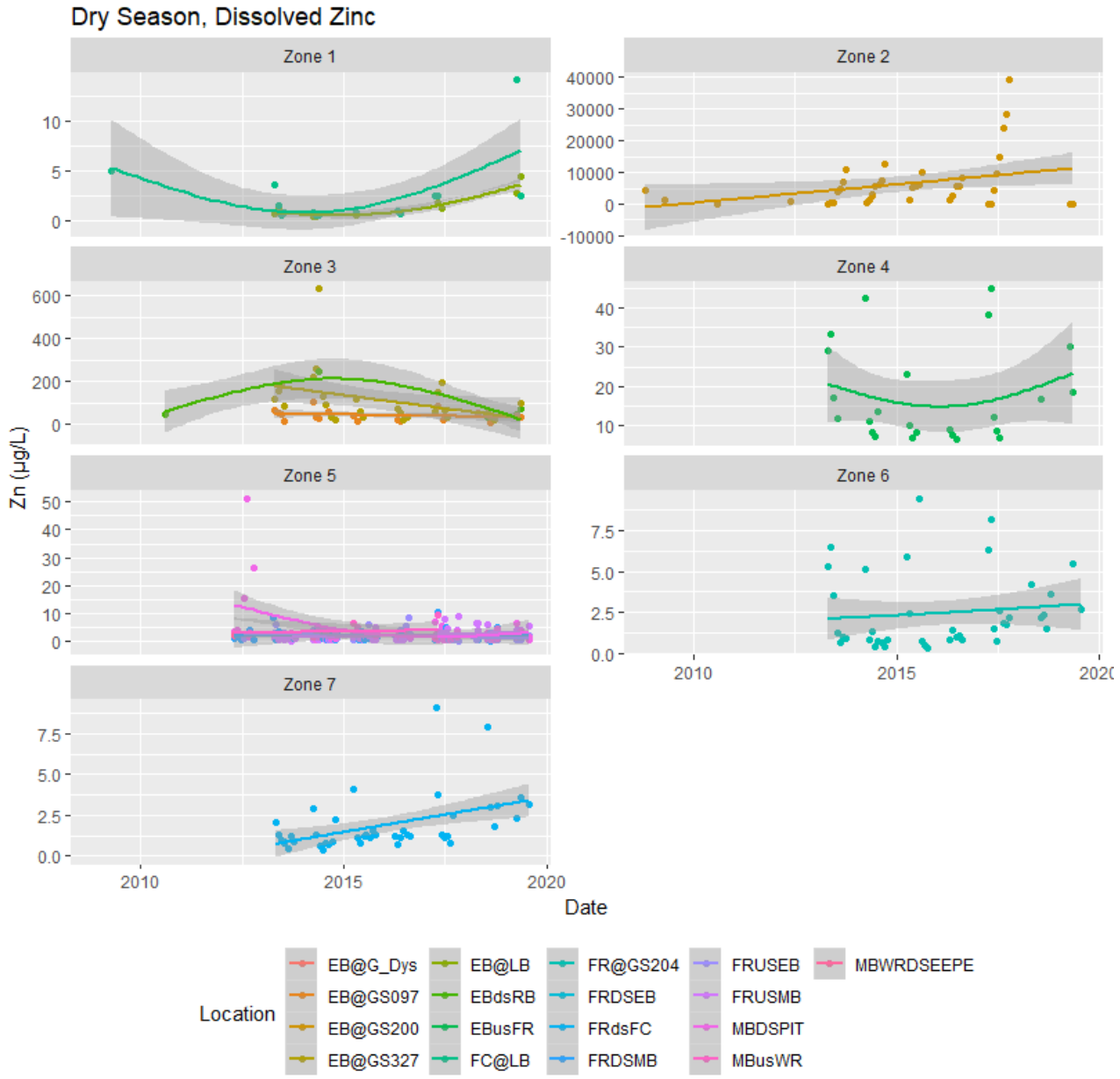

Wet Season, Dissolved Nickel
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Ni (µg/L)
Date
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

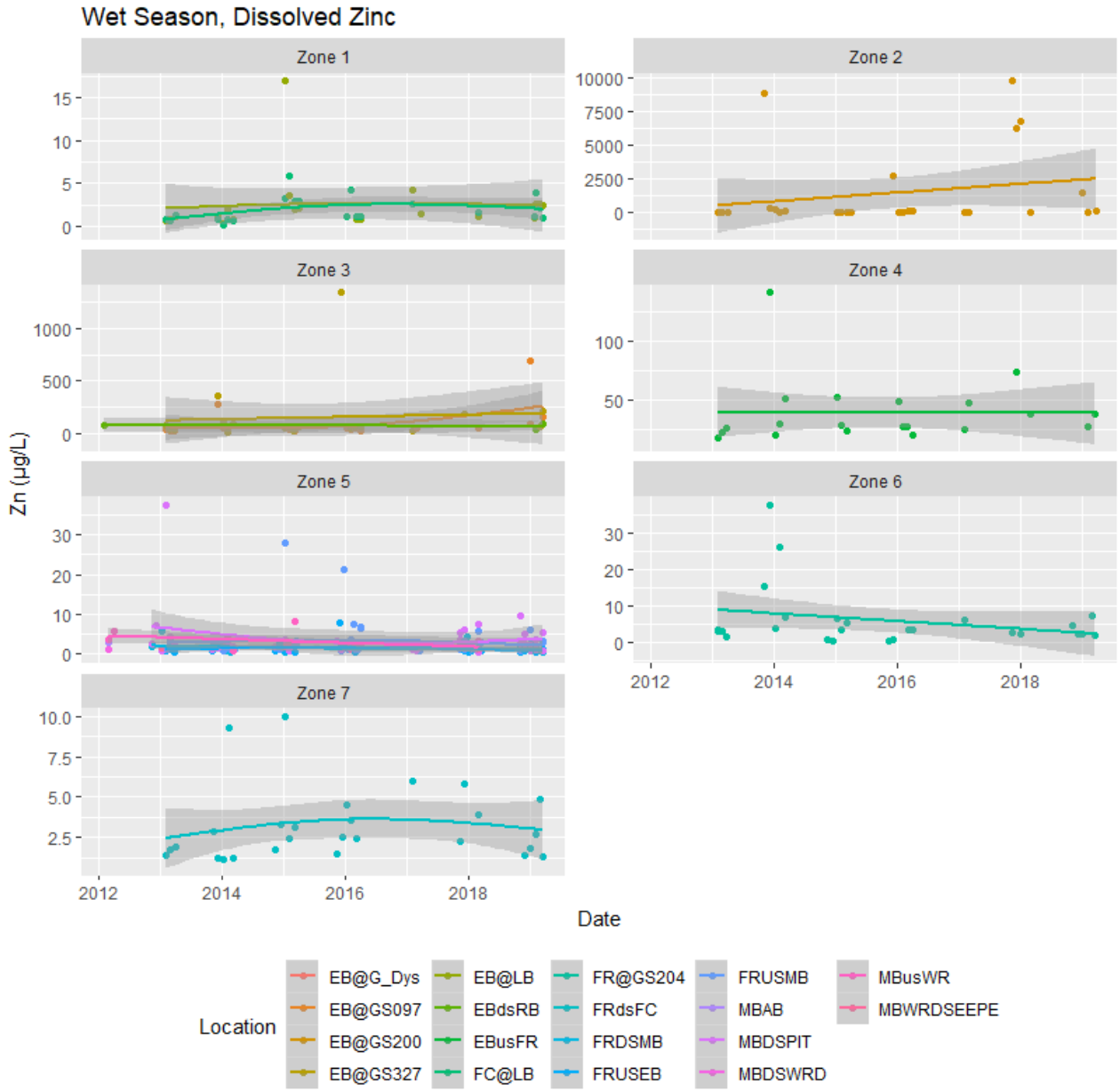

Dry Season, Dissolved Lead
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Pb (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Lead
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Pb (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE


Dry Season, Dissolved Uranium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
U (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Uranium
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
U (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE


Dry Season, Dissolved Zinc
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zn (µg/L)
Date
2010
2015
2020
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRDSEB
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBDSPIT
MBusWR
MBWRDSEEPE


Wet Season, Dissolved Zinc
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zn (µg/L)
Date
2012
2014
2016
2018
Location
EB@G_Dys
EB@GS097
EB@GS200
EB@GS327
EB@LB
EBdsRB
EBusFR
FC@LB
FR@GS204
FRdsFC
FRDSMB
FRUSEB
FRUSMB
MBAB
MBDSPIT
MBDSWRD
MBusWR
MBWRDSEEPE

APPENDIX B. DATA SUMMARIES

ZONE (1)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (95%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								55	13	0.2	1.4	*1.4*			1900	11	3.4	8	*0.5*
Proposed LDWQO	190.7					594		117		0.54	3.4	2.8	300	33.2	140	20		26.1	*2.8*
Wet season (Nov-Mar)																			
Median	52.5	6.92	85.4	11.4	23.4	0.28		111	0.13	0.02	0.70	0.13	129	3.14	7.75	0.31	0.13	1.75	0.31
20th percentile	45.9	6.68	80.6	9.0	20.3	0.23		72	0.11	0.02	0.58	0.11	105	2.69	5.94	0.25	0.10	1.16	0.26
80th percentile	60.3	7.16	89.6	14.3	26.8	0.34		1851	0.15	0.02	0.85	0.16	161	3.63	10.18	0.39	0.16	2.65	0.36
95th percentile	69.2	7.40	93.2	17.6	30.6	0.41		335	0.18	0.02	1.07	0.19	205	4.19	13.40	0.50	0.22	4.68	0.42
Max	149.8	8.25	114	36.1	80	0.9		811	0.25	0.02	2.59	0.33	344	12.3	21.1	1.1	0.46	16.9	0.76
Min	19.2	5.48	42.7	1.71	8.6	0.1		17	0.05	0.02	0.12	0.05	62	0.6	2.06	0.11	0.04	0.1	0.10
SD	19.3	0.6	12.8	8.8	11.6	0.2		166	0.05	0	0.51	0.06	67	2.0	4.8	0.2	0.1	2.7	0.16
No. of samples	72	73	69	51	39	41		41	41	41	41	41	41	41	41	41	41	41	41
No. of sites	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2
Dry Season (April to October) (if applicable)																			
Median	96.2	7.14	83.7	4.5	38.8	0.61		20.8	0.14	0.02	0.58	0.25	149	6.3	21.6	0.30	0.06	1.13	0.21
20th percentile	79.4	6.91	74.9	3.1	31.2	0.27		11.8	0.10	0.02	0.45	0.15	111	5.0	10.8	0.23	0.04	0.73	0.17
80th percentile	116.8	7.35	91.9	6.6	48.6	1.50		39.3	0.19	0.03	0.76	0.43	205	7.9	53.8	0.40	0.08	1.87	0.25
95th percentile	143.8	7.56	99.4	9.8	60.2	3.96		75.1	0.26	0.03	1.01	0.80	287	9.8	169	0.53	0.11	3.28	0.30
Max	305.7	8.30	120	18.3	86.0	8.5		131	0.5	0.2	1.7	3.4	380	15.8	900	0.9	0.3	14.1	0.45
Min	40.9	5.86	30.3	1.0	17.0	0.1		2.2	0.05	0.02	0.2	0.11	32	2.1	3.4	0.1	0.01	0.3	0.10
SD	45.8	0.55	19.3	3.6	19.5	2.3		30.8	0.12	0.03	0.4	0.64	102	3.7	175.1	0.2	0.06	2.7	0.10
No. of samples	53	53	50	34	26	27		27	27	27	26	27	27	27	27	27	27	27	27
No. of sites	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (2)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (70%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								236	301	1.6	3.2	*1.4*			5500	22	12.9	57	*0.5*
Proposed LDWQO	2985					1192		236		4.3	60.2	89	300	86.6	759	130.4		210.5	*31*
Wet season (Nov-Mar)																			
Median	514	6.32	83.0	7.0	15.5	4015		332	0.36	1.86	217	400	53.8	52.5	1008	560	0.58	1613	11.0
20th percentile	368	6.05	78.2	5.7	12.7	3956		191	0.30	1.28	133	226	40.0	41.3	766	427	0.19	1000	7.2
80th percentile	757	6.58	87.5	8.6	19.0	4105		623	0.44	2.85	370	744	72.7	69.2	1526	806	2.46	2752	17.5
95th percentile	1162	6.80	91.5	10.7	23.6	4254		1210	0.54	4.76	668	1431	97.0	95.0	2781	1258	12.2	4671	28.3
Max	2032	8.2	103	16.7	35.2	1320		4520	1.05	13.0	3240	4300	194	255	9420	3810	69.6	9810	108
Min	123.4	4.2	50.9	2.3	1.0	30.2		33.2	0.15	0.08	22.7	20.5	2.0	7.4	69.2	20.3	0.01	19.6	1.8
SD	667.6	1.0	12.9	4.0	9.3	422		1295	0.20	4.09	809	1405	44.0	77.6	3008	1217	14.5	2944	26.1
No. of samples	26	26	44	17	25	26		26	48	26	26	26	26	26	26	26	26	26	26
No. of sites	1	1	2	1	1	1		1	2	1	1	1	1	1	1	1	1	1	1
Dry Season (April to October) (if applicable)																			
Median	1627	6.37	75.9	3.1	38.0	896		652	0.67	8.5	726	3120	50.7	186	5196	2816	1.96	6075	38.1
20th percentile	1422	6.13	72.6	2.6	28.4	750		346	0.59	6.4	452	2138	30.5	159	3835	2029	0.92	4108	25.7
80th percentile	1850	6.60	79.1	3.7	50.9	1061		1333	0.77	11.3	1295	4732	85.3	215	7092	3954	4.60	9396	60.6
95th percentile	2101	6.80	81.8	4.5	68.7	1235		3098	0.87	14.9	2729	7124	145	244	9531	5477	11.3	14508	101.7
Max	4680	8	108	9.3	180	3480		14400	1.75	43.4	10200	16500	400	683	32200	14100	48.2	39200	572
Min	144	4.19	50.5	1.2	1	37.4		4	0.1	0.14	16.7	3.5	2	9.5	60.6	14.3	0.01	17	2.9
SD	1020	0.9	12.2	2.0	37.8	735		3294	0.4	9.4	2051	3372	101	143	6140	2991	9.5	8218	109
No. of samples	40	40	40	25	34	39		39	49	39	39	39	39	39	39	39	39	39	39
No. of sites	1	1	2	1	1	1		1	2	1	1	1	1	1	1	1	1	1	1

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (3)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (80%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								150	140	0.8	2.5	*1.4*			3600	17	9.4	31	*0.5*
Proposed LDWQO	2985					997		150		2.16	27.5	25.9	300	86.6	443	43.1		180	*22.5*
Wet season (Nov-Mar)																			
Median	306	6.79	86.8	7.8	20.9	122		45.0	0.32	0.25	32.8	80.0	40.7	26.1	395	89.9	0.10	112	2.20
20th percentile	261	6.54	82.2	6.2	18.7	96.9		35.3	0.28	0.18	26.8	55.4	31.1	21.1	284	67.6	0.06	77.7	1.92
80th percentile	365	7.04	91.6	9.9	23.5	157		56.2	0.37	0.35	39.8	122	52.2	33.0	581	124	0.18	167	2.49
95th percentile	449	7.29	96.5	12.6	26.3	207		68.3	0.42	0.53	48.3	203	65.4	43.3	871	173	0.34	263	2.82
Max	1203	8.4	114.5	38.8	41	581		124	0.8	2.6	96.3	1090	102	111	4310	788	1.35	1340	4.14
Min	74.5	5.35	69.4	2.3	7.6	20.5		8.6	0.15	0.04	5.07	16.6	2	4.7	82.9	19.6	0.01	16	0.66
SD	259	0.6	11.1	7.3	6.7	142		26.5	0.13	0.4	17.2	172	27.8	28.0	734	137	0.23	225	0.74
No. of samples	43	43	40	29	39	42		42	42	42	42	42	42	42	42	42	42	42	42
No. of sites	3	3	3	2	3	3		3	3	3	3	3	3	3	3	3	3	3	3
Dry Season (April to October) (if applicable)																			
Median	1062	7.02	55.8	3.7	61.4	443		18.4	0.35	0.15	11.4	26.7	9.01	95.6	258	59.2	0.03	57.5	9.34
20th percentile	946	6.91	52.1	3.3	56.1	379		12.6	0.31	0.11	9.90	17.4	5.95	82.8	206	46.2	0.02	41.9	7.46
80th percentile	1187	7.13	59.3	4.2	66.9	511		26.2	0.40	0.21	13.4	41.3	15.2	109	334	78.7	0.04	82.5	11.47
95th percentile	1329	7.23	62.6	4.6	72.7	582		39.2	0.48	0.30	16.1	62.3	32.6	123	470	108	0.07	128	13.71
Max	3232	7.92	106.2	8.4	152	1060		77.3	1.25	1.44	39.3	204	200	226	1310	453	0.24	632	27.7
Min	91.8	6.07	16.1	0.98	16	44.4		0.6	0.05	0.02	1.53	1.08	2.0	11.2	31	11.7	0.01	8.7	1.61
SD	566	0.4	16.4	1.7	27.8	270		22.1	0.16	0.2	8.7	48.8	29.7	55.9	233	74.2	0.04	99.0	6.3
No. of samples	54	55	48	35	49	53		52	54	52	52	52	52	53	52	52	52	52	52
No. of sites	3	3	3	3	3	3		3	3	3	3	3	3	3	3	3	3	3	3

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (4)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (90%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								80	42	0.4	1.8	*1.4*			2500	13	5.6	15	*0.5*
Proposed LDWQO	427					761		117		1.08	7.86	3.6	300	33.2	228	32.5		180	*13.2*
Wet season (Nov-Mar)																			
Median	232	6.80	89.4	7.60	27.3	78.9		34.3	0.42	0.10	24.5	31.1	64.3	18.4	188	41.8	0.21	39.7	1.86
20th percentile	203	6.58	85.0	6.30	22.0	66.2		25.7	0.39	0.09	20.6	25.0	48.6	15.6	144	37.7	0.14	33.9	1.69
80th percentile	265	7.00	93.4	9.08	38.8	92.0		45.6	0.46	0.12	29.2	39.2	87.6	21.3	268	46.4	0.32	47.1	2.08
95th percentile	302	7.17	96.8	10.8	62.5	105		60.3	0.49	0.14	34.8	50.1	123	24.4	417	51.3	0.47	55.7	2.33
Max	707	7.61	126	16.5	246	320		113	0.85	0.36	46.8	131	216	65.4	1450	136	1.34	141	3.35
Min	73.9	5.77	42.4	2.21	7	18.9		7.8	0.2	0.04	8.11	9.03	10	4.7	62.8	17.5	0.01	17.9	1.31
SD	158	0.5	12.8	4.0	50.5	76.2		26.9	0.15	0.07	10.5	28.5	56.7	15.6	299	28.4	0.30	28.0	0.52
No. of samples	36	37	35	27	20	20		20	20	20	20	20	20	20	20	20	20	20	20
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
Dry Season (April to October) (if applicable)																			
Median	351	7.03	81.0	3.14	84.1	77.8		15.1	0.58	0.05	7.64	13.1	12.1	29.6	184	20.9	0.02	15.8	11.2
20th percentile	313	6.83	75.0	2.69	72.9	62.5		9.7	0.51	0.04	6.62	10.9	9.83	26.1	158	17.3	0.02	12.3	8.43
80th percentile	394	7.20	87.7	3.57	95.7	94.3		22.2	0.65	0.06	8.82	16.1	15.3	33.9	212	24.8	0.04	20.0	14.0
95th percentile	443	7.36	95.0	3.97	107	112		31.3	0.73	0.08	10.2	20.5	19.5	38.7	242	29.1	0.05	24.6	17.2
Max	607	7.8	116	10.8	151	185		70.3	0.95	0.14	21.7	34.6	44	53.7	510	50.9	0.18	44.7	33.6
Min	50.0	5.73	33.5	0.95	22	27.7		0.9	0.25	0.02	3.99	4.82	2	9.8	51.2	11.9	0.01	6.7	1.25
SD	123	0.5	17.6	2.0	43.1	40.4		18.3	0.20	0.04	3.9	8.0	10.1	10.8	98.3	11.3	0.04	12.1	9.9
No. of samples	41	41	39	28	23	24		24	24	24	24	24	24	24	24	24	24	24	24
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (5)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (95%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								55	13	0.2	1.4	*1.4*			1900	11	3.4	8	*0.5*
Proposed LDWQO	190.7					594		117		0.54	3.4	2.8	300	33.2	140	20		26.1	*2.7*
Wet season (Nov-Mar)																			
Median	227.6	7.35	71.2	18.9	123			23.5	0.98	0.02	4.85	0.63	88.5	26.5	34.1	1.06	0.07	1.97	1.26
20th percentile	188.2	7.14	67.1	12.4	107			14.9	0.74	0.02	2.22	0.33	56.2	21.2	25.3	0.62	0.04	1.35	0.94
80th percentile	274.8	7.54	75.1	30.2	142			36.5	1.30	0.03	11.4	1.27	140	32.1	46.3	1.88	0.13	2.92	1.66
95th percentile	331.5	7.70	78.5	52.4	165			57.9	1.72	0.03	29.0	2.75	217	37.9	62.7	3.51	0.23	4.37	2.15
Max	546.0	8.61	96.6	298	245			287	2.95	0.32	254	17.1	500	48.5	420	17.6	1.48	37.8	4.91
Min	29.7	4.29	29.2	0.79	22			1.1	0.25	0.02	0.16	0.03	2	1.7	3.0	0.1	0.01	0.2	0.11
SD	162.3	0.6	12.8	34.9	75.8			36.8	0.7	0.0	39.5	2.7	98.3	14.1	43.1	2.9	0.2	3.9	1.0
No. of samples	270	270	182	200	44			184	150	187	187	187	187	187	187	187	187	186	187
No. of sites	8	8	4	5	5			8	5	8	8	8	8	8	8	8	8	8	8
Dry Season (April to October) (if applicable)																			
Median	363.9	7.55	71.9	6.10	177			26.0	0.97	0.02	6.90	0.61	100	25.4	26.8	1.16	0.08	1.89	1.22
20th percentile	338.6	7.22	67.9	4.43	168			17.2	0.77	0.02	3.36	0.34	65.03	20.8	20.6	0.72	0.05	1.37	0.93
80th percentile	393.3	7.96	75.8	8.94	189			39.7	1.24	0.03	15.9	1.21	157	30.4	35.2	1.94	0.13	2.69	1.61
95th percentile	428.2	8.49	79.5	14.6	202			62.3	1.57	0.03	40.2	2.54	265	35.8	46.5	3.48	0.23	3.83	2.17
Max	1312	8.37	108	236	244			683	3	0.64	6250	235	500	47.9	171	221	20.9	51.4	18
Min	54.7	5.89	30.1	0.3	30			0.8	0.25	0.02	0.18	0.02	4	0.6	3.4	0.04	0.01	0.1	0.09
SD	155.2	0.5	12.7	18.6	68.3			50.9	0.8	0.05	384	14.6	103.5	14.7	25.7	13.8	1.3	3.9	1.4
No. of samples	406	407	279	297	74			256	230	269	269	269	268	268	268	269	269	268	269
No. of sites	7	7	4	5	5			6	4	6	6	6	6	6	6	6	6	6	6

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (6)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (95%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								55	13	0.2	1.4	*1.4*			1900	11	3.4	8	*0.5*
Proposed LDWQO	190.7					594		117		0.54	3.4	2.8	300	33.2	140	20		26.1	*2.9*
Wet season (Nov-Mar)																			
Median	252.8	6.96	55.1	10.7	93.6	13.1		29.0	0.96	0.03	5.19	2.38	134	20.4	50.0	4.13	0.13	5.25	1.64
20th percentile	224.0	6.78	50.4	8.41	84.0	8.76		22.1	0.83	0.02	4.18	1.76	117	18.0	40.5	3.34	0.08	3.65	1.35
80th percentile	282.3	7.13	59.9	13.8	106	23.4		39.3	1.16	0.04	6.54	3.29	151	23.6	61.9	5.09	0.20	8.08	2.06
95th percentile	310.4	7.29	64.4	18.5	129	49.4		55.0	1.43	0.06	8.54	4.95	168	27.7	77.5	6.18	0.33	13.60	2.68
Max	552	7.73	85.1	47.7	260	226		91.6	2.45	0.32	26.9	14.9	370	48.5	203	16.2	1.32	37.8	5.72
Min	72.2	5.91	26.6	1.85	12.4	1.1		2.7	0.05	0.02	1.72	0.3	24	4.7	5.72	0.81	0.02	0.5	0.28
SD	154.4	0.6	18.1	11.2	83.7	43.2		27.6	0.70	0.06	5.0	3.0	84.5	14.9	40.5	3.4	0.3	8.4	1.6
No. of samples	27	27	24	18	25	26		26	26	26	26	26	26	26	26	26	26	26	26
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
Dry Season (April to October) (if applicable)																			
Median	340.1	7.07	59.8	4.01	159	5.79		12.0	0.89	0.02	2.61	1.22	46.4	30.0	59.6	2.18	0.04	2.08	2.63
20th percentile	303.1	6.94	57.4	3.55	148	4.57		8.71	0.84	0.02	2.33	1.03	39.5	28.9	52.4	1.70	0.03	1.59	2.41
80th percentile	387.8	7.19	62.1	4.59	170	7.71		16.4	0.94	0.02	2.92	1.44	54.4	31.2	68.7	2.79	0.05	2.72	2.87
95th percentile	455.2	7.31	64.4	5.35	181	11.1		22.6	0.99	0.03	3.27	1.69	62.5	32.4	79.9	3.60	0.07	3.60	3.11
Max	1165	7.95	91.7	11.6	328	26.3		56.3	2.2	0.1	6.3	4.65	154	43.5	274	9.71	0.22	9.5	4.57
Min	53.2	6.17	19.2	1.81	38	1.3		1.5	0.15	0.02	0.2	0.03	10	7.4	6.29	0.18	0.01	0.3	0.39
SD	178.2	0.4	17.5	2.6	70.5	7.3		13.2	0.47	0.01	1.3	1.0	43.6	10.1	47.6	2.5	0.05	2.3	1.21
No. of samples	39	40	37	28	40	41		41	41	41	41	41	41	41	41	41	41	41	41
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

ZONE (7)	Indicators																		
	Phys-chem				other			Metals (dissolved)											
Proposed Protection Level: (95%)	EC	pH	DO	Tur	Alkalinity	SO4	TSS	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
	µS/cm	s.u.	%	NTU	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Comparative Guideline Values:																			
ANZG 2018								55	13	0.2	1.4	*1.4*			1900	11	3.4	8	*0.5*
Proposed LDWQO	190.7					594		117		0.54	3.4	2.8	300	33.2	140	20		26.1	*2.7*
Wet season (Nov-Mar)																			
Median	63.7	6.60	69.8	13.4	23.8	2.95		51.6	0.55	0.02	3.58	0.70	230	3.72	17.5	1.66	0.14	2.91	0.34
20th percentile	50.5	6.35	66.6	10.5	14.4	2.16		41.8	0.51	0.02	3.02	0.54	204	2.77	14.8	1.45	0.12	2.23	0.28
80th percentile	80.9	6.86	73.3	17.4	46.4	4.12		64.5	0.59	0.02	4.29	0.89	256	5.19	20.2	1.92	0.18	3.83	0.44
95th percentile	102.6	7.10	76.9	23.0	116	5.71		82.2	0.63	0.02	5.28	1.13	281	7.87	22.9	2.27	0.23	5.13	0.66
Max	178.4	8.61	91.3	41.0	275	12.4		203	1	0.02	9.79	1.91	412	16.1	42.6	3.97	0.62	10	2.69
Min	15.3	5.46	46.8	2.64	2.6	0.1		17.5	0.3	0.02	0.92	0.08	52	0.5	3.88	0.7	0.04	1.1	0.092
SD	44.6	0.7	13.0	11.0	59.0	3.4		39.9	0.1	0.0	2.4	0.5	75.6	3.5	10.9	0.8	0.1	2.3	0.5
No. of samples	29	29	26	17	27	28		28	28	28	28	28	28	28	28	28	28	27	28
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
Dry Season (April to October) (if applicable)																			
Median	53.1	6.72	73.6	3.38	17.5	2.17		22.3	0.37	0.02	1.28	0.45	175	3.33	17.6	0.84	0.07	1.63	0.19
20th percentile	48.8	6.57	71.3	2.94	16.1	1.75		18.6	0.35	0.02	1.12	0.40	162	3.09	16.2	0.76	0.06	1.33	0.18
80th percentile	57.8	6.88	76.0	3.96	19.0	2.78		27.4	0.39	0.02	1.48	0.51	190	3.57	19.2	0.91	0.07	2.05	0.21
95th percentile	63.9	7.02	78.4	4.77	20.5	3.66		34.4	0.40	0.02	1.76	0.58	208	3.83	20.8	0.99	0.08	2.61	0.23
Max	97.7	7.92	110	11.7	40	11.3		75	0.6	0.02	5.02	1.05	354	6.5	29.2	2.3	0.17	9.1	0.35
Min	17.1	5.52	53.2	1.76	2.4	0.1		7	0.25	0.02	0.74	0.14	114	0.5	7.38	0.5	0.02	0.4	0.06
SD	24.7	0.5	9.7	2.2	9.1	2.6		15.9	0.08	0	1.0	0.2	46.4	1.8	4.6	0.5	0.03	1.74	0.08
No. of samples	44	44	41	30	43	44		44	45	44	44	44	44	44	44	44	44	44	44
No. of sites	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1

Note: guideline values and proposed LDWQOs in *italic* are interim values (low-reliability or unknown protection level)

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